Current and future hospitalization after heart attack

Helen Johansen, Cyril Nair and Gregory Taylor

Abstract

Objectives

This article provides an overview of patients who were hospitalized in 1993/94 because of acute myocardial infarction (AMI) and projects how many AMI patients there could be in the future.

Data source

The Person-Oriented Information Data Base was used for this analysis.

Analytical techniques

Hospital inpatients who had a primary diagnosis of AMI were analyzed, as well as their subsequent hospitalizations for coronary heart disease in the fiscal year. The age-sex specific hospitalization rates were used with population projections to estimate future hospital use.

Main results

Of the nearly 45,000 Canadians who were discharged from hospital in 1993/94 with a primary diagnosis of AMI, most (72%) had only one hospital stay within the fiscal year, but 18% had two related stays, and 10% had three or more. AMI patients were hospitalized an average of 14.6 days. The projected number of AMI patients and the number of hospital days used will increase by approximately 36% each decade to the year 2026.

Key words

acute myocardial infarction, projection, length of stay, hospital separation records, record linkage

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In 1994/95, nearly one in twenty Canadians aged 20 and older reported having heart disease,[1] a major cause of long-term disability and death.[2] The total cost of cardiovascular disease in Canada was estimated to range from $14.1 billion to $20.4 billion in 1994.[3]

One of the direct costs associated with heart disease is the use of hospital services. In this article, hospital use in 1993/94 is analyzed for patients who had a primary diagnosis of acute myocardial infarction (AMI)—commonly known as a heart attack.

AMI originates with a reduction or blockage of blood flowing through the coronary arteries. This may arise from a blood clot, spasm, or severe disruption in the heart's rhythm. The reduction in blood flow produces an inadequate oxygen supply to the heart, resulting in the death of heart-muscle tissue. An AMI patient usually experiences sudden, severe chest pain that may spread to the arms and throat. For women, mild angina is commonly the initial symptom, and diagnosis is more problematic for them, as the usual diagnostic tests are more difficult to apply.

Methods

Data source

Hospital morbidity files are provided to Statistics Canada annually by the provinces (data on the Nortwest Territories and the Yukon were not included here). Each record contains information abstracted from a patient's hospital chart and pertains to one continuous hospital stay. Before these data are forwarded to Statistics Canada, edit checks are conducted by the Canadian Institute for Health Information or by provincial health ministries. Statistics Canada performs further consistency edits to ensure the integrity of the data.

In the Person-Oriented Information Data Base used in this analysis, hospital records in each province for fiscal year 1993/94 were linked using health insurance identification numbers. (Patient names are not provided to Statistics Canada.) For further privacy protection, some provincial health ministries scrambled health insurance identification numbers to ensure that individuals could not be identified.

Analytical techniques

Hospital patients often receive multiple diagnoses. The condition accounting for the longest length of stay is known as the "tabulation diagnosis." The tabulation diagnosis is almost always the same as the primary diagnosis—the condition responsible for the hospital stay. In this article, for ease of reference, the term " primary diagnosis" is used for tabulation diagnosis. A tabulation diagnosis of AMI (ICD-9 code 410) was used to select hospital patients for analysis.[4] Subsequent hospitalizations among AMI patients with a tabulation diagnosis of coronary heart disease (ICD-9 codes 410 to 429) were analyzed as well. AMI patients who died in hospital were also included.

Researchers have concluded that the use of ICD-9 code 410 to identify hospitalized cases of AMI results in a modest overestimation of the true number, but that this approach is warranted because of the expense of validation procedures.[5] The inclusion of patients admitted to hospital for tests to rule out a diagnosis of AMI can artificially inflate the number of AMI patients.[6,7] Consequently, patients who were in hospital less than five days and who were discharged alive without having a percutaneous transluminal coronary angioplasty (the dilatation of a blood vessel by means of a balloon catheter that is inflated to flatten plaque against the artery wall) were excluded from this analysis.

Statistics Canada has published low-, medium-, and high-growth population projections for Canada.[8] The low-growth projection assumes declining immigration, a decline in fertility to 1.5 births per woman, and life expectancy of 77 years for males and 83 years for females. The medium-growth projection assumes a continuation of current trends: a constant immigration of 250,000 per year, a fertility rate of 1.7 births per woman, and life expectancy of 78.5 years for males and 84 years for females. The high-growth projection assumes an increase in immigration, an upturn in fertility to 1.9 children per woman, and life expectancy of 81 and 86 years for males and females, respectively.

