Projecting Hospital Bed Needs for 2020

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We thank the University of Manitoba, Faculty of Medicine, Health Research Ethics Board for their review of this project. The Manitoba Centre for Health Policy complies with all legislative acts and regulations governing the protection and use of sensitive information. We implement strict policies and procedures to protect the privacy and security of anonymized data used to produce this report and we keep the provincial Health Information Privacy Committee informed of all work undertaken for Manitoba Health.

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EXECUTIVE SUMMARY

There is much concern about the impact an aging population will have on Canada's medical system. A recent C.D. Howe Institute report captured this concern with the title "Will the Baby Boomers Bust the Health Budget." At the federal level the Auditor General has raised the need for governments to plan for the needs of the changing population.

One aspect of Manitoba's preparation to meet the health care needs of the changing population is the estimation of acute care bed day needs for in the future. This report attempts to project the number of acute care bed days that will be required in Manitoba by the year 2020. Projecting how many beds will be needed requires estimates of Manitoba's future demographic composition and hospital care needs of Manitobans. The demographic component comprises three parts:

- What will Manitoba's population be in 2020?
- Where in Manitoba will that population reside?
- What will the age and sex composition of the population be?

The Manitoba Bureau of Statistics (MBS) was contracted by Manitoba Health to develop population projections. The task of the Manitoba Centre for Health Policy (MCHP) was to assess how this population might use hospitals. There is no simple answer to this question. After considering the two components, our analysis suggests that there appears to be sufficient physical capacity in the existing system to handle the needs of 2020, provided the trend to outpatient surgery and shorter lengths of hospital stay continue. If these trends do not continue (and in recent years there has been some flattening of these trends), the acute hospital system would still have sufficient capacity, if efforts are made to ensure that those who occupy acute care beds actually need acute care beds. Previous studies have shown that substantial numbers of beds in Manitoba's acute hospitals are occupied by individuals who don't require this level of care, although most of them do require some alternative form of care.

Methodology

Estimates of Manitoba's population size and age/sex/regional distribution in 2020 are taken from projections provided by Manitoba Bureau of Statistics (MBS). MBS not only provided overall population figures, but also figures at the Regional Health Authority (RHA) level on an annual basis to 2020.

We develop and present two models for projecting future acute care hospital bed use. Both of our models make separate projections for surgical and non-surgical days, for men and women, and for different age groups. Having estimated how much use residents of each RHA will need, we then use data on where each RHA's residents were hospitalized in the recent past to estimate in-area hospital use rates for each RHA.

Our first model, called Current Use Projection, projects future use on the basis of current patterns of use. We used three years of hospital data, 1996/97 to 1998/99, to define the current use of acute care beds (by age and sex and region of residence), and then projected that use forward to 2020 based on MBS's predictions regarding the age and sex composition of the population.

Our second model, called Trend Analysis, is based on trends in hospital use over the recent 10-year period. It recognizes that "Projections of hospital days can be a useful tool for planning future resources. However, earlier attempts seem to indicate that these projections have *consistently over-estimated* future needs" (Carrière, 2000; emphasis added). Accordingly, our model focuses on trends in hospital use. Specifically, we identified the trends in hospital use for the various age and sex groupings and, using statistical regression, extrapolated those trends to 2020. The trend analysis builds into our estimations the assumption that policy changes and improvements in treatment and technology will be similar to those that occurred over the last 10 years. Projections based on current use do not allow for such improvements or changes. This may well be why, as Carrière noted, past projections generally overestimated future needs.

Results

The two models provide sharply divergent predictions for 2020. The Current Use Projection Model estimates increases of 25 percentage points in non-surgical days and of 35 percentage points in surgical days. That is, if we look strictly at the rate at which individuals were using hospitals in 1996 through 1999 and combine this with population estimates for 2020, we project quite substantial increases in hospital use across the province, largely due to the aging of the population, because utilization is held constant at current use levels. With older people making up a larger share of the population, and with older people using hospitals more than younger people, such a result seems eminently comprehensible. However, even if hospitals are used in 2020 the way they were used in 1999, other factors could well mitigate the pressures on the hospital system. First, in virtually all of the rural RHAs the hospitals have relatively low occupancy rates. Much of the increase in patient days could thus be met within the existing institutions. Second, a significant proportion of rural Manitobans are hospitalized in Winnipeg, and therefore an increase in the need for hospital days by those residents does not necessarily indicate the increased demand will primarily affect local hospitals. Third, with respect to Winnipeg, recent research has indicated that a substantial portion of the medical days spent in acute care beds do not actually require treatment in an acute setting. What this indicates is that current hospital use need not be considered 'best practise' and should not necessarily be used as a model for projecting future needs. Efforts to more appropriately and efficiently discharge patients might well eliminate the substantial increases in bed days the Current Use Projection Model estimates are needed for even the Winnipeg region. However, a best practice model

assumes that capacity is available in alternative settings including personal care homes, through home care and in rehabilitation facilities.

Two Models for Projecting Hospital Use in Manitoba in 2020

CURRENT USE PROJECTION	TREND ANALYSIS
Average Hospital Use 1996/97-1998/99	Trends in Hospital Use 1989/90-1998/99
Adjust for changes in Population Size	Adjust for changes in Population Size
Adjust for changes in Age and Sex Composition of Population	Adjust for changes in Age and Sex Composition of Population
Projections of Future Use	**Projections of Future Use**
Change in Non-Surgical Days: **+25%**	Change in Non-Surgical Days: **-17%**
Change in Surgical Days: **+35%**	Change in Surgical Days: **-30%**

The Trend Analysis Model projects a substantial decline in the number of bed days required in 2020. Specifically, it indicates that non-surgical days will be at only 83% of 1998/99 levels while surgical days will be at only 70% of 1998/99 levels. This model's projected declines apply to Winnipeg as well as most of the other RHAs. These declines stem partially from predictions that the sharp decline in the average length of stay for inpatient surgeries that has occurred in the past 10 years will continue and that inpatient surgery will continue to move to the outpatient setting. A recent report by Roos et al. (2000) looked at trends in health status and health care of Manitobans. Over the period 1985-1998 there was a marked drop in the hospital days experienced by Manitobans, although the rate at which they were admitted for hospital treatment was unchanged. This was achieved by falling lengths of stay and moving to outpatient surgery. Indeed, many of the projected decreases in length of stays for rural hospitals have already been achieved in Winnipeg hospitals. This suggests that the decline we are forecasting can likely be achieved.

It is important to keep in mind that 2020, the point at which these projections end, is essentially the beginning of the pressures on hospital beds which will be created by the aging "baby boomers," not the end. If the trends towards shorter stays and the move to outpatient surgery continue, Manitoba will have excess capacity in 2020 in its acute hospitals, and be well positioned to meet the needs of the aging boomers. However, if the trends do not continue, we project increased demand for acute care in 2020, demands that will grow in subsequent years. This reinforces the importance of continuing to monitor use patterns and population patterns to determine which of the projections we have developed more closely captures system behaviour. There are risks in both overestimating and underestimating hospital bed needs. Once the "baby boom bulge" ends, approximately 30 years later (that is in approximately 2050), one could have substantial excess capacity, capacity which will be as difficult to downsize as are underused rural facilities today. The risks in underestimating bed needs are also problematic although developing new capacity if needs become apparent probably takes less time than closing beds which are not needed.

Conclusion

Despite an aging population, we are cautiously optimistic about the ability of Manitoba's hospitals to meet the acute care needs of the province's population in 2020. If past trends continue, there may well be excess capacity. Even if past trends towards decreasing use of acute care hospitals do not continue, Manitoba could accommodate increased demands on acute hospitals in 2020 by treating patients requiring alternative forms of care–elsewhere. This of course assumes that alternatives are available.

Recommendations

- Revisit hospital use patterns every five years and apply actual population figures and hospital use, and updated population projections to our models. If the population projections are inaccurate, or hospital use patterns are different from the trend the model assumes, the projections will also be inaccurate. However, since 2020 is not the end of the pressures on hospitals, it will be critical to continue to assess the accuracy of usage projections into the future.
- Approach forecasted system changes from a "wait and see" perspective. Any increased pressures that occur will be gradual. Manitoba has already accommodated a 38% increase in the elderly population (between 1985 and 1998) over a period when there were substantial bed closures. Despite the increases in the numbers of elderly people and the decreases in the number of beds, the rate at which Manitobans were hospitalised actually increased over the period. The projections used here assume a further 15% increase in the population aged 75 years and older by the year 2020.
- Do not reallocate major hospital resources from Winnipeg to regions with large projected population increases. Although Winnipeg is the only RHA in which population decreases are predicted this does not mean that Winnipeg will be less important to the province's health system. Many residents of other RHAs are hospitalized in the capital and there is no evidence that this pattern is changing. Our projections assume the patient flow patterns that have occurred in the recent past will continue.
- Develop programs to maximize the use of acute care hospitals for acute care patients, and to provide appropriate alternate settings to care for patients who do not need acute care. Patients who do not require acute care beds inflate occupancy rates and create more pressure on beds.
- Monitor the presence of long-stay patients in acute care beds, and arrange for alternate care settings, like home care, as soon as is feasible. If it is possible to identify and care for the needs of these patients in another more appropriate setting then pressures on acute care beds will decline.
- Ensure facilities are available for moving surgery from the inpatient to the outpatient setting.
- The Trend Analysis Model assumes that surgery that previously has been performed on an inpatient basis will increasingly be done on an outpatient basis. If these moves do not take place, increased pressure on inpatient beds will ensue.

- Given the recent marked increases in the rates at which the population is undergoing surgical procedures, further work is needed to understand why these increases are occurring. Clinicians should be encouraged to adopt practice guidelines where they exist to ensure the appropriateness of surgery performed.
- This report has projected the need for hospital bed days for 2020 but does not estimate the cost and human resource implications of increased occupancy rates, increases in outpatient surgery or technological changes. The budgetary and education/training implications will need to be considered by planners who use the estimates provided here.

INTRODUCTION AND BACKGROUND

Apocalyptic visions about the future of health care often focus on the demographic changes that will take place over the next quarter of a century. It is clear that an ever greater proportion of the population will be over the age of 65 and it is equally clear that those over the age of 65 currently use a disproportionate amount of hospital days and medical services more generally (The 1999 Annual Report on the Health of the Montreal Population). The fear then, is that hospitals specifically, and the health system more generally, will be overwhelmed by the greying population. Victor Fuchs' "Health Care for the Elderly: How Much? Who Will Pay For It?" (1998) reflects this concern from an American perspective. As he puts it "The tendency of health care expenditures on the elderly to grow about 4 per cent per annum more rapidly than the GDP could plunge the nation into a severe economic and social crisis with two decades" (Abstract). In Canada, publications such as the C.D. Howe Institute's "Will the Baby Boomer's Bust the Health Care Budget?" (Robson, 2001) raise similar concerns. Such perspectives clearly capture bureaucratic and public attention.

This report:

- *responds to concerns that projected population changes in Manitoba Regional Health Authorities will affect the number of hospital beds that will be needed to care for residents.*
- *estimates the need for inpatient hospital days in each Regional Health Authority in Manitoba in the year 2020.*

In this report we were asked to project the need for acute care beds in Manitoba in 2020. In making our projections we look carefully at projected changes in the population of Manitoba, considering factors such as the age, sex and the region in which Manitoba's population will be located in 2020. Obviously, as indicated by the citation from Fuchs, the use of hospitals is not the only issue of concern regarding the health care system in 2020. However, it is important to keep in mind the point made by Anderson et al. in 1990, namely that "In the Canadian system acute care hospitals account for the largest proportion of health expenditures" (P. 352). The number of days needed in acute care hospitals will therefore have a dramatic impact on overall health costs.

Based on data contained in the Manitoba Population Health Data Repository[1] we provide two sets of projections of the need for acute care bed days in 2020. One model projects future bed utilization as a function only of demographic change and population size increase. The second also considers historical trends in acute care bed use in recent years.

Our first model identifies the utilization per capita of acute care days, by individuals in various age and sex groupings, in Manitoba's hospitals during the three-year period April 1996 – March 1999. We then look at the population estimations for 2020 in each age and sex group, and project use based on the number of individuals expected to exist in 2020 multiplied by

[1] The Population Health Research Data Repository contains anonymized encounter-based records of individuals' interactions with the provincial health care system. It is derived from information contained in the Manitoba Health Services Insurance Plan registry, and from health insurance claims routinely filed by physicians and health care facilities with Manitoba Health. For more information see http://www.umanitoba.ca/centres/mchp/data.html.

Two estimation methods are used:

- *The Current Use Projection Model assumes that the population of each RHA will use hospital beds in 2020 in the same way as they were used between 1996 and 1999.*
- *The Trend Analysis Model assumes that the trends in hospital use that occurred between 1989 and 1999 in each RHA will continue.*

the hospital use of this age/sex group of individuals over the 1996-99 period. This is our Current Use Projection Model.

Our second model of projections reflect the frequent observation that current use should not simply be projected into the future, and that trends in the recent past that have affected hospital use deserve attention. Accordingly, our second model for projecting the number of hospital days includes an examination of the trends in hospital use by age and sex of patients over multiple years; where, for example, rates of outpatient surgery have been increasing, this trend is projected to continue; where lengths of stay or admission rates have been falling, these trends are projected to continue. This is our Trend Analysis Model.

In both models we differentiate surgical and non-surgical uses of acute care beds. Moreover, our models take into account differences between Winnipeg hospital use levels and use in the rest of the province, as well as the historic patterns in specific Regional Health Authorities (RHAs) (that is, where residents of each RHAs are actually hospitalized since much of rural residents' use of hospitals takes place outside of their home region, much of it in Winnipeg). This report presents the estimations produced by both our models. In short, our Current Use Projection Model identified the average number of hospital days used by various age and sex groups in the period 1996/97-1998/99 and indicated the number of hospital days that would be required in 2020 if each age and sex group then used hospitals in the same way that the corresponding age and sex groups did in 1996/97-1998/99. This produces a much higher estimate of need than our Trend Analysis Model.

1.1 Learning from Past Research

There have been several calls highlighting the need to assess the impact of upcoming demographic change. In a report released in February 2001 the Auditor General urged the federal government to begin taking into account the long-term implications of an aging population. In an article on this report, the Globe and Mail referred to the Auditor General's concerns that "The aging population will put pressure on government spending, through pension payments and increased demands on health care services" (Rollason, February 7, 2001: A8). The 1999 Annual Report on the Health of the Montreal Population likewise raised concerns about the challenge of an aging society: "One of the primary and most pressing questions is that of financing health and social services in a society where the number of elderly—the biggest users of health care—will rise from year to year" (P. 13). The need to plan for the future is an obvious priority for governments at all levels.

There is clear agreement among demographers that the composition of the Canadian population is going to change dramatically. And there is no challenge to the assertion that the proportion that elderly people comprise of the Canadian population is going to increase. Similarly, there is virtually no debate that this will have an impact on the health care system. As Barer et al.

(1995) note "The aging of the population will have an impact on the use and costs of health care services. Older people use more services, on average, than their younger counterparts. And there will be more older people, relatively speaking, both in terms of numbers of individuals and proportion of the population, during the coming decades than at present" (P. 196). The literature is quite clear that elderly people use more hospital services than younger people. Indeed, as Carrière (2000) notes "Except for newborns, hospitalization rates are positively related with age" (P. 30). Moreover, the average length of stay in hospitals also increases with age (P. 31). In a summary of the utilization of medical care by seniors, Rosenberg and James (2000) conclude that "seniors, especially those aged 75 and over and female, are among the heaviest users of physician, hospital and ambulatory services" (P. 139). Finally, as Hertzman et al. wrote in 1990, "The proportion of Canada's health care services utilized by patients aged 65 and over has been rising rapidly for the past two decades" (P. 819). Despite the wide-spread agreement on these matters, there are however many questions about the impact these changes will have on social policy in general and health policy in particular.

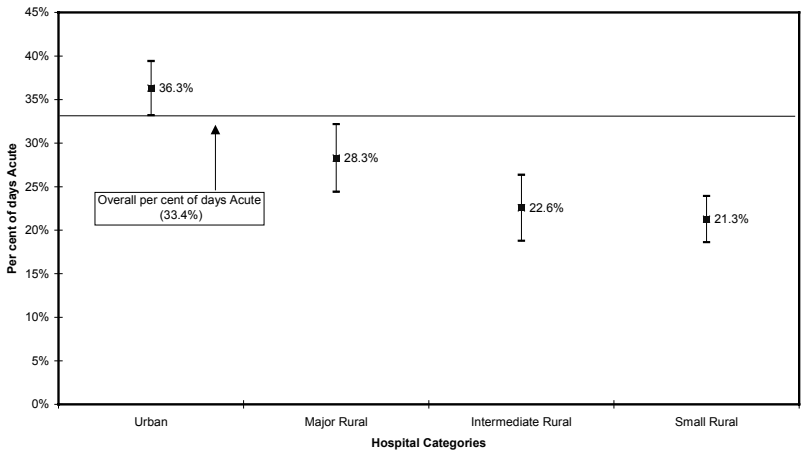
Key Point:

- *Studies have shown that people who do not need hospital care are occupying acute care inpatient beds in Manitoba. Changes in practice and/or policy have the potential to change or reduce this pattern of inappropriate hospital use.*

One of the reasons for concern about the future of hospital services as the population ages is that, as Rosenberg and James summarize, "Much of the research on patterns of hospital care through the 1970s and 1980s documented the growing length of stay by seniors" (P. 128). However, it is important not to treat existing patterns as a benchmark for desirable performance. In a study of hospital use in BC, Barer et al. indicate that "by the mid-1980s, the BC hospital system devoted nearly half its bed capacity to providing what was effectively a 'permanent residence' for a very small proportion of the province's elderly population" (P. 207). Thus the use elderly patients make of hospital services at a particular time or at a particular age may not be the most appropriate.

Earlier work by MCHP has made clear that in Manitoba, a striking proportion of those occupying acute care beds were not in fact in need of acute care. DeCoster et al. examined the use of acute care hospitals by adult medical patients in 1993/94 (1996: P. 4). The authors found that, "Overall, 33% of [adult medical] days were assessed as requiring Acute care – two of every three days could potentially be treated in a setting other than that of an acute care ward." (see Figure 1). It is important to note that most of the non-acute days required an alternative form of health care, such as long-term care or home care. Translating the findings from the study into bed-days, the equivalent of over 1,000 acute care beds could be potentially 'saved' if patients who did not require acute care were cared for in a more appropriate setting.

Figure 1: Per cent of Days Acute, Adult Medical, Hospital Categories



Source: DeCoster C, et al.: Alternatives to Acute Care. Manitoba Centre for Health Policy and Evaluation, July 1996.

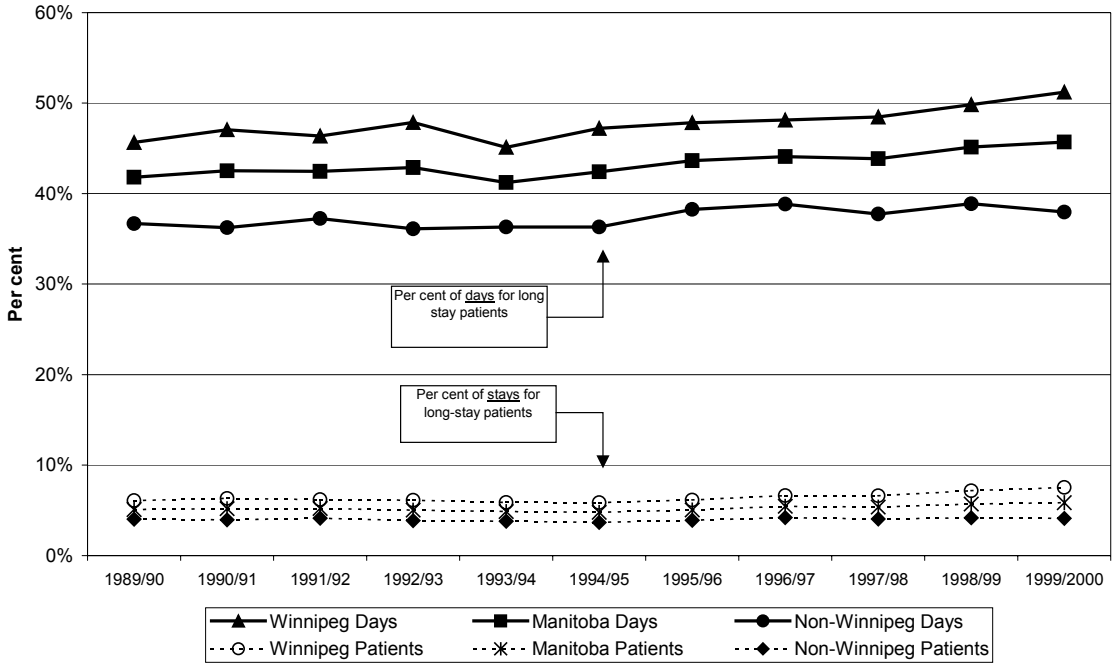
Looking more specifically at hospital use by the elderly, the authors found that 75% of the days spent by those aged 75 or over in acute care beds were not classified as requiring acute care (DeCoster et al., 1997). Hospitals outside of urban areas were particularly likely to have patients in them who were not classified as needing acute care. Only 40% of the medical days in major rural hospitals were classified as acute, and 35% in intermediate and small rural hospitals. The study focussed on medical patients; however, in intermediate and small rural hospitals, medical patient care comprised nearly 85% of all hospital days. These hospitals, which are the most numerous in Manitoba, have patterns of use that could be made more efficient. One should not treat the current use of hospitals as the standard that should apply in the future.