To estimate the future number of AMI patients to 2026, 1993/94 hospitalization rates by sex and five-year age group were applied to Statistics Canada's projected population estimates. The results were then summed for each sex. This projection is based on the premise that 1993/94 hospitalization rates will persist in the future.

To estimate the future hospital needs of AMI patients to 2026, their hospital days in 1993/94 by sex and five-year age group were applied to projected population estimates. The results were then summed for each sex. This projection is based on the assumption that the average length of hospital stay in 1993/94 will persist in the future.

Other projections were calculated based on the premise that the average annual percentage change in the number of patients and the average length of stay between 1989 and 1993 would continue until 2026. Also, the average percentage decline needed to maintain a steady state was calculated.

Patient counts and hospitalization rates for 1992/93 were also calculated but are not shown in this article. The figures for 1992/93 reveal patterns that correspond to those for 1993/94. However in 1993/94, counts and rates were slightly lower.

Limitations

In the Person-Oriented Information Data Base, record linkage was conducted separately for each province. Thus, a patient with AMI-related hospital admissions in two different provinces during the same fiscal year would be counted twice. Though possible, the likelihood of this event was considered negligible.

The linkage covers only one fiscal year, as hospital records for some provinces could not be linked for more than one year. For patients who were hospitalized in 1993/94 because of a heart attack and who also had related hospital stays in 1994/95, the latter stays were not considered in this article. This has the effect of underestimating the total number of stays and hospital days per patient.

It is difficult to diagnose the elderly, because they are more likely to have multiple conditions. Also, disease severity, which affects length of stay, is not known.

The validity and reliability of hospital discharge data need to be considered.[9] Some studies have found AMI hospital-discharge diagnoses to be good.[10-12] Two Canadian studies found false-positive rates of 8% to 21%, but they included patients who were admitted with a possible AMI that was later ruled out.[13,14] Meehan et al.[12] found an accuracy of 96% for the coding of an AMI among Medicare beneficiairies aged 65 and older who were hospitalized in six Connecticut hospitals between 1989 and 1991. Although the data from this research had very similar trends to those obtained from the FINMONICA acute myocardial infarction register, the actual rates were different.[15]

A considerable proportion of hospitalized AMI patients have subsequent hospital stays related to having had a heart attack. Thus, to examine the full extent of hospital use associated with AMI, all relevant hospital stays for individual AMI patients need to be included. In this analysis, hospital separation records for fiscal year 1993/94 for a patient who was admitted to hospital with a primary diagnosis of AMI were linked to that patient's subsequent separation records involving coronary heart disease.

The projected aging of the population suggests that the incidence of heart disease and the associated costs may increase. In this article, the future number of AMI patients and the hospital days that they will require were estimated for different scenarios based on Statistics Canada's population projections (see *Methods*).

More men than women have heart attacks

Nearly 45,000 Canadians were discharged from hospital in 1993/94 with a primary diagnosis of AMI (Table 1). Although men comprised the majority of AMI patients, women accounted for over a third. At younger ages, male patients greatly outnumber female patients (Chart 1). The prevalence peaked at a younger age for men (65 to 69 years) than for women (75 to 79 years). Because women tend to outlive men, it is not surprising that female patients exceed male patients after age 80.

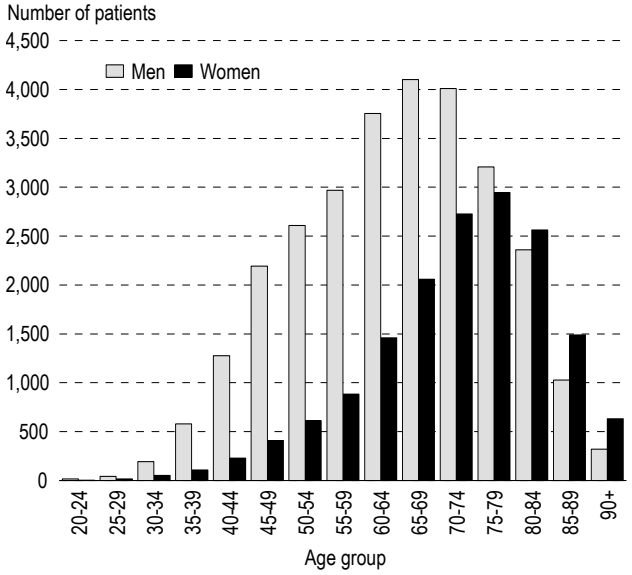
Taking into consideration the number of men and women at different ages, hospitalization rates show a different picture, increasing for both sexes until age 85 (Chart 2). Thereafter, the rates declined, probably because of competing illnesses and increased out-of-hospital AMI deaths. At all ages, AMI hospitalization rates were higher for men.

Table 1
Summary information on AMI patients, Canada excluding territories, 1993/94

	Both sexes	Men	Women
AMI patients	44,832	28,653	16,179
Hospital days†	654,983	394,182	260,801
Hospital discharges†	64,955	41,695	23,260
Average number of hospital days/patient†	14.61	13.76	16.12
Average number of discharges/patient†	1.45	1.46	1.44
In-hospital deaths	17.9%	14.7%	23.6%

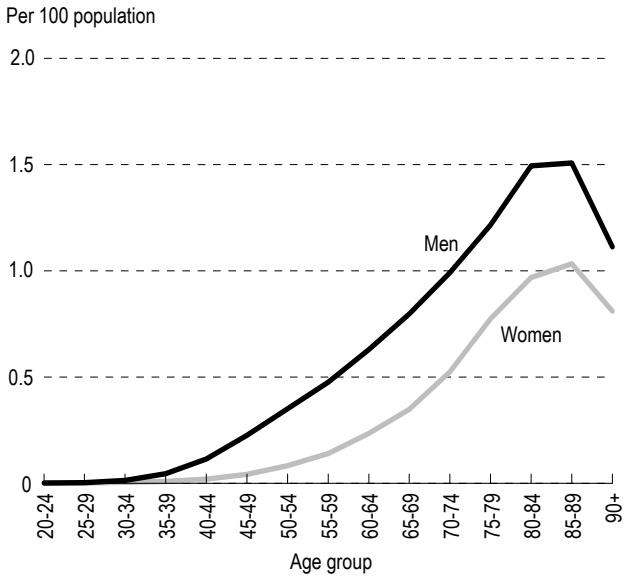
Data source: *Person-Oriented Information Data Base*
† Includes first AMI-related stay and all subsequent stays for coronary heart disease.

Chart 1
Number of hospitalized AMI patients, by age group and sex, Canada excluding territories, 1993/94



Data source: *Person-Oriented Information Data Base*

Chart 2
AMI hospitalization rate, by age group and sex, Canada excluding territories, 1993/94



Data source: *Person-Oriented Information Data Base*

Almost 3 in 10 re-hospitalized within the year

A sizeable proportion of AMI patients were re-hospitalized later in the year. In 1993/94, the majority (72%) of AMI patients had only one hospital stay, but 18% had two AMI-related hospital stays and 10% had three or more. Repeat hospitalization rates were similar for both sexes. Re-admissions occur for several reasons, including programs of planned in-patient care such as revascularization (bypass surgery) or reinfarction (another heart attack) and other cardiac complications.[16]

Younger patients—higher re-admission rates

Older AMI patients might be expected to have more hospital stays than younger patients. However, the average number of re-admissions is higher for younger patients (Chart 3). This may be due to longer stays and a greater chance of death among elderly patients. Also, younger patients are more likely to be re-admitted for cardiac procedures, such as bypass surgery. These procedures are often not done at the time of a heart attack, but deferred because of waiting lists and scheduling considerations.

Rates increase from west to east

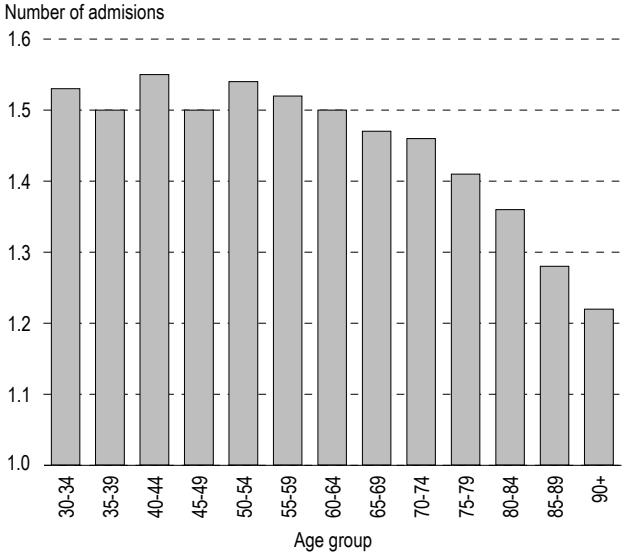
Age-adjusted hospitalization rates by province and sex tend to increase from west to east across Canada (Chart 4). Risk factor levels for heart disease also show a similar pattern, with a higher percentage of people with two or more risk factors increasing from west to east.[1]