A subsequent study of Winnipeg hospitals used somewhat different criteria to assess adult medical care in 1998/99 (Bruce, 2001). It found that 42% of adult medical days were not in need of an acute care hospital, in spite of the bed closures and restructuring that have taken place in the Winnipeg acute care hospital system. Since the non-Winnipeg hospitals have not undergone such major changes, it seems safe to conclude that there is probably still significant room to change/reduce the pattern of inappropriate hospital use.

One other study by MCHP also bears on this issue. A study of long-stay patients, defined as those with stays of more than 30 days, in Winnipeg acute care hospitals found that approximately 40% of all the medical-surgical days used in Winnipeg hospitals were used by long-stay patients (DeCoster et al., 2000). Of these days, 31% were used by the 13% of patients who eventually were admitted to a Personal Care Home. For these patients the average length of stay was nearly six months for medical patients and eight months for surgical patients, nearly half of which was spent post-panelling. In preparing the current report, we looked at the use of acute care hospitals by long-stay patients in each RHA over the past ten years; here we looked at all long-stays, not just those defined as medical-surgical (see Figure 2). The proportion of days used by long-stay patients has remained quite stable for all non-Winnipeg RHAs as a group, at around 37%, although there is variation by individual RHA. While we do not know how many of these days

needed an acute care hospital and how many did not, based on our study of Winnipeg, and knowing that occupancy is generally lower in non-Winnipeg hospitals, one can assume that at least some of these days could have been provided in an alternate care setting.

Figure 2: Long-stay Days and Patients in Acute Care Hospitals
(long-stays are stays of more than 30 days)

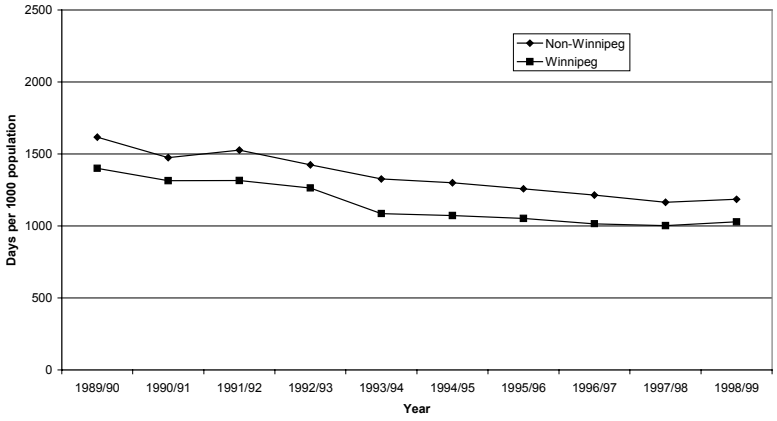


A valid estimation of future hospital use needs to consider how our use of hospitals has changed in the recent past – most clearly it is important to take into consideration trends in surgery. For instance, Wilmore and Kehlet in a 2001 article in BMJ note that "Ambulatory surgery has become routine for many procedures… even in patients at high risk" and that "In the future, the trend will be for shorter recovery periods after major operations". This has two quite clear implications for the issue under consideration here. First, we should expect an increase in the use of day surgery over time. Second, with shorter recovery periods, we should expect a decline in the length of stay required for surgeries. Both of these factors should reduce the overall number of hospital days required in the future.

Past investigations of hospital use in Manitoba support such a contention. In an examination of hospital use in Manitoba between 1985 and 1998, Roos et al. (2001) identified three trends that are likely to be significant in understanding hospital use in the future:

- Decreasing days of hospital use by the population (see Figure 3) (this decline in hospital use predates the bed closures of 1992)[2]
- Increasing use of outpatient surgery
- Decreasing length of stay

Figure 3: Age-Sex Standardized Rate of Inpatient Hospital Days (outpatient surgery is not included)



Key Points:

- *Studies have shown that the number of inpatient days used by Manitobans has decreased over the past 14 years.*
- *People who are 75 years of age and over are high users of hospital beds. In spite of a decreasing mortality rate, an increase in the number of people in this age group, and an increase in the number of hospitalizations, the number of hospital days has decreased substantially.*

Research has also raised questions as to whether current patterns of disease incidence or disability among older people will endure in the future. Indeed, a study of chronic disability trends in elderly US populations between 1982-1994 suggests that "the rates of serious illness could be falling in older people" (Seven Deadly Myths: P. 16). A change of this sort, that is a healthier population in the future, would further lessen the demand for hospital beds. Estimations of future hospital need must avoid treating current patterns as the final word (while acknowledging that improvements in treatment may also extend the demand for hospital beds).

The evidence from Manitoba provides strong support for the proposition that the numbers of elderly people can increase dramatically without this increase swamping the hospital system. Recent research has shown that although the elderly population has been increasing, the days of hospital use has not. As Roos et al. explain "The population of Manitoba that is 75 years and over is of particular interest, both because of the increasing numbers of people in this age group, and their relatively high use of the health care system ... The mortality rate of this age group has decreased by 7.9% over the 14- year period [from 1985 to 1999], and the population size has increased by almost 38%... [T]he rate of inpatient hospital care (i.e., discharges) has increased, but the number of hospital days has shown a substantial decrease" (Roos et al., 2001).

[2] Figure 3 indicates that in the most recent years for which we have data the decline in hospital inpatient days has levelled off. Our models take this recent development into consideration.

Some research actually indicates that the rising cost of health care has not been driven by population aging. For example, the Alliance for Aging suggests that "In other countries that have already experienced a sharp rise in the older population, health care spending has not risen proportionately… cross-national data do not suggest that high proportions of older people are inevitably associated with high health care costs" (Seven Deadly Myths: P. 15).

1.2 Projecting Hospital Use

The population projections used in this study were developed by the Manitoba Bureau of Statistics (MBS) and take into account factors such as immigration and emigration, birth and death rates and inter- and intra-provincial migrations. The result of this forecast provides us with estimates of the number of male and female Manitobans, in five-year groupings, who will live in each region of the province in 2020. It is important to keep in mind that the numbers projected in this report are based on the MBS data. Recent Statistics Canada estimates indicate that the levels on inter-provincial migration may be changing. For instance, "the last two years are the first since the mid-1980s that more Manitobans are staying than leaving" (Winnipeg Free Press, March 1 2001: A5). If the MBS projections on population movements are in error, then the population projections for 2020 will also be erroneous.

Nonetheless, our task, given the population forecasts made available to us, was to estimate the number of hospital days that will be required in each of the Regional Health Authorities (RHAs) in 2020. The simplest way to make such a projection is to look at the utilization of hospitals by each sex and age grouping in Manitoba today and extrapolate from this based on the projected population in the age, sex groupings in 2020. In *Planning for Saskatchewan's Future: Population and Health Services Projections to 2015*, HSURC (2001) followed essentially this strategy. In their words "To project future rates, we multiplied current service levels by projected population" (Methods, P. 2). As noted earlier, this approach is likely to lead to a high-end estimate of hospital needs. The evidence is strong, as Carrière has suggested, that "Projecting [future] needs and costs from data on a specific year is extremely misleading and only fuels an alarmist view regarding the impact of population aging" (P. 35). Nonetheless, to bracket our projected use estimates, our Current Use Projection Model provides estimations of what hospital use would look like in 2020 if use remains at the average level for the *three fiscal year period 1996/97-1998/99*. To place these data in context, we present data on whether regions during that period were using more or fewer hospital days than their need profiles suggest as well as data on occupancy rates and the capture of resident hospitalizations within the RHA.[3]

[3] Data on these issues are taken from Stewart et al., 2000.

Key Points:

- *The Current Use Projection Model uses the 1996 to 1999 use of inpatient hospital beds for each age grouping, sex, region of residence and type of care (surgical or non-surgical).*
- *The Trend Analysis Model uses the 1989 to 1999 trends in use of inpatient hospital beds for each age grouping, sex, region of residence and type of care (surgical or non-surgical).*
- *Specific trends that have affected the use of hospital beds are decreased length of stay and increased use of outpatient surgery (as opposed to inpatient surgery).*
- *The Trend Analysis Model estimates that Manitobans will require fewer inpatient hospital days in 2020 than are required now, in spite of an aging population and an overall increase in the number of residents.*

Most of the research in this area, however, would suggest that the best estimation of future hospital need requires an examination not just of current short-term use, but the recent past and more importantly, at the trends that can be seen from looking at data from a number of years. Accordingly, our Trend Analysis Model takes a broader perspective. Essentially, we look at 10 years of data on hospital use according to whether the use was for a non-surgical inpatient case, an inpatient surgery case or an outpatient surgery case. We then assess use according to the age, sex and residence of the patient receiving treatment to provide us with an indication of how each age/sex grouping used these services in the period 1989/90 – 1998/99. The use of ten years of data serves as a proxy for the sorts of changes in treatment that occur as a result of improvements in technology and population health, changing medical practice patterns, or movements towards more outpatient services. We develop separate models for non-surgical inpatient days and surgical inpatient days and use these models to project the number of hospital days required not only for each of the RHAs in 2020, but for different age/sex groupings within each region in 2020. The trend-based results suggest that the aging of the Manitoba population will place few pressures on hospital beds. If the patterns of the last ten years continue (which includes the recent "levelling off" of hospital days), Manitobans will actually require fewer hospital days in 2020 then they do today.

Moreover, even if the Current Use Projection Model's projections of hospital need are used, and this model, not surprisingly, does suggest that more days will be required, it is possible that factors such as improved bed management can play a mitigating role. If those managing the system deal with issues involving the appropriateness of hospital stays, the need for hospital services as opposed to the use of hospital services, and the low occupancy rates in most of the province's rural acute care institutions, even the high current use bed projections may not have a major impact on the numbers of hospital beds needed in 2020.

1.3 Developing our Models

As a first step in predicting future hospital use, we subdivided the population by age and sex. It is indisputable that the use of hospitals is associated with age and sex. For example, elderly people use hospitals much more frequently than younger people, while women of child-bearing age are more likely to be hospitalized than men of similar ages. Thus accurate projections of hospital need must take these factors into consideration.

In developing our Trend Analysis Model we looked at ten years (1989/90 – 1998/99) of data on hospital use. Hospital use was subdivided into three types: 1) non-surgical inpatient cases; 2) inpatient surgery cases and 3) outpatient surgery cases. These data were then analysed in conjunction with data on the patient's sex, age group, region of residence, and the fiscal year in which treatment was received. The hospital data consisted of fiscal year (April 1 of each year to March 31 of the following year) patient discharge

records (a computerized record is generated only upon the patient's discharge from hospital).[4]

The population data for each of the ten years 1989/90 –1998/99 were obtained from the Manitoba Population Health Research Data Repository while, as discussed above, projected population data for 2020 were provided by the Manitoba Bureau of Statistics.

In pursuing our analysis we divided the population into different age groups based on within-group similarities in past hospital inpatient utilization. The age and sex groups utilized are the following:

Non-Surgical[5] care:
Females: ages 0-14, 15-24, 25-34, 35-54, 55-64, 65-74, 75-79, 80-84 & 85+
Males: ages 0-14, 15-24, 25-34, 35-54, 55-64, 65-74, 75-79, 80-84 & 85+

Surgical care (inpatient and outpatient):
Females: ages 0-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84 & 85+
Males: ages 0-14, 15-34, 35-44, 45-54, 55-64, 65-74, 75-84 & 85+

We developed our non-surgical care estimates by first using Poisson regression[6] to model the observed rate of inpatient days per resident over the past 10 years in each of the above age-sex groups by area (Winnipeg vs. non-Winnipeg) of residence. Two variables were used to "predict" inpatient days per resident: 1) fiscal year and 2) the proportion of total inpatient days that were associated with long-stay cases (long-stays were defined as stays of greater than 30 days).[7] Estimates of age-sex specific rates of inpatient days per capita for 2020 were then obtained by using the population data for 2020

[4] If a patient's stay extended over the end of one or more fiscal years the appropriate number of days stay during each of the separate fiscal years were counted. For example, if a patient entered hospital 10 days before the end of a fiscal year and was discharged 40 days later, ten of the inpatient days were counted in the first fiscal year with the remaining 30 days of this stay attributed to the following fiscal year.
[5] Non-surgical care includes medical, obstetric and psychiatric cases.
[6] Poisson regression differs from the more commonly used ordinary least squares regression in two ways that make it more suitable for our purposes. First, it does not impose a straight line on trend data, which makes it more sensitive to recent data as well as the variations over time within the data set. Second, all estimates of subsequent hospital use are constrained to be greater than zero.
[7] For example, if for an age and sex group in a given fiscal year there were only two inpatient admissions: the first patient was in hospital 25 days while the second patient stayed 75 days. The proportion of days that were associated with long-stay cases would be: 75 / (25+75) = 0.75.

along with the 1997/98 observed values of the proportion of long-stay days in the resulting regression equations.[8]

Key Points:

- *Predictors used by the Trend Analysis Model to estimate the need for hospital beds by each age-sex group in each region are:*
  - *For non-surgical cases – year of hospital care (between 1989 and 1999) and the proportion of inpatient days that were associated with long-stay cases.*
  - *For inpatient surgical cases – year of hospital care (between 1989 and 1999), the proportion of inpatient days that were associated with long-stay cases, and the ratio of outpatient cases to inpatient cases.*
- *These predictors allow the trends that have been observed over the past 10 years to be projected forward over the subsequent 20 years.*

Our aim was to develop predictions for each of the RHAs, not simply for Winnipeg residents and non-residents. However, the small numbers in some of the RHAs would have created too much instability in the estimates. Thus, since regression models were derived only for Winnipeg residents and for non-Winnipeg residents another step was needed to obtain estimates for residents of each of the non-Winnipeg RHAs. Rates of inpatient days over the past ten years in each non-Winnipeg RHA were modelled (Poisson regression) against the overall non-Winnipeg rates (by age and sex) to create non-Winnipeg RHA-age-sex specific coefficients. These coefficients were then used to create the estimated 2020 non-Winnipeg inpatient days per capita rates.[9]

The next step was to multiply our 2020 estimated non-surgical inpatient days per capita by the MBS population estimates for 2020 in order to develop age-sex specific estimates of inpatient days. Summing these estimates over all age-sex groups for each RHA gave the total estimates of beds required by **residents** of each RHA. Our analysis is based on estimating the number of acute care hospital days that will be needed by residents of RHAs, rather than the days needed in hospitals within each RHA. In order to provide a better picture for health planners we also indicate how many days are likely to be needed in regional hospitals. This was done by looking at data identifying the number of hospital days an RHA's residents spent in non-RHA hospitals as well as the non-resident use of RHA hospitals. With the exceptions of the Brandon and Winnipeg RHAs, the use of external hospitals by RHA residents exceeded the use non-residents made of RHA facilities.

The methodology used to estimate inpatient surgical days largely replicates that used for non-surgical days. The only difference is the inclusion of one more "predictor" variable in the Poisson regressions. The additional variable was the ratio of the number of outpatient surgeries (cases) to the number of inpatient surgeries. This was combined with data on the year and the proportion of inpatient surgery days that were attributed to long-stay cases to

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[8] Note: if the regression coefficient for one of the "predictor" (i.e. independent) variables was not statistically significant (p-value > 0.05), in any of the age-sex models, then a regression equation was obtained which included only the variable which was statistically significant. If all independent variables were not statistically significant then the average observed rates per capita over the most recent three years were used as estimates for 2020. In most cases the proportion of long-stay patients was not significant, and the model thus assumes such patients will comprise the same proportion of total hospital stays in 2020.

[9] For example, over the past ten years the non-surgical utilization among South Westman males aged 0-14 was observed to be, on average, only 74.28 % of the corresponding age-sex non-Winnipeg inpatient days per capita. Thus our 2020 estimated rate for South Westman males age 0-14 was achieved by multiplying the estimated non-Winnipeg rate by 0.7428. Similar calculations were made for each of the non-Winnipeg RHAs, (for every age group and both sexes) giving us estimations sensitive to actual patterns of use in each RHA.

predict inpatient surgery days per capita. Estimated days per capita for 2020 were then obtained by placing that year, the 1997/98 observed values of % long-stay days and estimated 2020 values of the surgical outpatient to inpatient ratios, into the resulting regression equations.

Estimates for the outpatient to inpatient ratios were obtained by fitting linear regression models, with year as the only predictor variable, to the Winnipeg/non-Winnipeg, age and sex specific data over the past ten years. Placing the year 2020 into the resulting regression equations gave us our estimates.[10]

As with non-surgical inpatient days, the RHA specific inpatient surgical days per capita estimates for non-Winnipeg residents were obtained by multiplying the non-Winnipeg estimates by RHA "adjustment" coefficients (obtained, as before, by regressing each RHA specific data against the non-Winnipeg data for the past 10 years). The RHA-age-sex rates per capita estimates for 2020 were then multiplied by the corresponding 2020 estimated population values and summed over all age groups and sexes to get total estimates for **residents** of each RHA.

We made our projections regarding outpatient surgery by first estimating total surgery (inpatient + outpatient) and then utilizing projections, which outlined the proportion of total surgeries that would be outpatient. As with the inpatient days estimates, the number of surgeries per resident (by age and sex and Winnipeg/non-Winnipeg) over the past 10 years was used in Poisson regression models with year as the only independent variable. Again, the non-Winnipeg estimates were adjusted by non-Winnipeg RHA-age-sex specific regression coefficients to get RHA specific estimates for 2020. The per capita total surgery estimates were multiplied by the 2020 population estimates, which in turn, were multiplied by the estimated outpatient proportion of total surgery. This enabled us to forecast the number of outpatient surgeries required in 2020.

(See Appendix C for additional information regarding the methods that were used.)

[10] We put in place what we consider to be reasonable, if artificial, limits to the growth of outpatient surgery. We did not allow our 2020 estimates of the outpatient : inpatient ratio to be more than double the actual 1997/1998 ratio.