Women have longer stays

For a patient's first[a] AMI-related hospitalization in 1993/94, the average length of stay was 10.9 days, a figure consistent with past research.[17] When all subsequent stays with a primary diagnosis of AMI were included (that is, hospitalizations due to another heart attack were considered), the average rose to 11.8 days. And when subsequent stays with a diagnosis of coronary heart disease were included, the average reached 14.6 days. As expected, average stays—both for first hospitalizations only and for

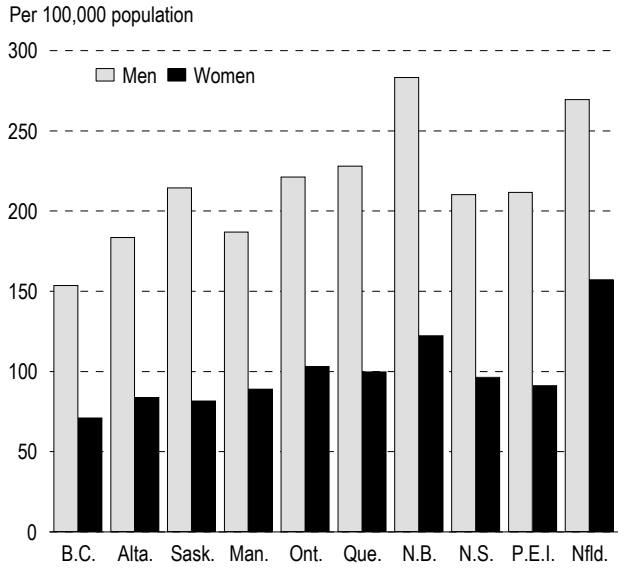
[a] *The first hospitalization in 1993/94 may not be a patient's initial hospitalization, as some patients may have been admitted to hospital in 1992/93 because of a heart attack.*

Chart 3
Average number of hospital admissions per AMI patient,† by age group, Canada excluding territories, 1993/94



Data source: *Person-Oriented Information Data Base*
† Includes first AMI-related stay and all subsequent stays for coronary heart disease.

Chart 4
Age-adjusted AMI hospitalization rate, by sex and province, 1993/94



Data source: *Person-Oriented Information Data Base*
Note: *Data are age-standardized to the 1992 Canadian population to control for differing age structures of provincial populations.*

those that include subsequent hospitalizations—were longer for older patients (Chart 5).

Female AMI patients tend to have longer hospital stays than male patients. The average total length of stay for women in 1993/94 was 16.1 days versus 13.8 days for men (Table 1). This is possibly a reflection of the fact that women tend to have more severe disease and complications.[18]

In-hospital death rates higher for women

Approximately 18% of hospitalized AMI patients died in hospital in 1993/94 (Table 1), a figure consistent with other research.[19] The overall in-hospital death rate was much higher for women than for men: 24% versus 15%. Even though female AMI patients tend to be older than their male counterparts, this did not explain the difference. When calculated by age group, in-hospital death rates remain higher for women at all ages younger than 75. After that age, the rates are approximately equal for both sexes (Chart 6).

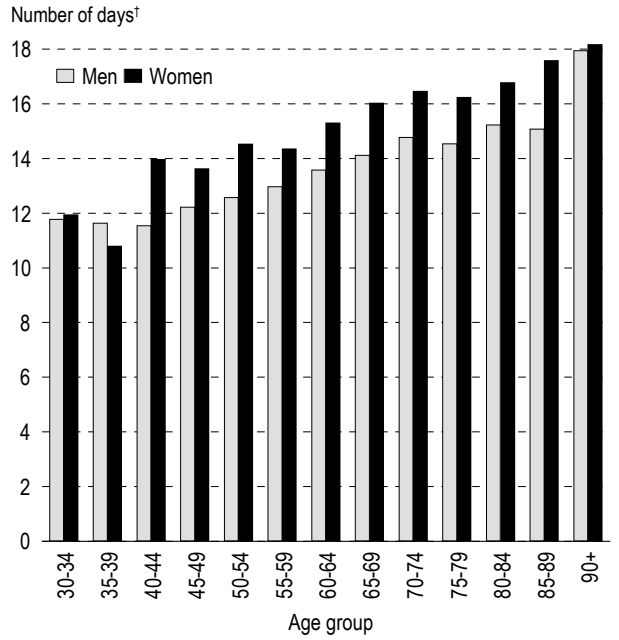
In-hospital deaths account for only a portion of AMI deaths: the majority occurred among patients not admitted to a hospital. (Patients in emergency rooms are not considered admitted.) According to vital statistics data, approximately 69% of male AMI deaths and 60% of female AMI deaths occurred outside hospitals.