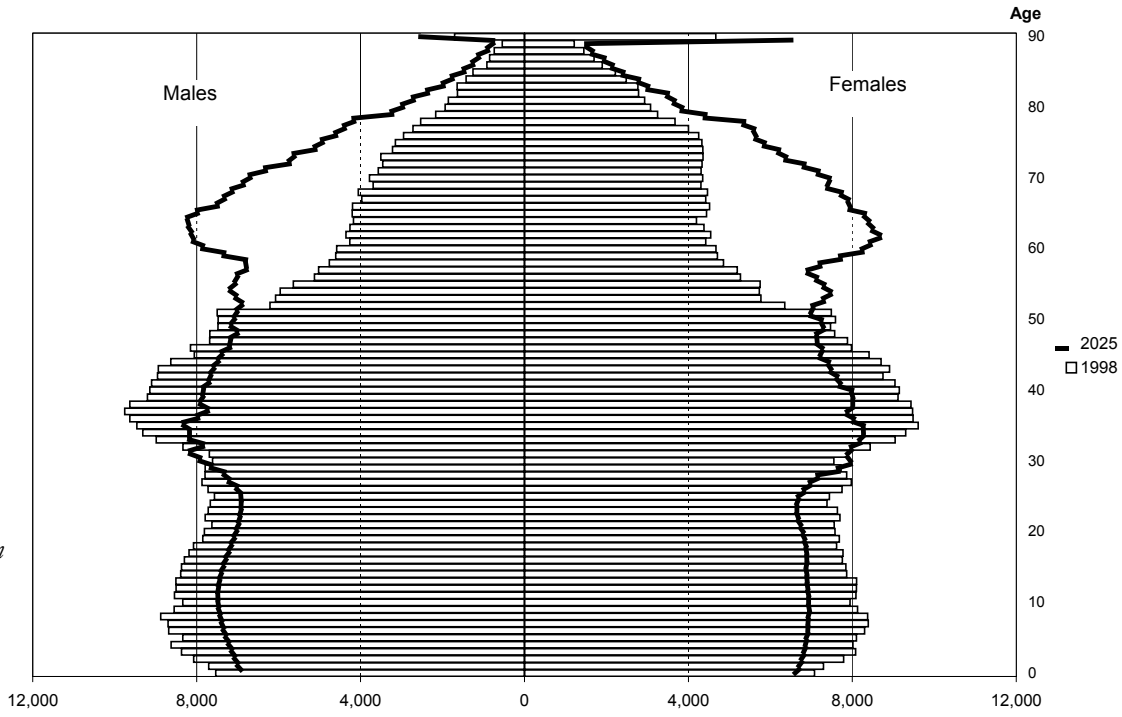
LOOKING FORWARD

The data provided by the Manitoba Bureau of Statistics suggests that the province's population will have grown only modestly by 2020 (1,196,360 as compared to 1,143,753). However, the distribution of the population will differ in two potentially quite important ways. (see Figure 4)[11]

Key Points:

- *The population of Manitoba is projected to increase by 4.6% between 1998 and 2020.*
- *Large increases in the population are projected for Burntwood/Churchill, South Eastman and North Eastman RHAs.*
- *Moderate increases in the population are projected for Interlake, Central and Nor-Man RHAs.*
- *Modest increases in the population are projected for Brandon, South Westman, Marquette and Parkland RHAs.*
- *A decrease in the population of Winnipeg is projected.*
- *An increase or decrease in the number of residents of an RHA does not tell the whole story though—because different age groups have different needs for hospital care it is also important to consider the numbers of people in each age group. Both models provided here do take this into account.*

Figure 4: Manitoba Population by Single Years of Age and Sex 1998 and 2025



First, their projections confirm the basic demographic changes that have prompted the newspaper headlines. There will be more people 75 years and over than there were in 1998 (86,055 rather than 74,725 – a 15% increase) and they will make up a larger share of the population (7.2% rather than 6.5%). Given the clear association between age and need for hospital services this has the potential to drive up the need for hospital beds. Second, the regional distribution of Manitoba's population will change.

More specifically, projections indicate that the population residing in Winnipeg will decline, while the populations in each of the other RHAs will increase. The most dramatic increases will be in South Eastman and Burntwood-Churchill (see Table 1). This will raise issues for RHAs regarding potential pressures on their systems. However, it is imperative that the impact of this change not be overestimated since a significant proportion of

[11] MBS has developed population projections to 2025, and these estimates are shown in the population pyramids that are presented here. This report has used the projections for 2020 in creating all estimates.

each RHAs residents are hospitalized in Winnipeg hospitals, and this is likely to continue. For example, in all of the rural RHAs, more than 50% of the surgical days required will be located outside the RHA, the bulk of these in Winnipeg.

Table 1: Population Projections for Manitoba 2020[12] (Source: Manitoba Bureau of Statistics)

	1998 Population	2020 Projection	Change in Population
Burntwood & Churchill	45,929	61,715	+34%
South Eastman	52,713	68,930	+31%
North Eastman	38,757	47,025	+21%
Interlake	74,482	86,800	+17%
Central	97,050	108,485	+12%
Nor-Man	25,347	28,180	+11%
Brandon	46,817	50,545	+8%
South Westman	34,674	36,375	+5%
Marquette	37,691	38,940	+3%
Parkland	43,376	44,500	+3%
Winnipeg	646,917	624,865	-3.4%
Manitoba	1,143,753	1,196,360	+4.6%

The emphasis in this report is on estimating the acute care hospital bed days needed in Manitoba in 2020. However, we recognize that the number of days required in a specific area is a concern of importance to health care planners. Accordingly, we carefully examined patterns of hospital use in Manitoba in 1997/98-1999/00. On the basis of this examination we were able to identify the number of days residents of a particular RHA used within the RHA, in other Manitoba hospitals, and elsewhere. Moreover, we noted the use of RHA hospitals by non-RHA residents. We have applied these proportions to 2020 data for both the Current Use Model and the Trend Analysis Model. This allows us to provide an estimation of the bed days that will be needed in each of the RHAs, given the out-of-region use by RHA residents and the in-RHA hospital use of non-residents

1.4 Current Use Projection Model

The first step in our analysis is to provide an indication of the need for hospital services if use in 2020 replicates the current pattern. The simplest projection would simply take the change in population and suggest that if the population will increase by 4.5%, as predicted by MBS, the use of hospitals will increase by a similar amount. This, of course, does not take into account changes in the composition of the population. Another approach is to use separate projections for groups differentiated on the basis of age and sex. Since these variables have a strong influence on hospital use, such a step is

[12] Burntwood and Churchill were combined by MBS because of the small number of people in the two regions. As a result, our analysis must report combined data for Burntwood and Churchill.

uncontroversial. Given the strong trend towards outpatient surgery, it is also useful to break up the category of hospital days into surgical and non-surgical. Making such separations we project changes in the demand for hospital services based on the average age group/sex specific utilization for 1996/97 through 1998/99. More simply, we examined the average number of hospital days used by each of these groups in the named years and then looked at the number of people MBS predicted would be in each of these categories in 2020 and produced a projection of hospital use (see Table 2). As we explained above, this is our Current Use Projection Model. This set of projections suggests that the number of non-surgical days and surgical days (as a percentage of the 1997/98 days) will grow 25 and 35 percentage points respectively. Moreover, the number of days used by residents of all but one of the RHAs for both surgical and non-surgical cases would grow. (Keep in mind at this point that we are projecting total use by area residents; not in-area increase in use). For most areas, a significant proportion of use is likely to take place outside of the RHA. The differences among the regions would be based largely on the differences in the ages of their populations. The Current Use projections then, take the three-year period (1996-1998) as a kind of benchmark – and assume no further changes in how hospitals are used will take place.

Table 2: Current Use Projection Model: 2020 Hospital Days in Manitoba

	Non- Surgical Hospital Days		Surgical Hospital Days	
	1997/98 Use	CURRENT USE PROJECTION for 2020	1997/98 Use	CURRENT USE PROJECTION for 2020
Central	96,062	107,813	20,136	25,074
N.Eastman	31,855	48,786	8,076	11,955
S.Eastman	34,217	56,599	7,738	13,606
Interlake	57,869	81,670	14,508	20,788
Nor-Man	24,547	35,539	4,838	7,518
Parkland	58,153	59,696	10,440	10,656
Burntwood & Churchill	30,651	56,723	9,114	17,252
Marquette	48,537	51,139	8,145	8,359
S.Westman	45,007	44,763	7,086	7,534
Brandon	43,403	56,696	13,798	18,919
Winnipeg	468,746	570,445	169,749	228,147
Manitoba	939,047	1,169,869	273,628	369,808

This is a conservative scenario since it reflects what would happen *if nothing changes in the provision of health care to Manitobans in the next 20 years*: no further move to outpatient surgery, no further decrease in length of stay, no move away from using acute hospitals for patients who don't require this level of care. We present these data so that there will be an awareness of what need would be if present use patterns were replicated in 2020 and there were no changes in health policy, technology or incidence of disease. This seems unlikely to be the case.

1.5 Trend Analysis Model

As explained earlier, we identified a number of factors that are likely to affect the hospital days used per person. We noted age, sex and the type of admission as discussed above. However, a number of other factors including the ratio of inpatient to outpatient cases, the proportion of hospital stays in which the length of stay was greater than 30 days for both surgical and non-surgical cases and year have also been considered. One important key to predicting the future is understanding the past. As a result, we carefully considered not only the population projections developed by MBS, but also the utilization of hospitals from 1989/90 to 1998/99. Examining use over a lengthy period enables us to get a sense of how changes in health and technology may affect the use of hospitals. As Figure 3 showed, the number of days spent in hospitals in Manitoba has declined significantly over time. Focusing on too short a period of time freezes use patterns, which are more appropriately considered as a dynamic process. In order to account for the slight upward trend in recent years, or plateauing for some indicators, we used a Poisson Regression model instead of a linear regression model. This, as explained earlier, is our Trend Analysis Model. The use of this model leads us to project, notwithstanding an overall increase in population and a striking increase in the proportion of the population over 65, that the number of hospital days used in 2020 will be fewer than those used in 1997/98. Overall, we project that the number of days used for non-surgical cases will be only 83% of the total days used in 1997/98 and the number of days used for surgical cases will be only 70% (See Table 3 which presents the estimates of the days needed).

Table 3: Trend Analysis Model: 2020 Hospital Days in Manitoba

	Non- Surgical Hospital Days		Surgical Hospital Days	
	1997/98 Actual Use	TREND ANALYSIS	1997/98 Actual Use	TREND ANALYSIS
Central	96,062	63,089	20,136	13,115
N.Eastman	31,855	29,129	8,076	6,032
S.Eastman	34,217	37,713	7,738	6,896
Interlake	57,869	50,254	14,508	11,020
Nor-Man	24,547	23,453	4,838	3,904
Parkland	58,153	38,984	10,440	5,414
Burntwood & Churchill	30,651	33,099	9,114	7,921
Marquette	48,537	31,514	8,145	4,367
S.Westman	45,007	26,334	7,086	3,658
Brandon	43,403	33,999	13,798	8,527
Winnipeg	468,746	410,177	169,749	121,661
Manitoba	939,047	777,745	273,628	192,515

The decrease in surgical requirements occurs despite projections that the total number of surgical cases in the province will increase substantially (see

Table 4). The decline results from estimations that outpatient surgical cases will double and the average length of stay for inpatient cases will decrease quite noticeably. We are not then projecting fewer surgical cases.

When looking at individual regions using the Trend Analysis Model we project that the number of days needed for non-surgical cases by residents of South Eastman and Burntwood/Churchill will increase, while the number needed for residents of the rest of the province will decline, most significantly in South Westman. With respect to surgical days we project an across-the-board decline. Again the decline should be most dramatic in South Westman where the number of days residents should need will be about half of those used in 1998/99 (see Table 3). Keep in mind again – that these projections are for total hospital use by area residents – some significant proportion of this use will be expected to take place outside of the rural RHAs.

These projections fly in the face of the conventional wisdom about future hospital use. It must be kept in mind that these projections are based on the ongoing decreases in average length of stay and increases in outpatient surgery (see Table 4). While in some cases the number of people to be treated will increase, the number of days will not. Examining the projections for specific regions should make the basis of these estimates clearer.

Table 4: Changes in Surgical Cases[13]- Trend Analysis Model

	Actual Cases 1997/98	Estimated Cases 2020	Estimated as a Per cent of Actual
Total Surgery Cases	83,229	143,250	172%
Outpatient Cases	54,343	110,104	203%
Inpatient Cases	28,886	33,146	115%
Average Length of Stay	9.5	5.8	(61%)

As mentioned earlier, we have attempted to provide projections, not only of the number of hospital days required to meet the needs of Manitobans in 2020, but also an indication of where in the province these days will be spent. This differs from the number of days required by the residents of a particular RHA since it recognizes that all hospital days will not take place in the region of residence. Table 5 shows the bed days estimated to be needed within each of the RHAs for residents and non-residents. The data reported in this table are of bed days needed in regional hospitals for both residents and non-residents—if the 1998/99 patterns continue.

[13] Appendix B presents data on total surgical cases for each age and sex grouping. It notes outpatient surgery totals as well as changes in the average length of stay. For some categories, actual increases in the average length of stay are forecast.

Table 5: In-Region Bed Days

	1997/98 Bed Days in RHA Hospitals	Current Use Model 2020 Bed Days in RHA Hospitals	Trend Analysis Model 2020 Bed Days in RHA Hospitals
Burntwood/Churchill	22,080	42,240	25,721
South Eastman	28,983	47,526	31,927
North Eastman	19,537	32,545	19,899
Interlake	42,426	64,589	40,545
Central	88,132	105,023	62,143
Nor-Man	24,248	35,184	24,635
Brandon	86,266	98,958	56,360
South Westman	37,478	36,721	21,762
Marquette	45,053	46,399	28,601
Parkland	61,013	63,489	40,935
Winnipeg	801,355	996,158	646,879

RHA SPECIFIC PROJECTIONS

On the basis of the Manitoba Bureau of Statistics projections for population change, we can divide Manitoba Regional Health Authorities into four categories. First, we look at those regions projected to experience a major increase in population (20% or more). Included in this group are Burntwood and Churchill, South Eastman, and North Eastman. Second, are those regions expected to have a moderate increase in population (10%-19%). This group is comprised of Interlake, Central, and Nor-Man. The third group of regions is expected to experience only a modest population growth (less than 10%). Brandon, South Westman, Marquette and Parkland fall into this category. The final group is actually projected to experience a decline in population. Winnipeg, with a projected decline in population of 3.4% is the only RHA in this category. The remainder of our discussion will be ordered on the basis of population change, looking first at those RHAs in which the population is expected to increase by the greatest amount and looking finally at Winnipeg.

Large Population Increases:

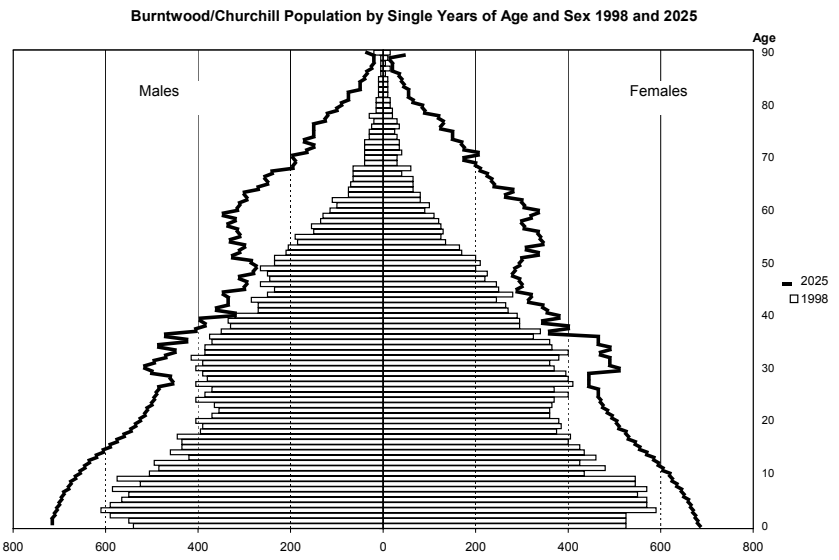
Burntwood/Churchill: (34% increase in population projected)[14]

	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	45,929	61,715	34%
Bed days required by residents – current use model	39,765	73,975	86%
Bed days required by residents – trend analysis model	39,765	41,020	3%
Bed days required in the region by residents and non-residents – current use model	22,080*	42,240	91%
Bed days required in the region by residents and non-residents – trend analysis model	22,080*	25,721	16%
Setup Beds	130		
Occupancy rate	37%		
Bed days available in the region at 100% occupancy	47,450		
In region separations as a per cent of all separations for region residents	64%		

* This is the annual average bed days used for the period 1996/97 to 1998/99

In December 1998 the population of Burntwood and Churchill was 45,929 and the combined populations of Burntwood and Churchill are expected to increase by almost 16,000 people by 2020. The population of males between 65-84 is expected to almost quadruple while the population of females of the same age is expected to triple. In all age-sex categories the population of this

[14] Available bed days are calculated by multiplying the set-up beds by 365. A higher total could be obtained by using rated beds. The set-up beds are taken from Manitoba Health Annual Statistics, 1998-1999, pp. 49-54.



region is expected to increase (see Appendix A1).[15] If we were to use the 1998 data as a base, and assume no change in practice patterns (the Current Use Model), we would then expect the number of both non-surgical and surgical days to almost double (see Figure 5). In understanding the 1998 data it is important to look at the need for hospital use[16], occupancy rate[17] and in-region hospitalization[18] for the same period.[19] As Table 6 shows, residents of the more populous Burntwood region used hospitals at a slightly greater than expected rate, while those in Churchill made less use of hospitals than expected. Thus the current use rates for the region are in line with what we would expect given the characteristics of the regional populations and their past use of hospitals. However, when we

Key Point:

- *The combined RHAs of Burntwood and Churchill are expected to have a large increase in population, and this increase will occur in all ages, although the percentage increase is expected to be greatest in the groups over age 55. However, under both models the need for hospital days in the region can be met with existing beds because of the relatively low occupancy rate and the relatively high use of hospital days outside of the regions.*

[15] Appendix A shows the 1998 population and 2020 population projections for each of the age, sex and regional groupings in our analysis. It also presents the results of our Trend Analysis Model for each of these groupings including the RHA specific correction applied to the non-Winnipeg days per resident we described earlier. The appendix provides the following data in separate columns: age group, sex, 1998 population, estimated 2020 population, 2020 population as a percentage of 1998 population, 1998 observed days per resident, 2020 estimated non-Winnipeg days per resident, the correction applied for each RHA, 2020 estimated days per resident, 2020 days per resident as a percentage of 1998 days per resident, 1998 observed inpatient days, 2020 estimated inpatient days, and 2020 inpatient days as a percentage of 1998 inpatient days.

[16] This measure was used extensively in *Assessing the Performance of Rural Hospitals in Manitoba: A First Look*, 2000. The need for hospital services was calculated by examining the population characteristics of particular areas as well as past patterns of hospital use. Based on these factors the report projected the number of days needed per 1000 residents. It then looked at the actual use the residents of each area made of hospitals and created a use to need ratio. A score of more than one indicated that residents of the area used hospitals at greater than expected rates. For the purposes of this report, the score reported is the average of all the areas in a particular RHA. No rates were calculated for either Brandon or Winnipeg.

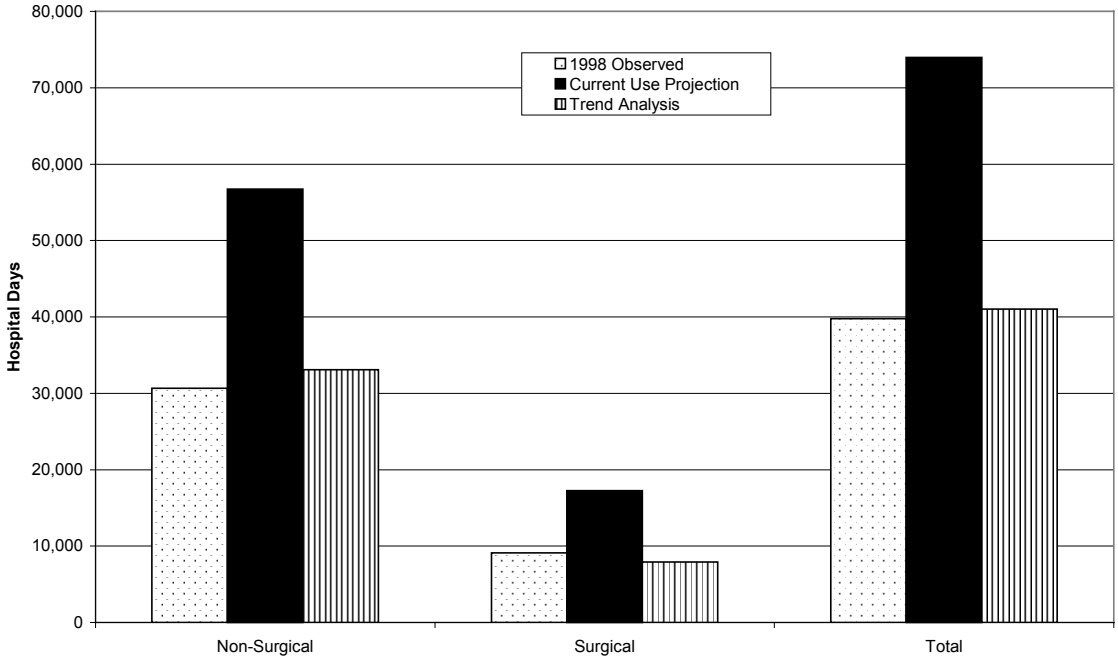
[17] Occupancy rates for hospitals in the rural RHAs were taken from *Assessing the Performance of Rural Hospitals in Manitoba: A First Look*. It is the "Average proportion of beds in each hospital that were filled throughout the 3-year period."

[18] In region hospitalization is a measure that identifies the proportion of hospitalizations for each RHAs residents that took place within RHA hospitals. A higher proportion indicates that more residents were hospitalized locally.

[19] Data on these issues for the rural Manitoba RHAs can be found in Stewart et al., 2000.

examine capacity, we see that the hospitals in the region during the 1996/97-1998/99 period had very low occupancy rates.[20] The average occupancy rate for hospitals in Burntwood was only 40% while in Churchill the occupancy rate was an even lower 26% (the combined occupancy rate for both regions was 37%). As well, 64% of the hospitalizations of residents of these RHAs took place in RHA hospitals. Thus, even with the conservative scenario prediction of hospital use based on current use, bed shortages would not appear to be an issue.