Numbers projected to rise

Statistics Canada has published low-, medium-, and high-growth population projections for Canada.[8] Regardless of which projection scenario is considered, the proportion of Canadians aged 65 and older will increase from 12% of the total population to approximately 16% between 1993 and 2016. The most rapidly growing age group will be those aged 85 and older, whose numbers will more than double.

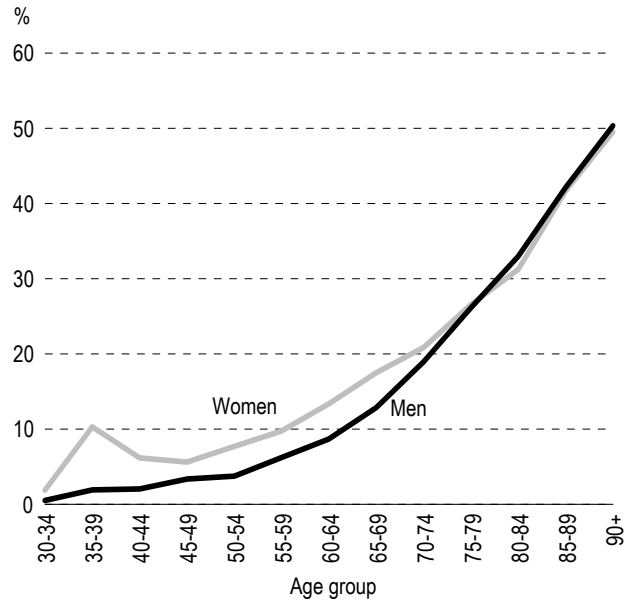
As the proportion of seniors increases, the number of AMI patients will climb (see *Related research*). Assuming that the 1993/94 AMI hospitalization rate by age and sex persists in the future, the number of male AMI patients in 2026

Chart 5
Average number of hospital days per AMI patient, by age group and sex, Canada excluding territories, 1993/94



Data source: *Person-Oriented Information Data Base*
† Includes days from first AMI-related stay and all subsequent stays for coronary heart disease.

Chart 6
Percentage of hospitalized AMI patients who died in hospital, by age group and sex, Canada excluding territories, 1993/94



Data source: *Person-Oriented Information Data Base*

Related research

Researchers using a computer model that projected coronary heart disease in the United States found that without changes in risk factors or the efficacy of therapies after 1980, population aging would increase coronary heart disease prevalence by approximately 40% to 50% by the year 2010.[20] A more recent study predicted a 30% increase (over 1993 figures) in the number of patients requiring cardiac revascularization (surgical procedures that increase blood flow to the heart muscle) by 2010.[21] This picture of a dramatic increase in the use of inpatient services has been shown for hospital patients in general and reflects the increasing proportion of older Canadians in the population.[22]

will be between 57,100 (based on the low-growth population projection) and 68,000 (based on the high-growth population projection). For women, the numbers range from 33,200 to 38,200 (Chart 7). This increase for men and women combined is approximately 36% in each decade.

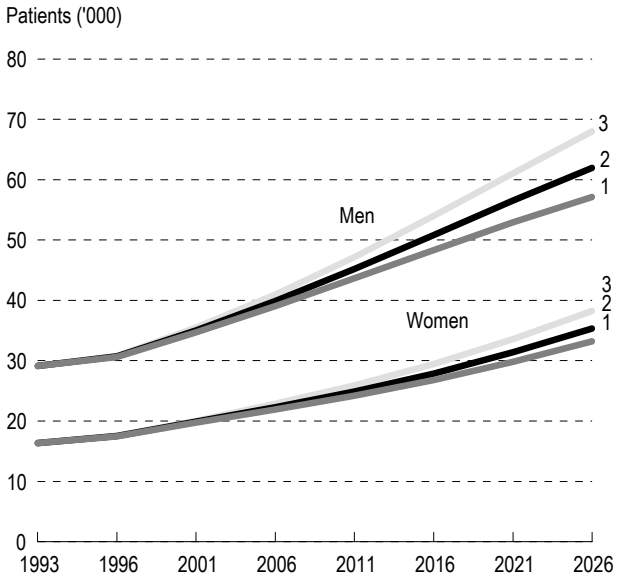
To maintain the number of AMI patients at the 1993/94 level, the percentage of patients in each age group (by sex) would have to decrease 2.3% each year.