Figure 5: Burntwood/Churchill Hospital Days
Current and Projected to 2020



Key Points:

- *For the population of many regions, a large proportion of hospital stays occur outside of the region.*
- *The average occupancy rate in all regions shows that the physical capacity exists to care for more patients.*

Table 6: Hospital Use in Rural Manitoba 1996/97- 1998/99

	% of Resident Separations from RHA Hospitals	Average Occupancy Rate	Average Use to Need Ratio
Churchill	50	26	.84
Burntwood	64	40	1.05
South Eastman	56	63	1.01
North Eastman	39	70	1.06
Interlake	47	61	.98
Central	65	60	1.02
Nor-Man	76	52	.97
South Westman	54	54	1.04
Marquette	64	55	1.05
Parkland	78	66	1.11

[20] Available bed days are calculated by multiplying the set-up beds by 365. A higher total could be obtained by using rated beds. The set-up beds are taken from Manitoba Health Annual Statistics, 1998-1999, pp. 49-54.

When we use our Trend Analysis Model to project hospital use in 2020 we expect a much lower use of hospitals. We project a modest increase of eight percentage points in non-surgical days and an actual decline of almost 13 percentage points in surgical days (see Figure 5). With the change in population, our model projects increases in the non-surgical days for all male age groups above 65 and female age groups above 55 and decreases for male groups under 65 and female age groups under 55 (see Appendix A1). No such clear pattern exists with respect to surgical cases. We predict increases in the number of days of surgery required for males 55 or older while for females, a decrease in the number of surgical days is expected for those 75 and older (see Appendix A1).

In understanding the hospital needs of the region it is important to keep in mind not just the hospital days required by residents, but where those days are likely to occur. As Table 6 shows, over 35% of the separations of Burntwood residents occurred in out-of-region hospitals. Burntwood and Churchill residents will actually spend only 54% of their projected days (Trend Analysis Model) in the regions' hospitals in 2020. The rest of the days will be spent in hospitals in other RHAs – primarily in Winnipeg hospitals. Eighty-three per cent of the surgical days required by area residents will take place outside of the region as will 37% of the non-surgical days. As Figures 6 and 7 reveal, this is not offset by the number of non-RHA residents who will require hospitalization in Burntwood and Churchill, despite the frequent use of Churchill's hospital by residents of Nunavut. It should be kept in mind that a substantial number of non-Manitobans will require hospital services in the region. Indeed, this region is expected to have the third largest number of non-Manitobans in its non-surgical beds in 2020. The data provided by MBS cannot project changes in population outside of Manitoba. In our analysis we assume that out-of-province use will make up the same proportion of hospital stays in 2020 that it did in 1998/99. The specific needs of out-of-province patients will need careful consideration from regional planners.

Figure 6: Location Where Residents of Each RHA Will Receive Inpatient Hospital Care
2020 Trend Analysis Model

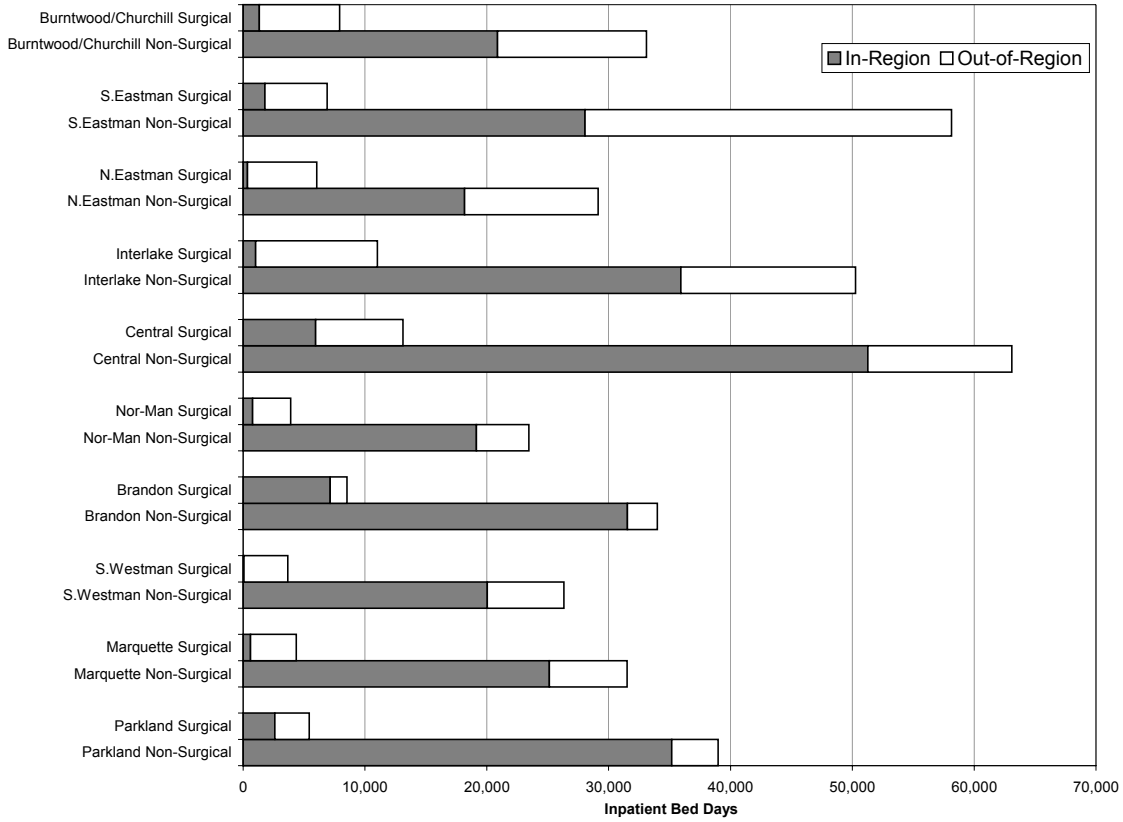
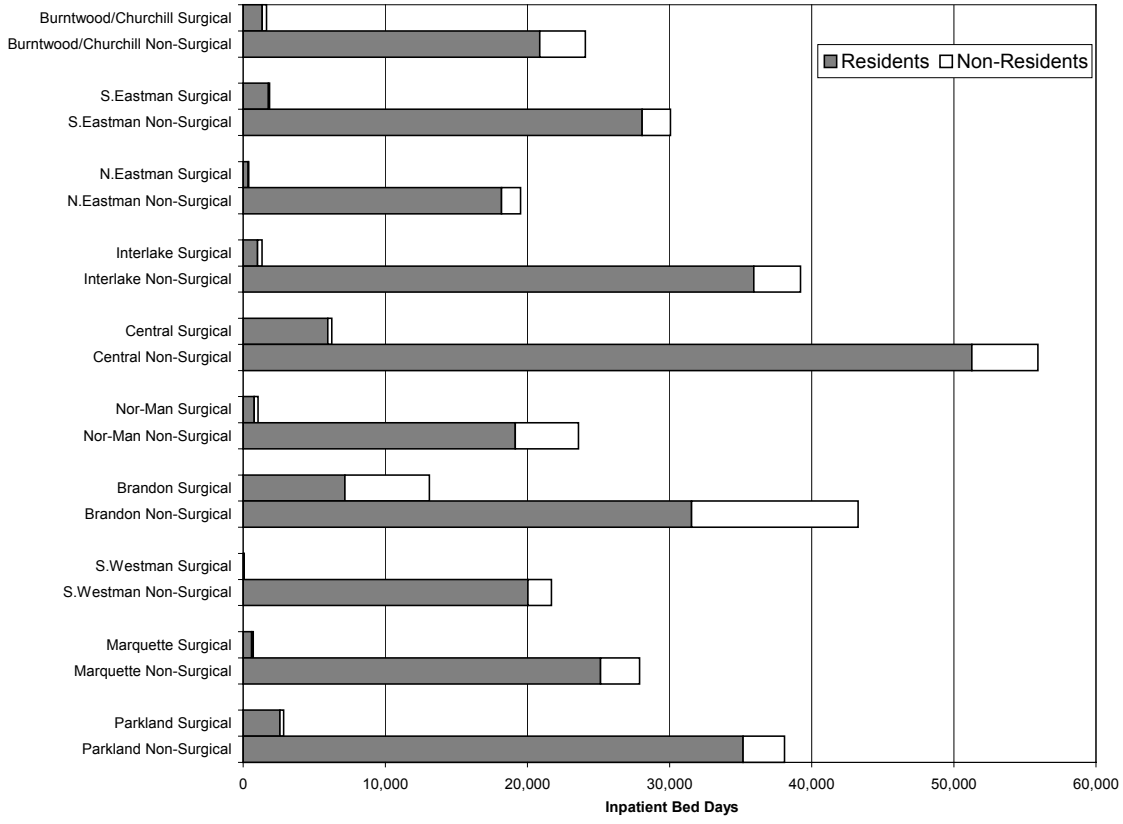


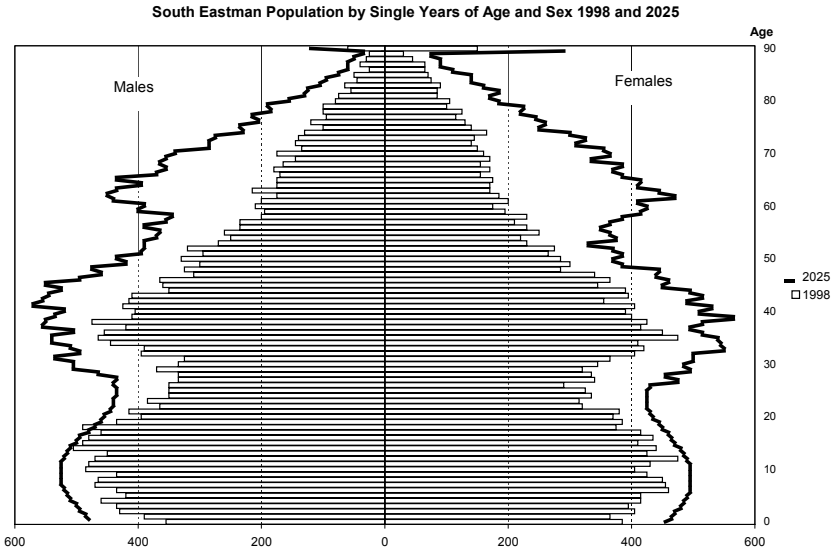
Figure 7: Use of Acute Care Hospital Beds by Residents and Non-Residents by RHA
2020 Trend Analysis Model



South Eastman: (31% increase in population projected)

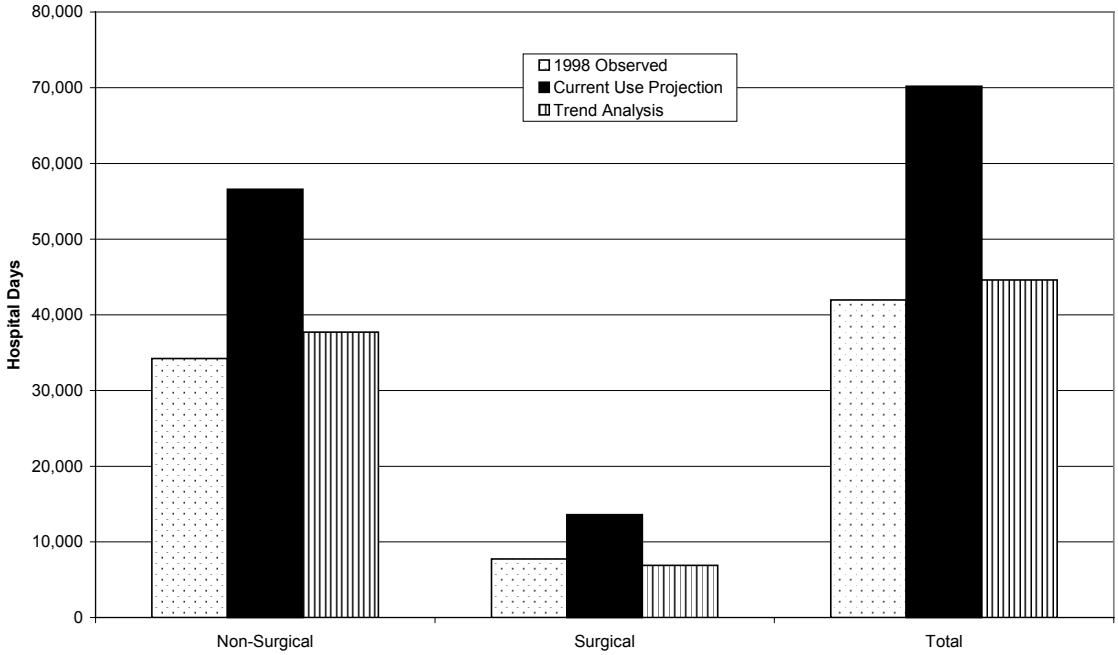
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	52,713	68,930	31%
Bed days required by residents – current use model	41,955	70,205	67%
Bed days required by residents – trend analysis model	41,955	44,609	6%
Bed days required in the region by residents and non-residents – current use model	28,983*	47,526	64%
Bed days required in the region by residents and non-residents – trend analysis model	28,983*	31,927	10%
Setup Beds	104		
Occupancy rate	63%		
Bed days available in the region at 100% occupancy	37,960		
In region separations as a percent of all separations for region residents	56%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 52,713 people resided in the South Eastman RHA. By 2020 this population total is expected to increase by more than 16,000 people. For both men and women, the largest increase in population will be for those aged 55-64 (see Appendix A2). Based on the average use of hospitals in 1996/97-1998/99, our conservative scenario (the Current Use Model) would estimate the number non-surgical days used by area residents to increase by 65 percentage points and the number of surgical days to increase by 76 percentage points (see Figure 8). Such increases might be expected to create some pressure on hospital beds since residents of South Eastman used hospitals at the expected rate in 1996/97-1998/99 and the four hospitals in the region had, for non-Winnipeg hospitals, a relatively high average occupancy rate of 63%. However, as Table 6 showed, fully 44% of South Eastman residents were hospitalized outside their RHA in the period under analysis. If the same proportion of South Eastman residents were hospitalized in other regions in 2020, there would be sufficient beds within the region to meet the demand. Indeed, even if we assume the average separation rate for the rural RHAs (60.3%) (Stewart et al., 2000) for South Eastman, there would be sufficient space to meet the demand for hospitals.

Figure 8: South Eastman Hospital Days
Current and Projected to 2020



Key Points:

- *A large increase in the population of South Eastman RHA is projected, with the 60 and over age group showing the largest increase in size. The number of people in their 60s will exceed the number of children in 2020.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *The Trend Analysis Model predicts that there are sufficient beds in the region to provide care for the population in 2020.*

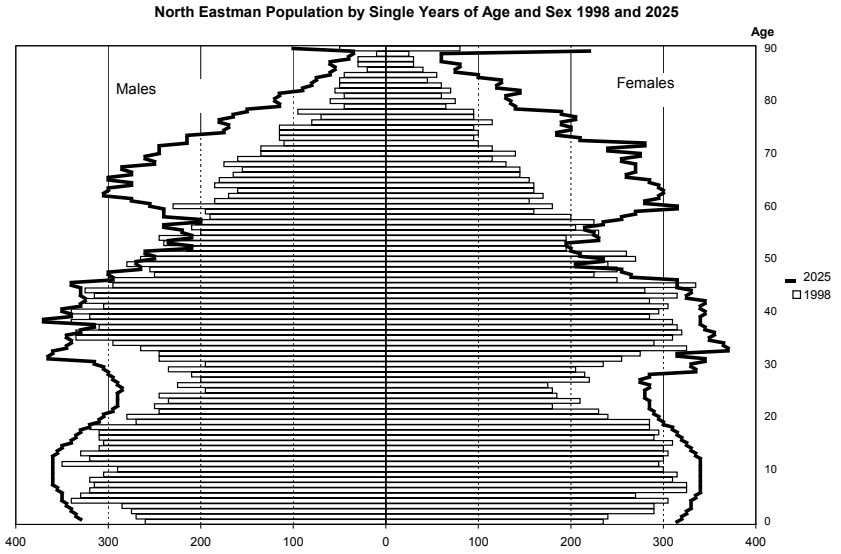
Our Trend Analysis Model suggests a more modest increase in non-surgical days of only 10 percentage points with increases in the number of inpatient days required for non-surgical cases to increase for almost all age groups over 54. The most dramatic increase would be for women between 55-64, a group which is expected to double in size by 2020. South Eastman is the only RHA other than Burntwood/Churchill where our model projects an increase in the number of non-surgical days. We do not project a corresponding increase in surgical days and, in fact, expect the use in 2020 to be only 89% of the 1997/98 total. We do expect an increase in the number of surgical days required by some age groups, particularly males 85 or older. The number of hospital days required for this group is expected to double while the days required for females 85 or older is expected to fall by almost half. This is based on both the change in population numbers and the trends in use for the different age-sex categories outlined earlier.

Almost three quarters of the surgical days predicted for area residents are expected to take place in hospitals outside the South Eastman region while three quarters of the non-surgical days will be in regional facilities. Overall, the number of days expected for the four hospitals in the region is equal to about 71% of the hospital days predicted for residents of the region. Only a handful of surgical inpatient days will be required for non-residents.

North Eastman: (21% increase in population projected)

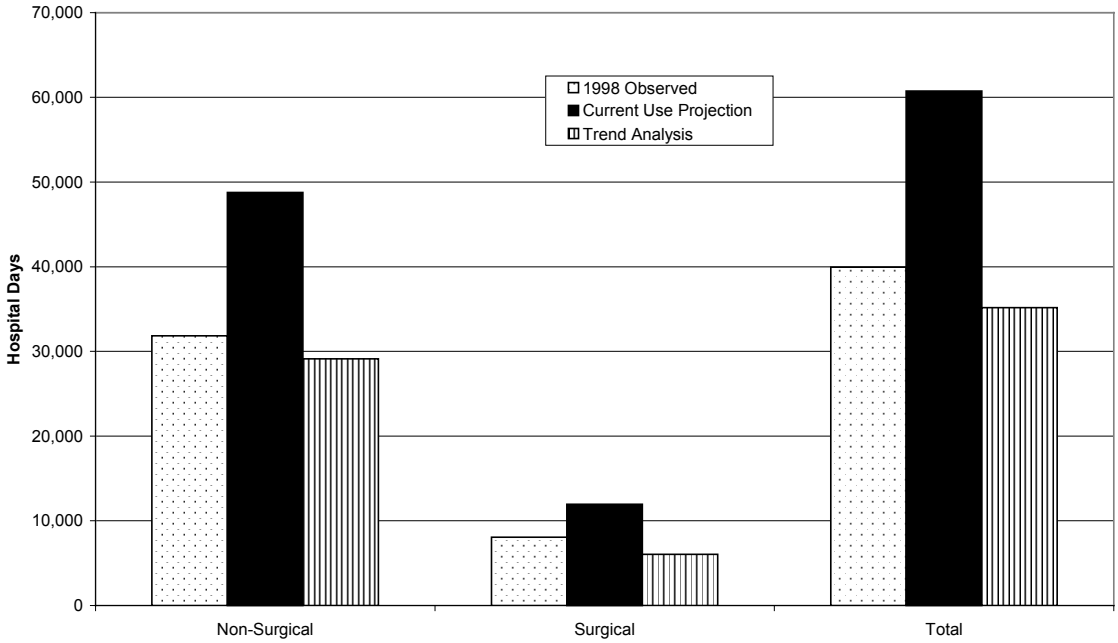
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	38,757	47,025	21%
Bed days required by residents – current use model	39,931	60,741	52%
Bed days required by residents – trend analysis model	39,931	35,161	(12%)
Bed days required in the region by residents and non-residents – current use model	19,537*	32,545	67%
Bed days required in the region by residents and non-residents – trend analysis model	19,537*	19,899	2%
Setup Beds	80		
Occupancy rate	70%		
Bed days available in the region at 100% occupancy	29,200		
In region separations as a percent of all separations for region residents	39%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of North Eastman was 38,757 and by 2020 it is expected to increase by almost 9000 people. Increases are expected for virtually every age group with the largest increases expected for those 55 or older (see Appendix A3). The use patterns of 1996/97-1998/99 indicate that such a population increase would result in a 53 percentage point increase in the number of non-surgical days required by area residents (Current Use Model)(see Figure 9). This is the second greatest increase in the province. With respect to surgical days, an increase of 48 percentage points would be expected. However, in assessing these figures it is important to keep in mind that the use of hospitals by area residents in 1996/97-1998/99 was somewhat greater than expected. The region had an average use to need ratio of 1.06 and the four hospitals in the region had an average occupancy rate of 70%. If the region's residents were to use hospitals at rates closer to the expected, it is possible that the capacity exists in area hospitals to meet even the conservative scenario increases. When we consider that North Eastman residents were more likely than the residents of any other rural Manitoba RHA to have separations from out of area hospitals, concerns that the demand for regional hospital beds will outstrip supply in 2020 are further mitigated (see Table 6).

Figure 9: North Eastman Hospital Days
Current and Projected to 2020



Key Points:

- *A large increase in the population of North Eastman RHA is projected, with the 60 and over age group showing the largest increase in size.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *The Trend Analysis Model predicts that there are sufficient beds in the region to provide care for the population in 2020.*

Our Trend Analysis Model does not project an increase in hospital days for North Eastman residents. This model estimates that the number of non-surgical days will remain relatively constant (91% of 1997/98 levels). An increased number of days will be required for men between 25-34 as well as those 75 or older. Among women, more days will be required for those 85 or older as well as those from 64-79 (see Appendix A3).

A more noticeable decline is predicted for surgical days with the number of surgical days expected to be only 75% of the 1997/98 levels. More days are expected for males from birth to age 14 as well as for a number of the female age categories, most notably those 85 or older. The decline in surgical days for men is expected to be greater than the decline among women.

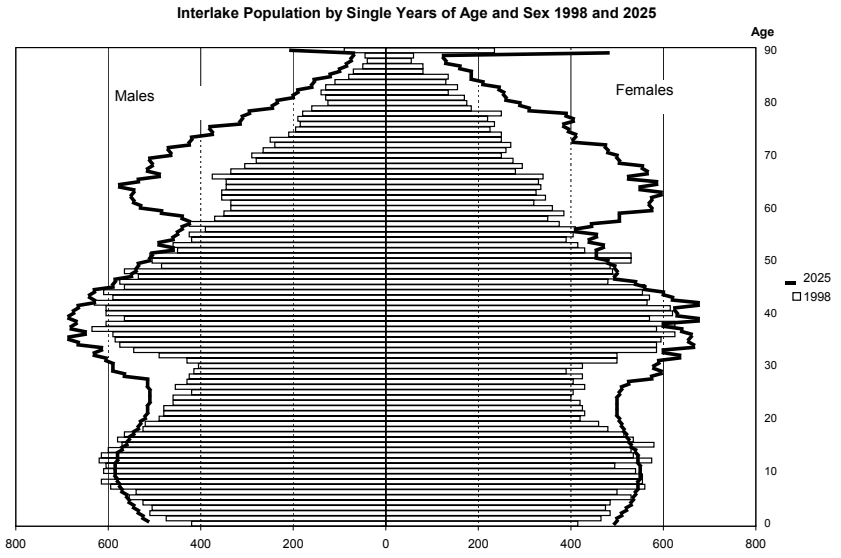
Almost all of the surgical days (94%) required by North Eastman residents will take place outside the region as will just over a third of the non-surgical days. Overall, the number of hospital days predicted for the region's four hospitals is equal to 57% of the days that residents are expected to need. In other words, the number of days that will be used in area hospitals is considerably less than the number of hospital days required by area residents. The bed needs of North Eastman residents will continue to fall heavily on other RHAs, specifically Winnipeg.

Moderate Population Increase:

Interlake: (16% increase in population projected)

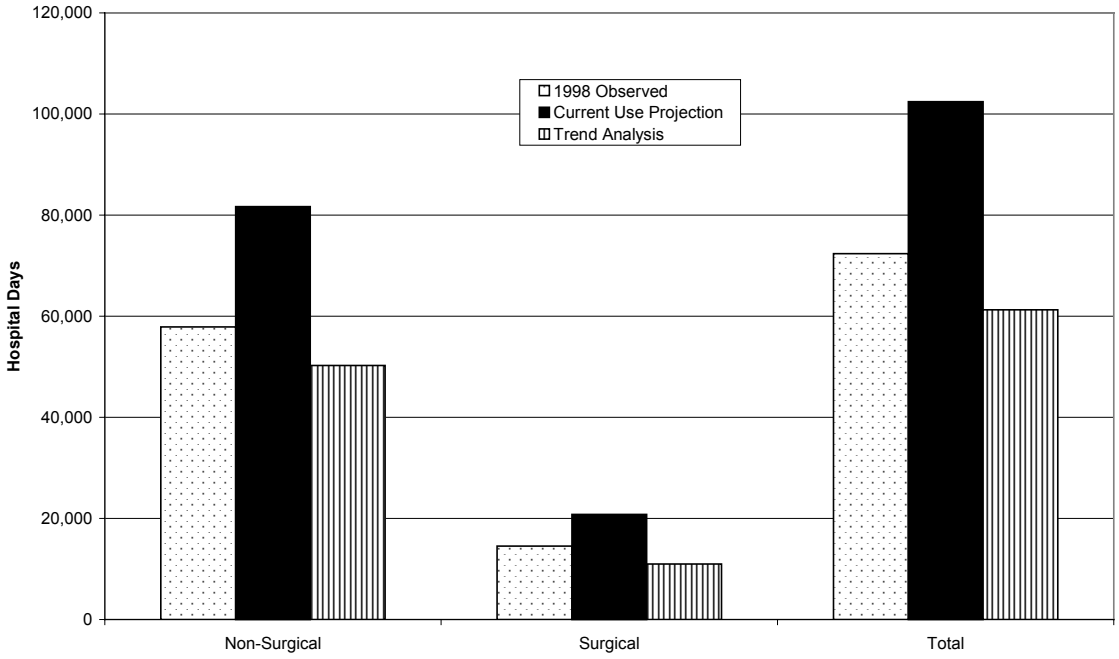
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	74,482	86,800	16%
Bed days required by residents – current use model	72,377	102,458	42%
Bed days required by residents – trend analysis model	72,377	61,274	(15%)
Bed days required in the region by residents and non-residents – current use model	42,426*	64,589	52%
Bed days required in the region by residents and non-residents – trend analysis model	42,426*	40,545	(4%)
Setup Beds	187		
Occupancy rate	61%		
Bed days available in the region at 100% occupancy	68,255		
In region separations as a percent of all separations for region residents	47%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of the Interlake RHA was 74,482 and it is expected to grow by more than 12,000 people by 2020. The most dramatic increases will be in those 85 or older (see Appendix A4). This growth, on the basis of the Current Use Model focussing on 1996/97-1998/99 average utilization, would suggest an increase of 41 percentage points in non-surgical days and a 43 percentage points increase in the number of surgical days required by Interlake residents in 2020 (see Figure 10). The residents of the Interlake RHA during that time period had a use to need ratio of .98 suggesting that the use of hospitals is what one would expect given the characteristics of the population of the RHA. The eight hospitals in the region had an average occupancy rate of 61%. When this is combined with a separation rate of 47% from area hospitals (see Table 6), it suggests that even with the conservative Current Use projection of hospital use based on the increased population in 2020 might not require additional set-up beds.

Figure 10: Interlake Hospital Days
Current and Projected to 2020



Key Points:

- *A moderate increase in the population of Interlake RHA is projected, with the 60 and over age group showing the largest increase in size.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *Both the Trend Analysis Model and the Current Use Projection Model predicts that there are sufficient beds in the region to provide care for the population in 2020.*

Our Trend Analysis Model projects decreases in both surgical and non-surgical days. The number of non-surgical days is expected to be only 87% of the 1997/98 total, while surgical days will be only 76% of those used in 1997/98.

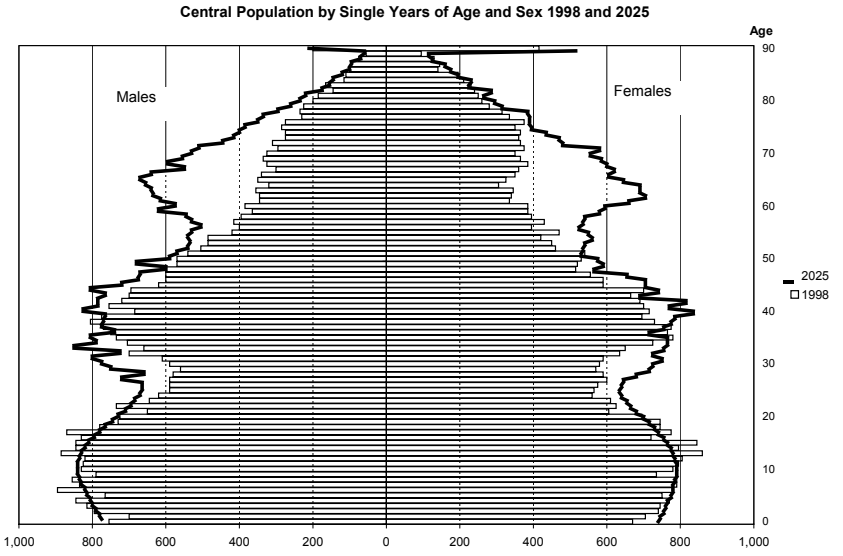
Residents 85 or older are expected to require more non-surgical and surgical beds in 2020. Those in almost every other age group are expected to need fewer surgical beds, while declines in the number of non-surgical beds are expected for all men under the age of 65 and for women younger than 75.

Most of the surgical inpatient days (91%) required for Interlake residents will take place outside of the region. In contrast, 72% of the non-surgical days required will be in regional hospitals and about 8% of the non-surgical days in these hospitals will be filled by non-RHA residents. Overall, the number of days expected to be used in regional facilities is about two thirds of the number of days used by residents.

Central: (12% increase in population projected):

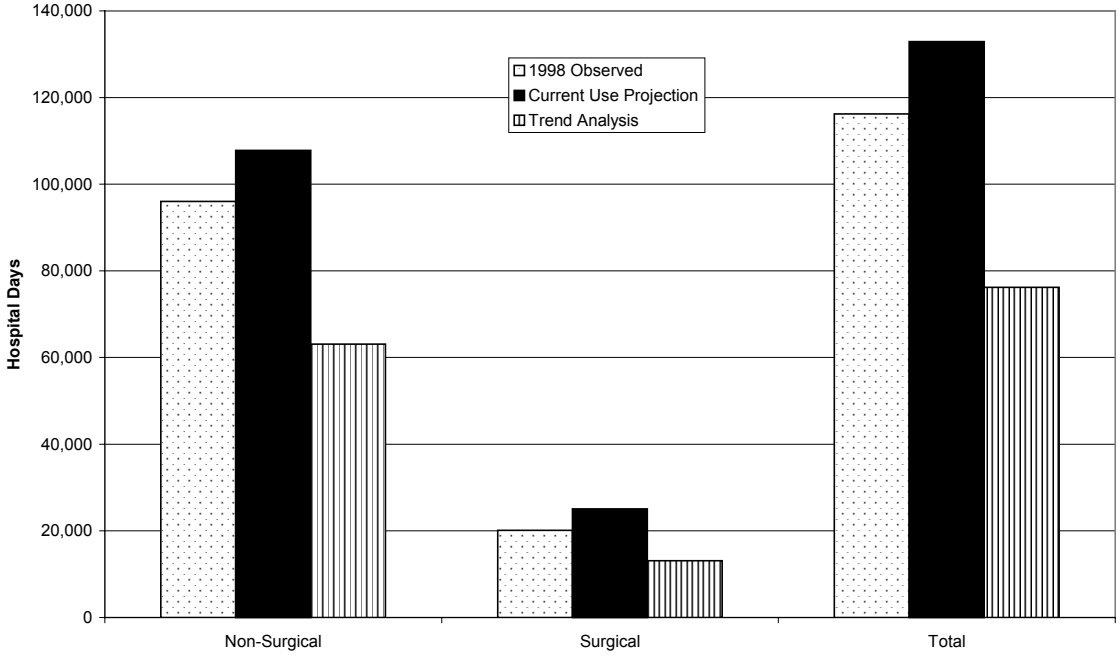
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	97,050	108,485	12%
Bed days required by residents – current use model	116,198	132,887	14%
Bed days required by residents – trend analysis model	116,198	76,204	(34%)
Bed days required in the region by residents and non-residents – current use model	88,132*	105,023	19%
Bed days required in the region by residents and non-residents – trend analysis model	88,132*	62,143	(29%)
Setup Beds	326		
Occupancy rate	60%		
Bed days available in the region at 100% occupancy	118,990		
In region separations as a percent of all separations for region residents	65%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of the Central RHA was 97,050 and it is expected to increase by more than 11,000 people in 2020. The greatest increases will be for those aged 55-74 while the population 75 or older will be virtually unchanged (see Appendix A5). Given this and the 1996/97-1998/99 use patterns, using the Current Use Model we would expect a modest increase of 12 percentage points in non-surgical day requirements and 25 percentage points in days for surgical inpatients (see Figure 11). During the period for which the simple projections were made, the residents of the region had a use to need ratio of 1.02, suggesting that the use is essentially what one would expect given the population characteristics. The average occupancy rate for the region however, was 60%, suggesting that the increases projected by our conservative scenario model could be absorbed easily. It should also be noted that only 65% of residents' hospitalizations occur in area hospitals (see Table 6).

Figure 11: Central Hospital Days
Current and Projected to 2020



Key Points:

- *A moderate increase in the population of Central RHA is projected, with the 60 and over age group showing the largest increase in size.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *Both the Trend Analysis Model and the Current Use Projection Model predicts that there are sufficient beds in the region to provide care for the population in 2020.*

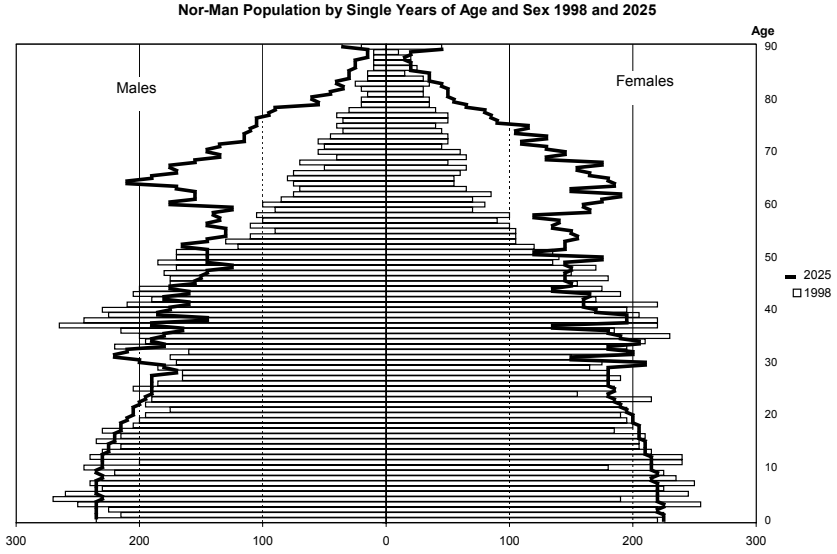
Our Trend Analysis Model suggests that the number of hospital days used by residents of the most populous rural Manitoba RHA would decline. The expected decline is about 34% for both surgical and non-surgical days. The number of non-surgical days would decline for all age groups with the exception of males 65-74. Similarly, the only category in which fewer surgical days will not be required in 2020 is females in the age group 55-64, and even in this group, the expected increase is very modest.

Although Central has the largest number of beds of any of the rural RHAs, more in fact than Brandon, most of the surgery days (55%) for area residents take place in hospitals outside the region. A much higher percentage (81) of the non-surgical days required by Central residents will be captured by the region's 14 hospitals. The number of hospital days required by Central residents outside their region far exceeds the number of days that will be used by non-residents coming into Central based hospitals.

Nor-Man: (11% increase in population projected)

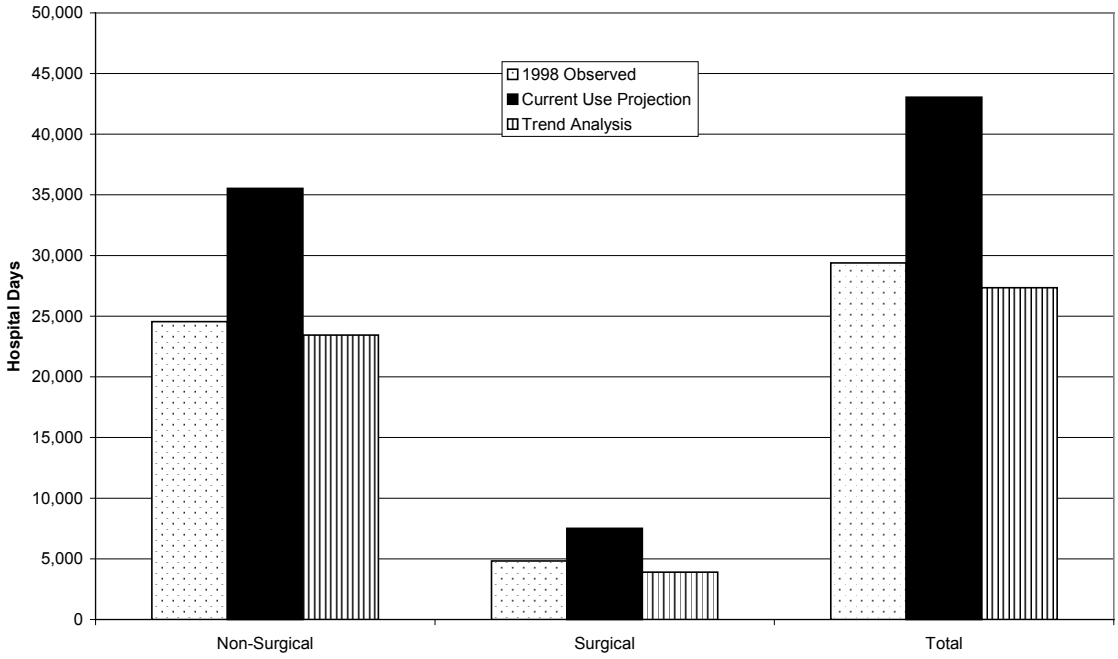
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	25,347	28,180	11%
Bed days required by residents – current use model	29,385	43,057	47%
Bed days required by residents – trend analysis model	29,385	27,357	(7%)
Bed days required in the region by residents and non-residents – current use model	24,248*	35,184	45%
Bed days required in the region by residents and non-residents – trend analysis model	24,248*	24,635	2%
Setup Beds	105		
Occupancy rate	52%		
Bed days at available in the region 100% occupancy	38,325		
In region separations as a percent of all separations for region residents	76%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December of 1998 the population of Nor-Man, the RHA with the smallest population for which we make projections, was 25,347 and it is expected to increase by almost 3,000 people by 2020. The largest increase will be in the age group 55-74 (see Appendix A6). Based on 1996/97-1998/99 use patterns and the change in the age composition, this would correspond to an increase in the need for non-surgical days of 45 percentage points and 55 percentage points in surgical days (Current Use Model)(see Figure 12). Indeed, in 1996/97-1998/99 Nor-Man residents actually used hospitals at slightly below the expected rate. However, the three hospitals in the region had relatively low occupancy rates with an average of just 52% of the set-up beds occupied. Since 76% of area residents separated from local hospitals (see Table 6), the occupancy rates suggest that such increases could be met by the existing facilities. Like the Churchill hospital, the hospital in Flin Flon has a high proportion of its patients from outside Manitoba. Planners need to carefully consider the future demand for hospital beds from Saskatchewan residents.

Figure 12: Nor-Man Hospital Days
Current and Projected to 2020



Key Points:

- *A moderate increase in the population of Nor-Man RHA is projected, with the 60 and over age group showing the largest increase in size, and reductions in the numbers of people in most age groups under 50.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *Both the Trend Analysis Model and the Current Use Projection Model predict that there are sufficient beds in the region to provide care for the population in 2020.*

Our Trend Analysis Model projects that the 2020 need for non-surgical days in Nor-Man will be almost exactly at 1997/98 levels (96%) while the number of surgical days required will be only 81%. More non-surgical days will be used by men, but this will be offset by a decline in the number of days required by women in the region. The biggest increases will be for men aged 75-79 and women 55-64. The population under 55 will be using fewer hospital days for non-surgical reasons. More surgical days will be needed for men 55 or older and women 55-84. Again, this potentially should be offset by a dramatic decline in the number of inpatient surgical days needed by Nor-Man residents.