More hospital days

Of course, the number of hospital days needed for AMI will also increase. Assuming that the average, total length of stay by age group and sex in 1993/94 persists in the future, the number of hospital days used by male AMI patients is projected to be between 800,000 and 914,000 in 2026 (Chart 8). The number of hospital days used by female AMI patients would range from 540,000 to 564,000. Assuming that 365 hospital days are equivalent to one hospital bed, the total need would rise from 1,794 beds in 1993/94 to between 3,673 and 4,049 beds in 2026.

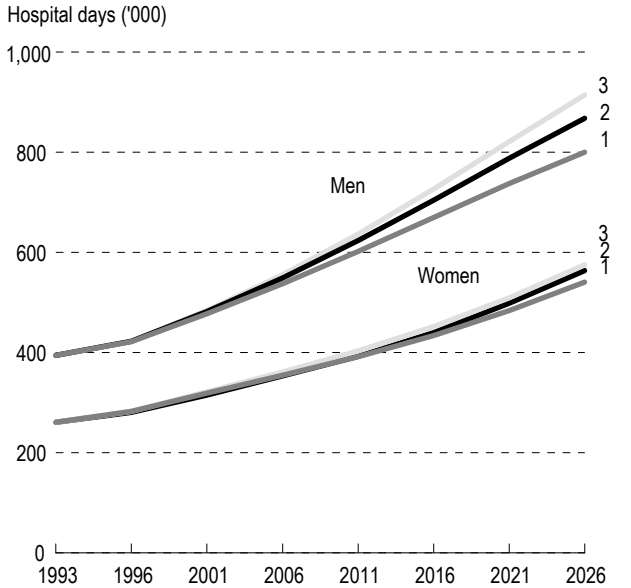
To maintain the number of hospital days at the 1993/94 level, a decrease of 2.3% each year in days per 1,000 population would be needed.

Chart 7
Projected number of AMI patients, Canada excluding territories, 1993 to 2026



Data source: *Population Projections Section, Demography Division, Statistics Canada; Person-Oriented Information Data Base*
Notes: *Projections assume 1993/94 hospitalization rates persist in the future. Low-, medium- and high-growth projections are numbered 1, 2 and 3, respectively.*

Chart 8
Projected number of hospital days needed for AMI patients, Canada excluding territories, 1993 to 2026



Data source: *Population Projections Section, Demography Division, Statistics Canada; Person-Oriented Information Data Base*
Notes: *Projections assume 1993/94 hospitalization rates persist in the future. Low-, medium- and high-growth projections are numbered 1, 2 and 3, respectively.*

Other scenarios

For these projections, current hospitalization rates and the average length of stay were assumed to remain constant in the future. However, it is unlikely that this will happen.

Changes in smoking, exercise, diet, and other lifestyle behaviours will likely affect future rates. A number of additional factors may also influence these rates. For example, health promotion intiatives, improved treatments and screening programs have helped to decrease the number of people going to hospital by reducing the occurrence and severity of disease.

The total number of hospital days used for AMI has also declined in recent years. Quality care management approaches have improved the effectiveness and efficiency of hospital care. Developing and implementing Patient Care Maps—a timetable of tests, procedures and medications needed for an average patient with a given condition—has reduced the waiting time between tests and procedures.[23-25]

Reductions in the average length of hospital stay have also been achieved by replacing hospital care with less expensive alternatives. For example, ambulatory care has been used after selected surgeries.[26]

"Telemedicine," too, is being explored as an option for patients in remote regions. They are linked with specialists who conduct patient interviews and send test results via telephone before a decision is made to move the patient to an urban centre.

Since future changes in hospitalization rates for AMI cannot be predicted, hospital discharge rates between 1989 and 1993 were examined. A decline of 0.16% per year occurred during this period. If it is assumed that this decline persists in future, the number of AMI hospital patients will increase by 16.7% a decade, about half as much as shown in Chart 7.

Similarly, if the average annual decrease in the number of hospital days for AMI that occurred between 1989 and 1993 continues, the projected number of hospital days *declines* in spite of an aging population. However, this decrease in the number of days per discharge was close to 4% a year and it is unlikely that this rate of decline could continue indefinitely.

Concluding remarks

The projections provide an indication of the impact that the aging of the population will have on hospital resources needed for AMI. Continuation of past initiatives and new approaches will be needed to control costs as the population ages. ●

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