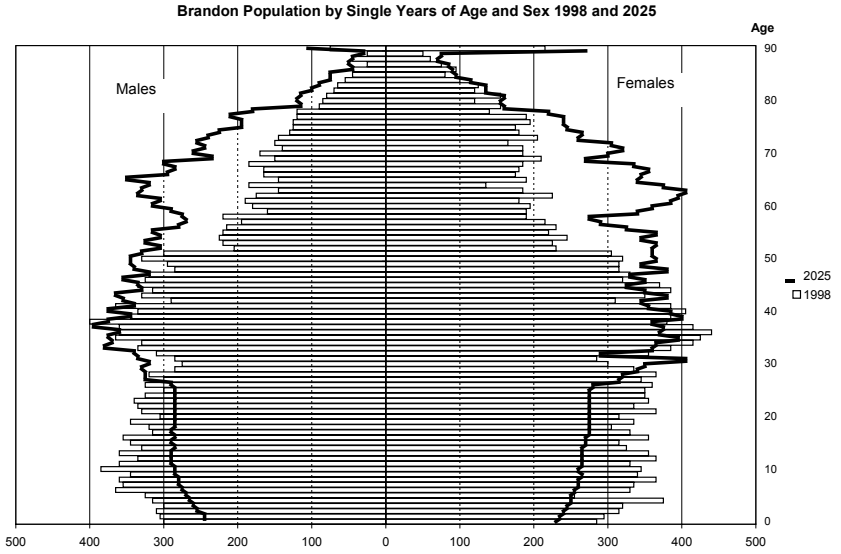
Just over 80% of the surgical days required by residents will take place in hospitals outside the region and only a few surgical beds will be required by non-residents. The picture is somewhat different with respect to non-surgical beds as the number of inpatient days used by non-residents in Nor-Man hospitals is very close to the number of days Nor-Man residents use elsewhere. Overall, the hospital days needed in regional facilities are less than the number of days needed by regional residents, even with the past use of area facilities (but not the change in population demographics) by Saskatchewan residents factored in.

Modest Population Increase:

Brandon: (8% increase in population projected)

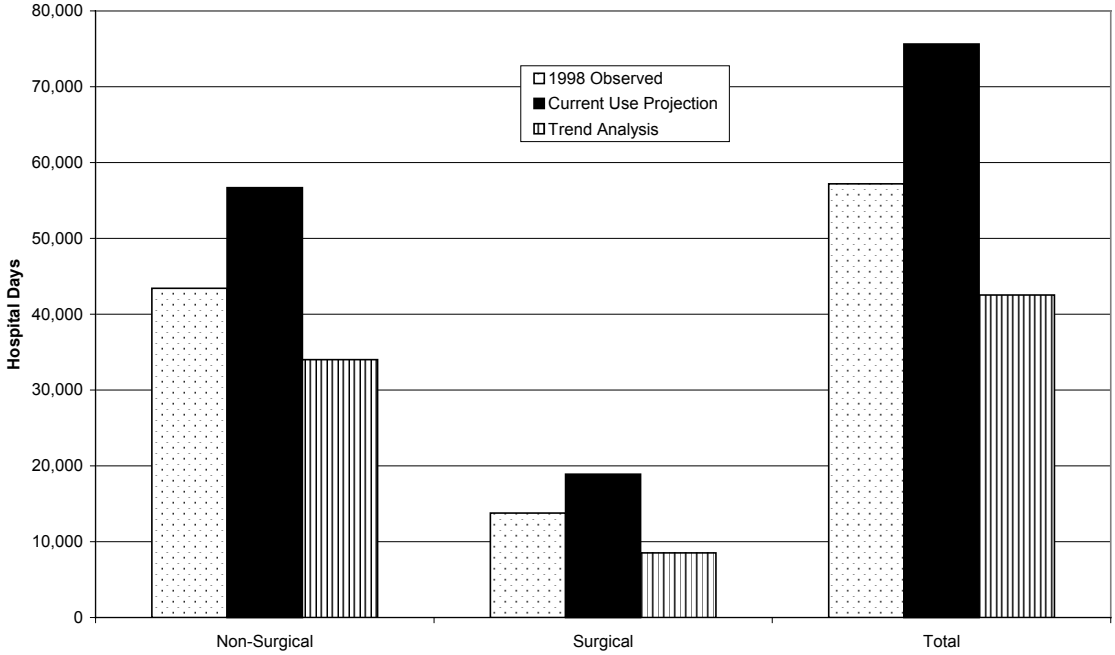
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	46,817	50,545	8%
Bed days required by residents – current use model	57,201	75,615	32%
Bed days required by residents – trend analysis model	57,201	42,526	(26%)
Bed days required in the region by residents and non-residents – current use model	86,266*	98,958	15%
Bed days required in the region by residents and non-residents – trend analysis model	86,266*	56,360	(35%)
Setup Beds	247		
Occupancy rate	69%		
Bed days available in the region at 100% occupancy	90,155		
In region separations as a percent of all separations for region residents	80%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of Brandon RHA was 46,817 and it is expected to increase by almost 4,000 people by 2020. The population will not double in any age group and the largest increases will be among women 55-64 and men 65-74. Population declines are expected in the under 25 age groups (see Appendix A7). According to the 1996/97-1998/99 use patterns (the Current Use Model) and the population changes, the number of non-surgical days would increase by 31 percentage points while the surgical requirements would increase by 37 percentage points (see Figure 13). During the three-year period upon which the Current Use Projection Model is based, the occupancy rate of Brandon's community hospital was almost 70% suggesting that the capacity to hospitalize all residents who require it would not be present in 2020.

Figure 13: Brandon Hospital Days
Current and Projected to 2020



Key Points:

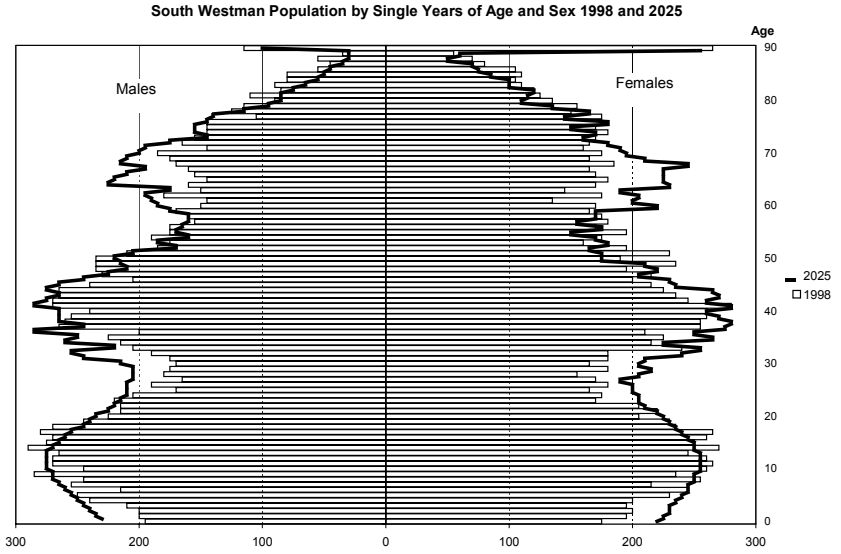
- *A modest increase in the population of Brandon RHA is projected, with the 55 and over age group showing the largest increase in size, and reductions in the numbers of people in most age groups under 30.*
- *The occupancy rate for the hospital in this region shows that there is the physical capacity to care for additional patients.*
- *The Trend Analysis Model predicts that there are sufficient beds in the region to provide care for the population in 2020.*

However, our ten-year Trend Analysis Model suggests a very different picture. Our projections would have Brandon's non-surgical requirements at 78% of the 1997/98 total with increases expected in only a handful of categories (men 25-34, 55-74) while the surgical inpatient bed needs would be only 62% of 1997/98 levels. The need for surgical days is expected to increase only for men 85 or older. Brandon differs from the RHAs discussed to this point in that it provides substantial service to non-RHA residents. It is the only RHA other than Winnipeg, for which more days are projected for regional hospitals than will be needed for residents (see Figures 6 and 7). Brandon residents will use almost 1,400 surgical days in non-Brandon hospitals while non-residents will use almost 6,000 days in Brandon. Similarly, with respect to non-surgical days, while residents of the Brandon RHA will use approximately 2,500 days in other areas, more than 11,000 days will be used by non-residents in Brandon. Nonetheless, even with this total, the number of bed days available should exceed requirements.

South Westman: (5% increase in population projected)

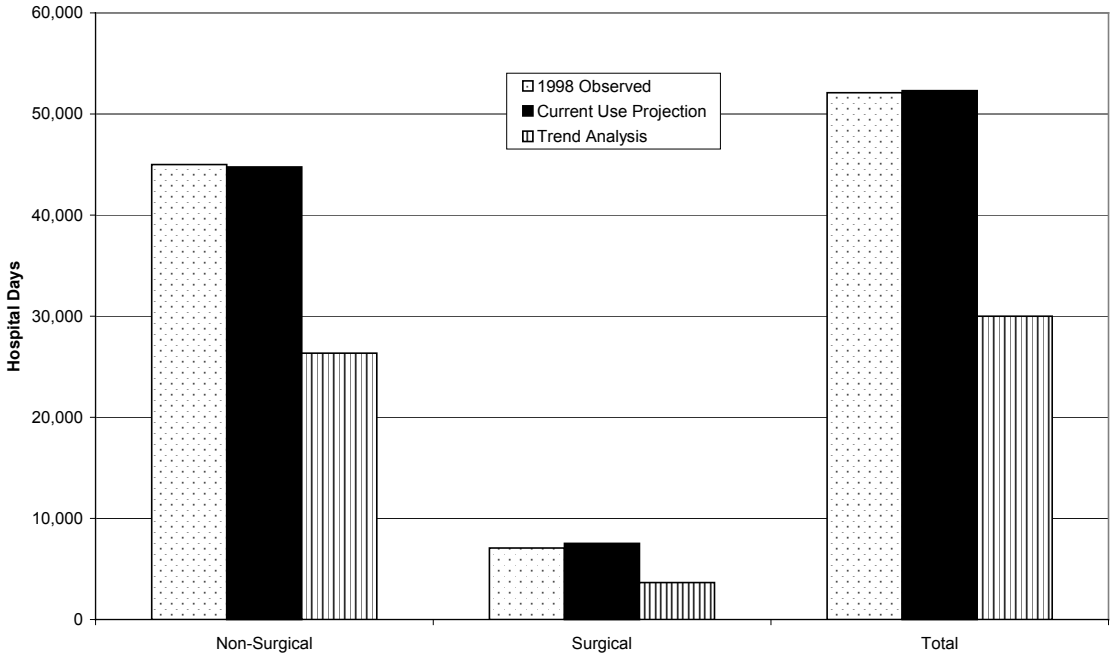
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	34,674	36,375	5%
Bed days required by residents – current use model	52,093	52,297	0%
Bed days required by residents – trend analysis model	52,093	29,992	(42%)
Bed days required in the region by residents and non-residents – current use model	37,478*	36,721	(2%)
Bed days required in the region by residents and non-residents – trend analysis model	37,478*	21,762	(42%)
Setup Beds	201		
Occupancy rate	54%		
Bed days available in the region at 100% occupancy	73,365		
In region separations as a percent of all separations for region residents	54%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of South Westman was 34,674 and it is expected to increase by over 1,700 people in 2020. However, the region's population profile diverges from that of the province at large since the number of men and women over the age of 75 in the region is expected to be smaller than it was in 1998 (see Appendix A8). The population greying trend is not expected to have much of an impact in the region by 2020. Thus, use projections based on the 1996/97-1998/99 utilization average (the Current Use Model) leave South Westman as the only RHA in which an increase in the number of non-surgical days is not expected. Use requirements in 2020 would be almost exactly what they were in 1997/98 (see Figure 14). Residents of South Westman in that time period used hospitals at an expected rate based on their population characteristics. Given that the 11 hospitals in the region, on average, had an occupancy rate of 54% and that 46% of the separations for area residents occurred in non-regional hospitals (see Table 6), there would not appear to be any increased pressure on hospital space in 2020.

Figure 14: South Westman Hospital Days
Current and Projected to 2020



Key Points:

- *A modest increase in the population of South Westman RHA is projected, with the 60 to 70 age group showing the largest increase in size, and reductions in the numbers of people in many other age groups.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *Both the Trend Analysis Model and the Current Use Projection Model predict that there are sufficient beds in the region to provide care for the population in 2020.*

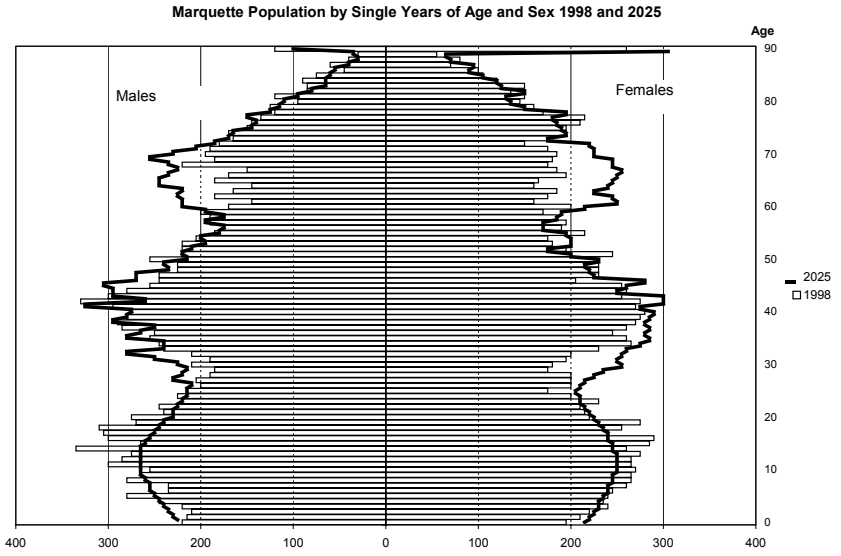
Indeed, our Trend Analysis projections are for striking decreases in the need area residents will have for hospital days. This model projects the number of inpatient days required for surgery to be just over half those used in 1997/98 and the non-surgical days to be only about three fifths of the 1997/98 total. Only for women from birth to 14 are increases in the need for surgical bed days expected. In every other age category, the projection is for use to fall.

South Westman stands out in having the highest proportion of its residents predicted to receive their surgical hospitalizations elsewhere and only 69 surgical days are projected for the RHA's 11 acute care hospitals in 2020. A much higher proportion of non-surgical days will likely take place in local facilities, assuming current trends continue, but the region is clearly another where the number of days required locally is far below the number of days residents will require.

Marquette: (3% increase in population projected)

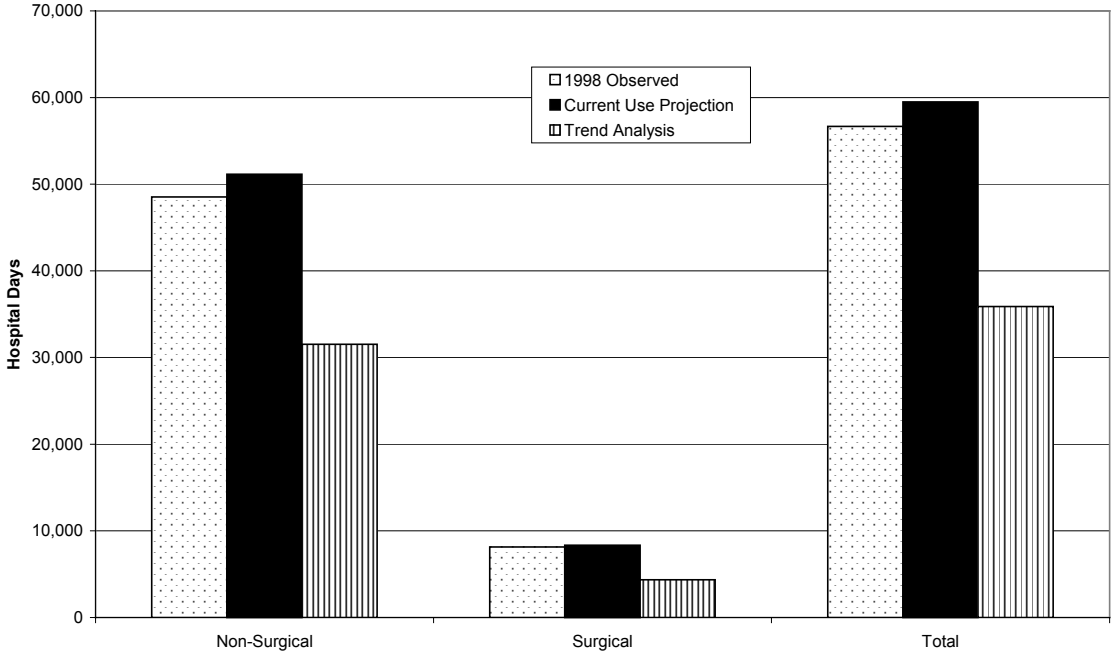
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	37,691	38,940	3%
Bed days required by residents – current use model	56,682	59,498	5%
Bed days required by residents – trend analysis model	56,682	35,881	(37%)
Bed days required in the region by residents and non-residents – current use model	45,053*	46,399	3%
Bed days required in the region by residents and non-residents – trend analysis model	45,053*	28,601	(37%)
Setup Beds	220		
Occupancy rate	55%		
Bed days available in the region at 100% occupancy	80,300		
In region separations as a percent of all separations for region residents	64%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of Marquette was 37,691 and it is expected to increase by about 1,250 people by 2020 (see Appendix A9). With a modest population projection growth of this magnitude, it is not surprising that the 1996/97-1998/99 use patterns (the Current Use Model) produce modest increases in hospital use projections of only five percentage points in non-surgical days and three percentage points in surgical days (see Figure 15). Residents of Marquette used hospitals at a greater than expected rate, but even then, the average occupancy rate for the region's 10 hospitals was 55%. Finally, 36% of the hospitalizations of area residents took place in hospitals located outside the region (see Table 6). The region should have more than ample capacity to handle hospital needs in 2020.

Figure 15: Marquette Hospital Days
Current and Projected to 2020



Key Points:

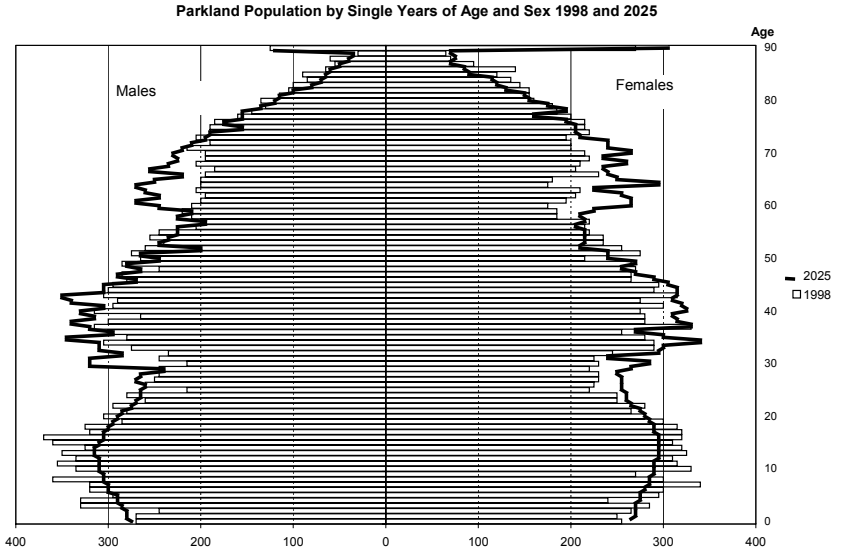
- *A modest increase in the population of Marquette RHA is projected, with the 60 to 70 age group showing the largest increase in size, and reductions in the numbers of people in many other age groups.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *Both the Trend Analysis Model and the Current Use Projection Model predict that there are sufficient beds in the region to provide care for the population in 2020.*

Our projection of hospital needs based on the Trend Analysis Model suggests that Marquette's needs for surgical bed days will fall in every age category and end up at nearly half of the 1997/98 figures. The pattern is similar for non-surgical days as well. The only increases predicted are for men 25-34 and women 55-64. Overall, the non-surgical days needed by Marquette residents in 2020 will be about two thirds of the 1997/98 total. Only 14% of the days area residents will need for surgery will take place in the region's 10 facilities and the number of non-surgical days residents will use elsewhere is more than double the number of days non-residents will use in Marquette hospitals.

Parkland: (3% increase in population projected)

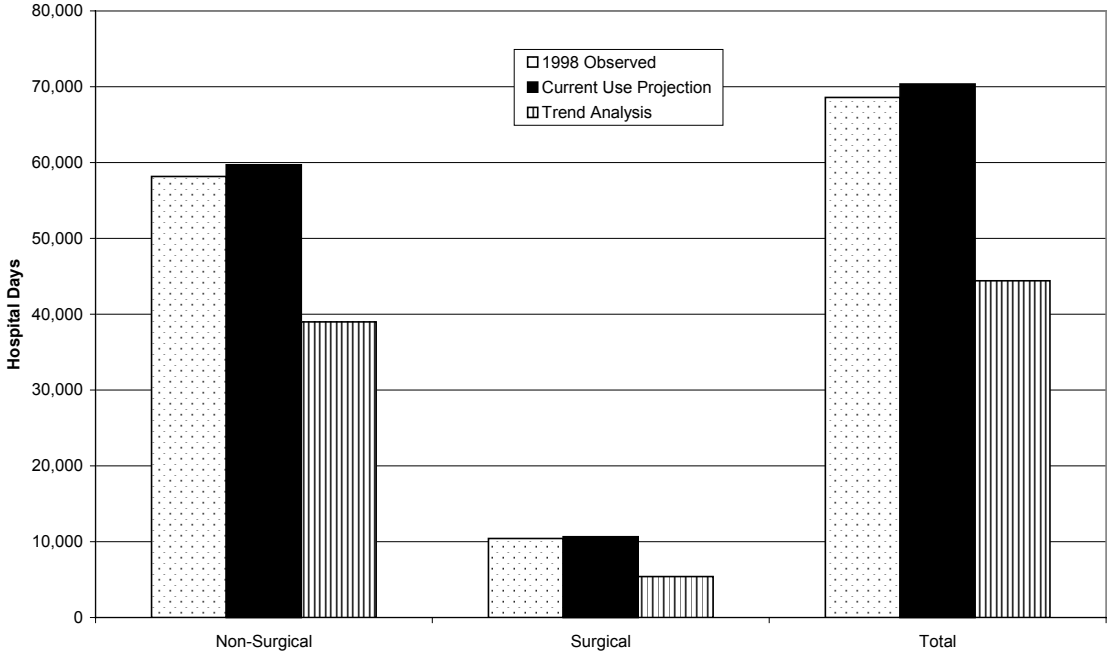
	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	43,376	44,500	3%
Bed days required by residents – current use model	68,593	70,352	3%
Bed days required by residents – trend analysis model	68,593	44,398	(35%)
Bed days required in the region by residents and non-residents – current use model	61,013*	63,489	4%
Bed days required in the region by residents and non-residents – trend analysis model	61,013*	40,935	(33%)
Setup Beds	236		
Occupancy rate	66%		
Bed days available in the region at 100% occupancy	86,140		
In region separations as a percent of all separations for region residents	78%		

* This is the annual average bed days used for the period 1996/97 to 1998/99



In December 1998 the population of Parkland was 43,276 and it is expected to increase very modestly, by about 1,125 people. Contrary to the overall provincial trend, the number of residents over the age of 75 is actually projected to decline by 2020 (see Appendix A10). With this projection, the Current Use Projection Model suggests needs for surgical and non-surgical beds that are similar to 1997/98 levels (see Figure 16). And these levels appear sustainable since in 1996/97-1998/99 the residents of Parkland used somewhat more hospital days than expected. Their score on our use to need ratio was the highest in rural Manitoba at 1.11. This RHA also retained the highest proportion of its residents of any rural Manitoba region with 78% of separations coming from local facilities (see Table 6). Even with that greater than expected use ratio, the average occupancy rate for the eight hospitals was only 66% indicating that the region is well placed to accommodate the 2020 needs.

Figure 16: Parkland Hospital Days
Current and Projected to 2020



Key Points:

- *A modest increase in the population of Parkland RHA is projected, with the 60 to 75 age group showing the largest increase in size, and reductions in the numbers of people in many other age groups.*
- *The occupancy rate for hospitals in this region shows that there is the physical capacity to care for additional patients.*
- *Both the Trend Analysis Model and the Current Use Projection Model predict that there are sufficient beds in the region to provide care for the population in 2020.*

When we use our Trend Analysis Model to project future bed needs, Parkland looks as if it has more than ample beds. Like Marquette, it will likely need only half as many days for surgery and only two thirds the present total for non-surgical cases. None of the age groupings will require more surgical days and an increase in non-surgical days is predicted only for men 25-34 and 55-74. These are the only male age groups in which the population is expected to increase by 2020.

The eight Parkland hospitals are expected to provide almost half the surgical days required by regional residents and the number of non-surgical days expected in area hospitals is almost equal to the days area residents will need. Of the rural Manitoba RHAs, Parkland will come closest to providing as many days in regional hospitals as area residents will need.

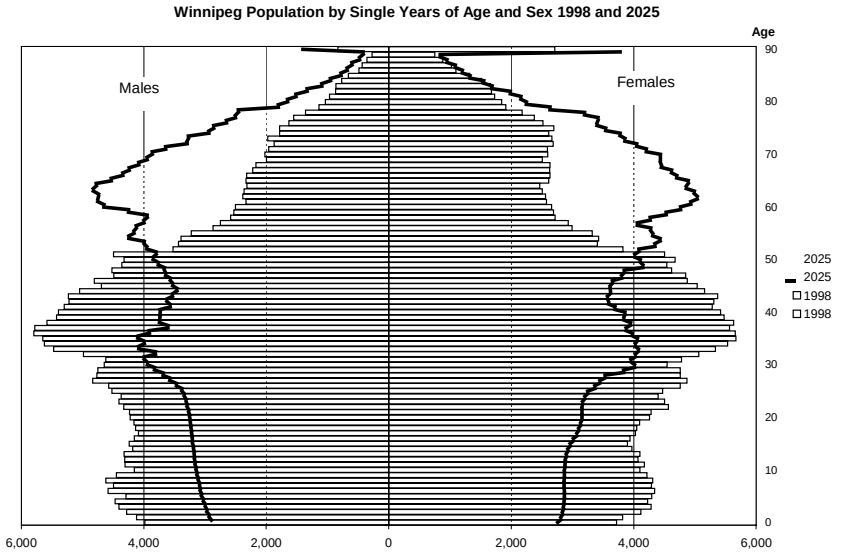
Decline in Population:

Revised June 27, 2002

Winnipeg: (3% decrease in population projected)[21]

	1998 Actual	2020 Projection	Per cent Increase (Decrease)
Population	646,917	624,865	(3%)
Bed days required by residents – current use model	638,495	798,592	25%
Bed days required by residents – trend analysis model	638,495	531,838	(17%)
Bed days required in the region by residents and non-residents – current use model	801,355*	996,158	24%
Bed days required in the region by residents and non-residents – trend analysis model	801,355*	646,879	(19%)
Setup Beds	2,169		
Occupancy rate	86%		
Bed days available in the region at 100% occupancy	791,685		
In region separations as a percent of all separations for region residents	96%		

This is the annual average bed days used for the period 1996/97 to 1998/99. The 2,169 set up beds reflects the removal in 1999 of 194 beds at Misericordia from acute care bed counts. The beds required in 1998 do not capture this change.

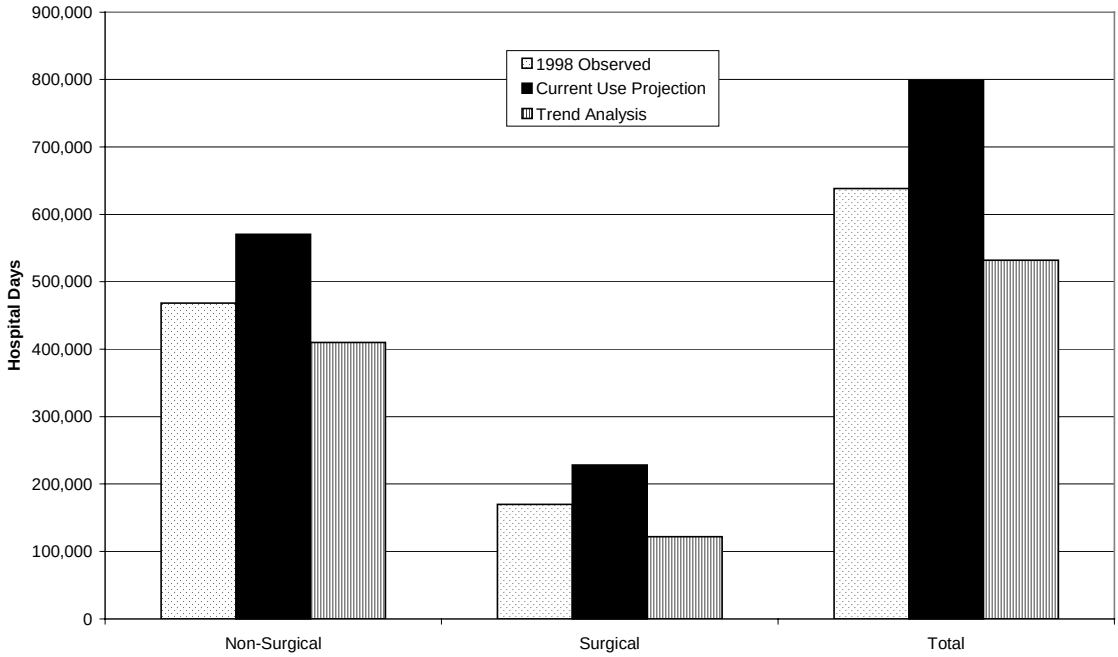


In December of 1998 the population of the Winnipeg RHA was 646,917 (almost 3/5 of Manitoba's population) and it is the only RHA that is projected to experience a decline in population. And in raw numbers the decline is substantial with MBS forecasting that 22,000 fewer people will live in the capital city in 2020. Indeed, the number of people under the age of 14 is expected to decline by over 34,000 (see Appendix A11). This will be counterbalanced to some degree by increases in the population over the age of 55. With such a change in the age composition of the city, the Current Use Projection Model suggests that Winnipeg will need 22 percentage points more days for non-surgical cases and 34 percentage points more days for surgical cases (see Figure 17). Winnipeg differs dramatically from rural Manitoba in terms of excess capacity. There are not many empty hospital beds in Winnipeg and during the 1996/97-1998/99 period the average

[21] Note that the "Bed Days required" relate to a three-year average while the "Bed days available" relates to one year. There was a net decrease of 155 beds in Winnipeg during the three years for which bed requirements are reported. As a result, although it appears that more bed days were required in Winnipeg than were available, this was not the case.

occupancy rate was 86%. As well, it is possible that some of the population loss that Winnipeg will experience will be to bedroom communities that surround the city. When one looks at past practice, it seems likely that many of these people will continue to use city facilities even if they are counted as residents of another RHA.

Figure 17: Winnipeg Hospital Days
Current and Projected to 2020



Key Points:

- *A decline in the population of Winnipeg RHA is projected, with increases in the population over 50 years old and decreases in the population under 50.*
- *Winnipeg has the highest occupancy rate in the province yet there is the physical capacity to care for additional patients.*
- *The Trend Analysis Model predicts that there are sufficient beds in the region to provide care for the population in 2020.*

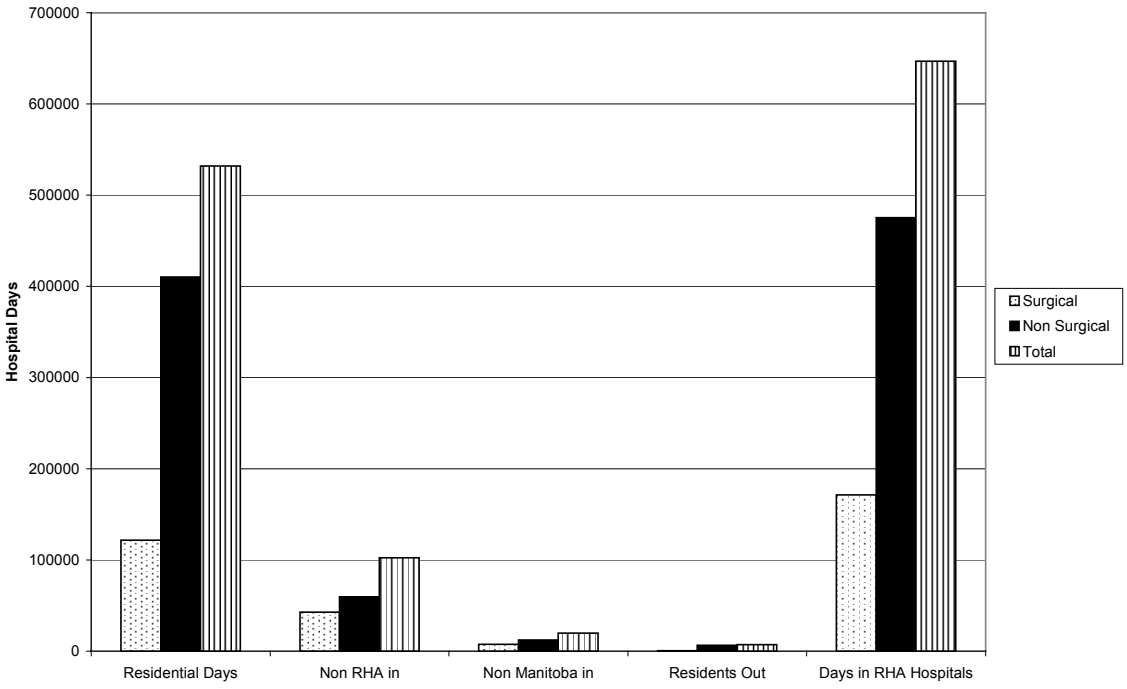
The Trend Analysis Model's projections provide some indication that the city's needs for hospital beds is manageable. Winnipeg is projected to need only 88% of the 1997/98 days for non-surgical cases and just 72% of the surgical day total. It is critically important to keep in mind Winnipeg's service to the rest of the province. Many residents of other RHAs are hospitalized in the city and, like Brandon, but to an even greater extent, the number of non-Winnipeg residents who will be hospitalized in area hospitals will be much greater than the number of Winnipeg residents hospitalized elsewhere. In addition to the surgical days required by Winnipeg residents, almost 50,000 more surgical days will be needed to accommodate non-Winnipeg residents in the city's six hospitals in 2020. To put it another way at a 100% occupancy rate about 138 beds will be needed daily for non-residents. With respect to non-surgical days, our projections suggest that of the total number of beds required in Winnipeg hospitals, almost 15% will be filled by non-residents of the city (see Figure 18).

Revised June 27, 2002

Key Point:

- *People from throughout the province use Winnipeg hospital beds. Therefore a decrease in the number of residents in Winnipeg will not in itself mean there will be less need for hospital beds in Winnipeg. The estimates presented here take into account the increases in population in other RHAs and the historical use of these populations of Winnipeg hospital beds.*

Figure 18: WRHA Resident Days Required and Use of WRHA Hospitals (Trend Analysis)



UNDERSTANDING THE RESULTS

The two models provide dramatically different portraits of hospital needs in 2020. The 10-Year Trend Analysis Model indicates that the capability to meet the hospital needs of 2020 is present in our current system. At first glance, the 3-Year Current Use Projection Model raises some questions about the ability to meet future needs. However, when this model is examined in conjunction with data on occupancy rates and how hospitals were used in the 1990's (that is, a large proportion of their use has been for patients who do not require an acute level of care), it seems that most RHAs have sufficient beds to meet the future needs. Among the rural RHAs, only North Eastman and South Eastman do not have sufficient beds to meet the need for in-area hospitalization in 2020 under the Current Use Model. And for both these RHAs, a small number of additional beds would cover this eventuality.

The situation differs dramatically in Brandon and Winnipeg. Although neither of these areas is expected to grow substantially in population, the Current Use Model suggests a substantially increased need for hospital beds by residents that, in conjunction with facility use by non-residents, would see demand for beds far outstripping supply. (This demand must be considered in light of the concerns about appropriate use raised earlier in the report). More reassurance is provided by the ten-year trend analysis data which indicates that even Brandon and Winnipeg should be able to meet the acute care hospital needs of Manitobans in 2020, with existing bed capacities.

1.6 Looking Farther Forward

For this project we were asked to project the need for hospital use in the future based on the available MBS population projections. Using these, we focussed on the year 2020. However, if one looks back at Figure 4, it is clear that the year 2020 is the beginning, not the end of pressures on hospital beds. The "baby boom" generation that in 1998 was between 34 and 52 years old will be between 56 and 74 years old in 2020. This places this expanded population on the cusp of entering the age group (75+) that has historically included the heaviest users of hospitals.

We have cautiously concluded that the hospital system in Manitoba currently has sufficient physical capacity to meet the need for hospital care in 2020. However, we recognize that the years following 2020 will bring further pressures on the hospital system, with increasing numbers of the population being in the age group that requires the most use of hospitals. As the baby boomers reach the end of their life spans, there will be decreasing numbers of people in the older age groups. By 2054 the last of the surviving baby boomers will be 90 years old. For Manitoba as a whole, the population projections developed by MBS that take into account the birth rate of children born to baby boomers shows the population that follows the boom will be fairly evenly distributed throughout the age groups, and the boom is not expected to repeat.

These factors highlight the importance of continuing to monitor changes in population projections and hospital usage in the coming years. It is also important to recognize that the pressures produced by an aging population will not be over in 2020, but are in fact likely to increase gradually beginning in 2021. However, this should not be anticipated as a permanent change, but as a wave of grey moving through the system, creating a set of pressures that will not likely be repeated in the foreseeable future.

1.7 Other Issues: Costs

This study has looked only at the need for acute care hospital beds and the research indicates that there is little cause for alarm as it relates to the availability of such beds in 2020. However, this study has not addressed the issue of cost. That is, there may well be substantial issues relating to the staffing of hospitals or the acuity of inpatient cases and the drug costs associated with that. Also, we project a marked increase in outpatient surgery which will require facilities for coping. The issue of cost implications of these trends is beyond the scope of this analysis.

DISCUSSION

The two models provided sharply divergent projections for 2020. The Current Use Projection Model indicates increases of greater than 25 percentage points in non-surgical days and of more than 35 percentage points in surgical days. That is, if we look strictly at the rate at which individuals were using hospitals in 1996 through 1999 and combine this with population estimates for 2020, we estimate quite substantial increases in hospital use across the province, largely due to the aging of the population, and to the fact that the rate of surgery has been increasing in the recent past. With older people making up a larger share of the population, and with older people using hospitals more than younger people, such a result seems eminently comprehensible. However, even if hospitals are used in 2020 the way they were used in 1999, other factors could well mitigate the pressures on the hospital system. First, in virtually all of the rural RHAs the hospitals have relatively low occupancy rates. Much of the increase in patient days could thus be met within the existing institutions. Second, a significant proportion of rural Manitobans are hospitalized in Winnipeg, and therefore an increase in the need for hospital days by those residents does not necessarily indicate the increased demand will focus on local facilities. Third, with respect to Winnipeg, recent research has indicated that a substantial portion of the medical days spent in acute care beds do not actually require treatment in an acute setting. What this indicates is that current hospital use need not be considered 'best practise' and should not necessarily be used as a model for projecting future needs. Efforts to more appropriately and efficiently discharge patients might well eliminate the substantial increases in bed days the Current Use Projection Model estimates are needed for even the Winnipeg region. However, a best practice model assumes that capacity is available in alternative settings including personal care homes, home care and rehabilitation facilities.

The Trend Analysis Model projects a substantial decline in the number of bed days required in 2020. Specifically, it indicates that non-surgical days will be at only 83% of 1998/99 levels while surgical days will be at only 70% of 1998/99 levels. This model's projected declines apply to Winnipeg as well as most of the other RHAs. These declines stem partially from projections that the decline in the average length of stay for inpatient surgeries will continue and that inpatient surgery will continue to move to the outpatient setting. As this report documents, such changes have occurred in Manitoba over the last 15 years. Indeed, many of the projected decreases in length of stays for rural hospitals have already been achieved in Winnipeg hospitals. This suggests that the decline we are forecasting can likely be achieved.

Finally, it is important to keep in mind that 2020, the point at which these projections end, is essentially the beginning of the pressures on hospital beds that will be created by the aging baby boomers, not the end. If the trends towards shorter stays and the move to outpatient surgery continue, Manitoba will have excess capacity in 2020 in its acute hospitals, and be well positioned

to meet the needs of the aging boomers. However, if the trends do not continue, we project increased demand for acute care in 2020, demands that will grow in subsequent years. This reinforces the importance of continuing to monitor use patterns and population patterns to determine which of the projections we have developed more closely mimics system behaviour. There are risks in both overestimating and underestimating hospital bed needs. Once the "baby boom bulge" ends, approximately 30 years later (that is in approximately 2050), one could have substantial excess capacity, capacity that will be as difficult to close as are underused rural facilities today. The risks in underestimating bed needs are also problematic although developing new capacity if needs become apparent may take less time than closing beds which are not needed.

RECOMMENDATIONS

- Revisit hospital use patterns every five years and apply actual population figures, updated population projections, and hospital use to our models.

It is very difficult to estimate future hospital needs with accuracy and it is no simple matter to project future population levels. Accordingly, our first recommendation is that the issue of population change and hospital use should be revisited every five years. These revisitations would provide opportunities for assessing and if necessary changing the population projections as well as determining which of our projection models is capturing changing hospital use patterns most accurately. The use projected by our models could be examined with the accurate population and utilization figures as a means of assessing the degree to which they can be expected to predict future needs. This would make it possible to assess the validity of our contention that greater confidence should be placed in the Trend Analysis Model.

- Approach forecasted system changes from a "wait and see" perspective. Any increased pressures which occur will be gradual.

Manitoba has already accommodated a 38% increase in the elderly population (between 1985 and 1998) over a period when there were substantial bed closures. Despite the increases in the numbers of elderly people and the decreases in beds, the rate at which Manitobans were hospitalized actually increased over the period. The projections developed by the Manitoba Bureau of Statistics assume a further 15% increase in the population aged 75 years and older by the year 2020.

- Do not reallocate hospital resources from Winnipeg to regions with large projected population increases.

We also recommend that the population decline projected for the Winnipeg RHA not be assumed to mean fewer pressures on the Winnipeg hospital system. An examination of past hospital use makes absolutely clear that Winnipeg's hospitals do not simply serve the local population and that they are crucial in the delivery of health care to all Manitobans. Moreover, some of the projected population increases in Manitoba are in areas that touch on Winnipeg and based on past practice, we would expect many of the people in these areas to use Winnipeg services. Also since some of the projected decline in Winnipeg's population stems from movements to surrounding bedroom communities, this will not necessarily be accompanied by a switch in physicians or in the hospitals for which those physicians have admitting privileges.

- Develop programs to maximize the use of acute hospitals for acute care patients, and to provide appropriate alternate settings to care for patients who do not need acute care. Patients who do not require acute care beds inflate occupancy rates and create more pressure on beds.

We again draw attention to the MCHP study entitled "Acuity of Patients Hospitalized for Medical Conditions at Winnipeg Acute Care Hospitals" (Bruce, 2001). That study determined that only 76% of medical patients admitted to Winnipeg acute care hospitals were assessed as acute" (P. 3). Moreover, almost half (45%) of days in acute care hospital beds after admission were not classified as needing these beds. In an earlier report, looking specifically at hospital use by elderly people, the authors found that 75% of the days spent by those aged 75 or over in acute care beds were not classified as requiring acute care (DeCoster et al., 1996). Translating the findings from the Acuity study into bed-days, the equivalent of over 1,000 acute care beds could be potentially 'saved' if patients who did not require acute care were cared for in a more appropriate setting.

The presence of patients in acute care beds who do not need acute care inflates the hospital use data on which our projections are based. A more appropriate use of acute care beds would have resulted in lower projections for 2020 such that even Winnipeg and Brandon hospitals might possess sufficient capacity to handle the Current Use Model scenario.

- Monitor presence of long-stay patients in acute care beds, and arrange for alternate care settings, like home care, as soon as is feasible.

In a related vein, we recommend that efforts be made to reduce the number and proportion of long-stay patients, those with stays longer than 30 days. The acuity study cited above attributed most of the non-acute subsequent days to long-stay patients (P. 60). If alternative methods of care are available, it may be possible to lower the number of people who will need to be in acute care beds today as well as in 2020.

However, it must also be acknowledged that a failure to have sufficient home care resources as well as sufficient personal care beds available for the increasingly elderly population would almost certainly result in more people with needs for such resources occupying acute care hospital beds. This would be an inefficient use of the health system's limited resources. It is critical that the system look beyond acute care. The increasing proportion of elderly people in the population will have an impact on the health care system that goes far beyond the need for acute care beds. As Barer et al. (1995) note "The relatively rapid growth of the very elderly population—85 years of age and up—is having and will presumably continue to have a major impact on the long-term care sector, whether in the form of extended or intermediate level institutional care, or community-based programs" (P. 198). Failure to meet these needs will have clear implications for hospitals. While the sky

does not appear to be falling with respect to the need for acute care beds, the implications of a greying population for the overall health system requires continued monitoring and attention.

- Ensure facilities are available for moving surgery from the inpatient to the outpatient setting.

The Trend Analysis Model assumes that surgery that previously has been performed on an inpatient based will increasingly be done on an outpatient basis. If these moves do not take place, increased pressure on inpatient beds will ensue.

- Given the recent marked increases in the rates at which the population is undergoing surgical procedures, further work is needed to understand why these increases are occurring, and clinicians should be encouraged to adopt practice guidelines where they exist to ensure the appropriateness of surgery performed.

Between 1997 and 2020 we are projecting that the number of surgical cases will increase from 82,000 to 143,000, an increase of 74%, at a time when the growth of the Manitoba population is minimal. While some of this is explained by the increased numbers of elderly people, most of the increase is explained by increasing rates of surgery that have occurred in recent years and are projected for the future. We have not examined which types of procedures have been increasing in the past, nor which are projected to increase so markedly. Knowing this will be important.

Regional Health Authorities should also encourage the development and adoption of practice guidelines for surgical procedures.

Cautions

- If there is no continued move to outpatient surgery and if length of stay does not continue to decline, then the Current Use projections will likely prove more accurate. Manitoba's acute hospitals have the capacity to accommodate even the Current Use projections for 2020, if steps are taken to ensure acute hospitals are used for acute care patients, and the needs of non-acute patients can be met elsewhere.
- Our projections are based on MBS data for 2020 population; if the population projections are invalid then the bed projections will be invalid.

- Population projections only identify changes in the age and sex composition of the population, but other changes in the make up of the population (including socioeconomic status) may also affect the need for hospitals. Changes in the overall health status of the population would also likely affect the need for inpatient care.

- Our projections do not address cost of delivery of services. In particular, technological innovations may reduce costs in some situations, but may increase costs in others (recent increases in the overall cost of drugs is an example of this). We have also indicated that there is physical capacity to handle future demand (i.e., space in hospitals), but have not dealt with the incremental operating costs of increasing occupancy rates (for example the cost of medical/surgical supplies, staffing costs, and particularly drugs) or, for example, the home care costs associated with increased day-surgery rates.

Conclusion

Despite an aging population, we are cautiously optimistic about the ability of Manitoba's hospitals to meet the acute care needs of the province's population in 2020. If past trends continue, there may well be excess capacity. Even if past trends towards decreasing use of acute hospitals do not continue, Manitoba could accommodate increased demands on acute hospitals in 2020, by treating patients requiring alternative forms of care – elsewhere. This of course assumes that alternatives are available.

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APPENDIX A: RHA ESTIMATED NON-SURGICAL AND SURGICAL INPATIENT DAYS IN 2020: TREND ANALYSIS MODEL

Appendix A1: Burntwood and Churchill Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	8104	9535	117.7%	0.4873	0.2002	1.3387	0.2680	55.0%	3949	2,556	64.7%
15-24	Male	3974	5175	130.2%	0.1683	0.0606	1.3699	0.0830	49.3%	669	429	64.2%
25-34	Male	7145	7935	111.1%	0.2616	0.1627	1.4005	0.2278	87.1%	1869	1,808	96.7%
35-54	Male	2364	3300	139.6%	0.5372	0.1834	1.2621	0.2315	43.1%	1270	764	60.2%
55-64	Male	1272	2830	222.5%	1.2437	0.4428	1.2447	0.5511	44.3%	1582	1,560	98.6%
65-74	Male	502	1760	350.6%	3.4582	1.4874	1.5397	2.2902	66.2%	1736	4,031	232.2%
75-79	Male	124	495	399.2%	4.0323	3.4621	1.0785	3.7340	92.6%	500	1,848	369.7%
80-84	Male	56	235	419.6%	14.0000	4.7226	1.0403	4.9128	35.1%	784	1,155	147.3%
85+	Male	48	105	218.8%	7.5833	9.1113	0.7117	6.4845	85.5%	364	681	187.1%
All Ages	Male	23,589	31,370	133.0%						12,723	14,831	116.6%
0-14	Female	7799	9020	115.7%	0.3979	0.1783	1.4292	0.2548	64.0%	3103	2,298	74.1%
15-24	Female	3885	4910	126.4%	0.8448	0.2193	1.9493	0.4276	50.6%	3282	2,099	64.0%
25-34	Female	3806	4625	121.5%	0.9280	0.3260	1.3660	0.4453	48.0%	3532	2,060	58.3%
35-54	Female	5089	6565	129.0%	0.5522	0.2276	1.4413	0.3281	59.4%	2810	2,154	76.6%
55-64	Female	1064	2735	257.0%	1.6805	0.4909	1.6553	0.8126	48.4%	1788	2,222	124.3%
64-74	Female	438	1725	393.8%	2.3242	0.9948	1.7846	1.7753	76.4%	1018	3,062	300.8%
75-79	Female	134	420	313.4%	8.9552	3.5473	1.5367	5.4510	60.9%	1200	2,289	190.8%
80-84	Female	70	235	335.7%	7.0429	3.8990	1.1670	4.5504	64.6%	493	1,069	216.9%
85+	Female	55	110	200.0%	12.7636	7.8672	1.1711	9.2129	72.2%	702	1,013	144.4%
All Ages	Female	22,340	30,345	135.8%						17,928	18,268	101.9%
Total	Male + Female	45,929	61,715	134.4%						30,651	33,099	108.0%
SURGICAL												
0-14	Male	8104	9535	117.7%	0.1586	0.0249	1.8420	0.0458	28.9%	1285	437	34.0%
15-34	Male	7902	9840	124.5%	0.1048	0.0360	1.4533	0.0524	50.0%	828	515	62.2%
35-44	Male	3217	3270	101.6%	0.1358	0.0489	1.7441	0.0853	62.8%	437	279	63.8%
45-54	Male	2364	3300	139.6%	0.3469	0.0838	1.5237	0.1277	36.8%	820	421	51.4%
55-64	Male	1272	2830	222.5%	0.6368	0.1958	1.4832	0.2904	45.6%	810	822	101.5%
65-74	Male	502	1760	350.6%	0.9880	0.3651	1.1770	0.4297	43.5%	496	756	152.5%
75-84	Male	180	730	405.6%	1.6611	0.6200	1.6616	1.0302	62.0%	299	752	251.5%
85+	Male	48	105	218.8%	0.4167	0.7350	0.7808	0.5739	137.7%	20	60	301.3%
All Ages	Male	23,589	31,370	133.0%						4,995	4,043	80.9%
0-14	Female	7799	9020	115.7%	0.0477	0.0160	1.7465	0.0279	58.4%	372	251	67.6%
15-24	Female	3885	4910	126.4%	0.0589	0.0216	1.4336	0.0310	52.7%	229	152	66.5%
25-34	Female	3806	4625	121.5%	0.1111	0.0389	1.5597	0.0607	54.6%	423	281	66.4%
35-44	Female	3008	3280	109.0%	0.1872	0.0625	1.4962	0.0936	50.0%	563	307	54.5%
45-54	Female	2081	3285	157.9%	0.3676	0.1032	1.7485	0.1804	49.1%	765	593	77.5%
55-64	Female	1064	2735	257.0%	0.6335	0.1739	2.0461	0.3558	56.2%	674	973	144.4%
65-74	Female	438	1725	393.8%	1.4406	0.2739	2.0584	0.5639	39.1%	631	973	154.1%
75-84	Female	204	655	321.1%	1.8873	0.4866	0.8990	0.4374	23.2%	385	287	74.4%
85+	Female	55	110	200.0%	1.4000	0.6858	0.8234	0.5647	40.3%	77	62	80.7%
All Ages	Female	22,340	30,345	135.8%						4,119	3,878	94.2%
Total	Male + Female	45,929	61,715	134.4%						9,114	7,921	86.9%

Appendix A2: South Eastman Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	6631	7425	112.0%	0.2699	0.2002	0.6273	0.1256	46.5%	1790	933	52.1%
15-24	Male	4347	4345	100.0%	0.1196	0.0606	0.9127	0.0553	46.2%	520	240	46.2%
25-34	Male	7846	10225	130.3%	0.1461	0.1627	0.6989	0.1137	77.8%	1146	1,162	101.4%
35-54	Male	3178	3885	122.2%	0.3260	0.1834	0.7203	0.1321	40.5%	1036	513	49.5%
55-64	Male	2125	4210	198.1%	0.5021	0.4428	0.8671	0.3839	76.5%	1067	1,616	151.5%
65-74	Male	1564	2825	180.6%	1.4284	1.4874	0.9123	1.3570	95.0%	2234	3,833	171.6%
75-79	Male	519	840	161.8%	3.6185	3.4621	1.0461	3.6216	100.1%	1878	3,042	162.0%
80-84	Male	329	485	147.4%	7.8967	4.7226	1.0692	5.0495	63.9%	2598	2,449	94.3%
85+	Male	233	375	160.9%	8.3047	9.1113	0.9471	8.6294	103.9%	1935	3,236	167.2%
All Ages	Male	26,772	34,615	129.3%						14,204	17,025	119.9%
0-14	Female	6343	7020	110.7%	0.2111	0.1783	0.6389	0.1139	54.0%	1339	800	59.7%
15-24	Female	3812	4205	110.3%	0.2605	0.2193	0.6593	0.1446	55.5%	993	608	61.2%
25-34	Female	3514	5060	144.0%	0.6332	0.3260	0.8801	0.2869	45.3%	2225	1,452	65.3%
35-54	Female	7127	8430	118.3%	0.3074	0.2276	0.7785	0.1772	57.6%	2191	1,494	68.2%
55-64	Female	2046	4120	201.4%	0.4614	0.4909	0.8698	0.4270	92.5%	944	1,759	186.4%
64-74	Female	1578	3050	193.3%	1.7300	0.9948	0.9531	0.9482	54.8%	2730	2,892	105.9%
75-79	Female	642	980	152.6%	4.2165	3.5473	1.0897	3.8655	91.7%	2707	3,788	139.9%
80-84	Female	438	740	168.9%	7.0274	3.8990	0.9968	3.8864	55.3%	3078	2,876	93.4%
85+	Female	441	710	161.0%	8.6304	7.8672	0.8985	7.0690	81.9%	3806	5,019	131.9%
All Ages	Female	25,941	34,315	132.3%						20,013	20,688	103.4%
Total	Male + Female	52,713	68,930	130.8%						34,217	37,713	110.2%
SURGICAL												
0-14	Male	6631	7425	112.0%	0.0446	0.0249	0.8193	0.0204	45.6%	296	151	51.1%
15-34	Male	7906	9485	120.0%	0.0557	0.0360	0.8042	0.0290	52.1%	440	275	62.5%
35-44	Male	4287	5085	118.6%	0.0534	0.0489	0.7802	0.0382	71.4%	229	194	84.7%
45-54	Male	3178	3885	122.2%	0.1293	0.0838	1.0070	0.0844	65.2%	411	328	79.8%
55-64	Male	2125	4210	198.1%	0.2682	0.1958	0.7959	0.1558	58.1%	570	656	115.1%
65-74	Male	1564	2825	180.6%	0.5358	0.3651	0.9415	0.3437	64.1%	838	971	115.9%
75-84	Male	848	1325	156.3%	0.9033	0.6200	0.8738	0.5418	60.0%	766	718	93.7%
85+	Male	233	375	160.9%	0.5880	0.7350	1.1485	0.8442	143.6%	137	317	231.1%
All Ages	Male	26,772	34,615	129.3%						3,687	3,609	97.9%
0-14	Female	6343	7020	110.7%	0.0194	0.0160	0.6534	0.0104	53.8%	123	73	59.5%
15-24	Female	3812	4205	110.3%	0.0420	0.0216	0.8499	0.0184	43.8%	160	77	48.4%
25-34	Female	3514	5060	144.0%	0.1224	0.0389	0.8376	0.0326	26.6%	430	165	38.4%
35-44	Female	4115	4705	114.3%	0.0707	0.0625	0.9996	0.0625	88.4%	291	294	101.1%
45-54	Female	3012	3725	123.7%	0.1839	0.1032	0.8762	0.0904	49.1%	554	337	60.8%
55-64	Female	2046	4120	201.4%	0.2278	0.1739	0.7762	0.1350	59.3%	466	556	119.4%
65-74	Female	1578	3050	193.3%	0.4734	0.2739	0.8554	0.2343	49.5%	747	715	95.7%
75-84	Female	1080	1720	159.3%	0.5296	0.4866	0.8636	0.4202	79.3%	572	723	126.4%
85+	Female	441	710	161.0%	1.6054	0.6858	0.7128	0.4888	30.4%	708	347	49.0%
All Ages	Female	25,941	34,315	132.3%						4,051	3,287	81.1%
Total	Male + Female	52,713	68,930	130.8%						7,738	6,896	89.1%

Appendix A3: North Eastman Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	4581	5125	111.9%	0.3517	0.2002	1.0073	0.2017	57.3%	1611	1,034	64.2%
15-24	Male	2800	2890	103.2%	0.1564	0.0606	1.1120	0.0673	43.0%	438	195	44.4%
25-34	Male	5490	6525	118.9%	0.1515	0.1627	0.8500	0.1383	91.2%	832	902	108.4%
35-54	Male	2643	2350	88.9%	0.3507	0.1834	0.8448	0.1549	44.2%	927	364	39.3%
55-64	Male	1974	2970	150.5%	0.9154	0.4428	0.8975	0.3974	43.4%	1807	1,180	65.3%
65-74	Male	1454	2200	151.3%	2.2111	1.4874	0.8289	1.2330	55.8%	3215	2,713	84.4%
75-79	Male	429	690	160.8%	4.3054	3.4621	0.8895	3.0797	71.5%	1847	2,125	115.0%
80-84	Male	241	435	180.5%	7.4398	4.7226	1.0319	4.8731	65.5%	1793	2,120	118.2%
85+	Male	198	325	164.1%	9.4697	9.1113	0.9400	8.5647	90.4%	1875	2,784	148.5%
All Ages	Male	19,810	23,510	118.7%						14,345	13,416	93.5%
0-14	Female	4400	4850	110.2%	0.3348	0.1783	0.8867	0.1581	47.2%	1473	767	52.0%
15-24	Female	2543	2795	109.9%	0.5250	0.2193	1.0876	0.2386	45.4%	1335	667	49.9%
25-34	Female	2329	3385	145.3%	0.6123	0.3260	0.9867	0.3217	52.5%	1426	1,089	76.4%
35-54	Female	5503	5340	97.0%	0.3842	0.2276	1.1053	0.2516	65.5%	2114	1,344	63.6%
55-64	Female	1864	2920	156.7%	0.8664	0.4909	0.9623	0.4724	54.5%	1615	1,379	85.4%
64-74	Female	1256	2335	185.9%	1.2723	0.9948	0.9743	0.9692	76.2%	1598	2,263	141.6%
75-79	Female	474	800	168.8%	5.5169	3.5473	0.9539	3.3837	61.3%	2615	2,707	103.5%
80-84	Female	319	555	174.0%	9.7806	3.8990	0.9944	3.8771	39.6%	3120	2,152	69.0%
85+	Female	259	535	206.6%	8.5483	7.8672	0.7952	6.2557	73.2%	2214	3,347	151.2%
All Ages	Female	18,947	23,515	124.1%						17,510	15,714	89.7%
Total	Male + Female	38,757	47,025	121.3%						31,855	29,129	91.4%
SURGICAL												
0-14	Male	4581	5125	111.9%	0.0231	0.0249	0.9997	0.0249	107.5%	106	127	120.2%
15-34	Male	5053	6275	124.2%	0.0902	0.0360	1.0928	0.0394	43.6%	456	247	54.2%
35-44	Male	3237	3140	97.0%	0.0905	0.0489	0.9362	0.0458	50.6%	293	144	49.1%
45-54	Male	2643	2350	88.9%	0.2104	0.0838	1.1851	0.0993	47.2%	556	233	42.0%
55-64	Male	1974	2970	150.5%	0.3516	0.1958	1.1602	0.2272	64.6%	694	675	97.2%
65-74	Male	1454	2200	151.3%	0.6527	0.3651	1.0028	0.3661	56.1%	949	805	84.9%
75-84	Male	670	1125	167.9%	2.0194	0.6200	1.0519	0.6522	32.3%	1353	734	54.2%
85+	Male	198	325	164.1%	1.8838	0.7350	1.0838	0.7967	42.3%	373	259	69.4%
All Ages	Male	19,810	23,510	118.7%						4,780	3,224	67.5%
0-14	Female	4400	4850	110.2%	0.0195	0.0160	1.1590	0.0185	94.6%	86	90	104.3%
15-24	Female	2543	2795	109.9%	0.0338	0.0216	1.2133	0.0263	77.7%	86	73	85.4%
25-34	Female	2329	3385	145.3%	0.0953	0.0389	1.0569	0.0411	43.1%	222	139	62.7%
35-44	Female	3023	3055	101.1%	0.0986	0.0625	1.2325	0.0771	78.2%	298	235	79.0%
45-54	Female	2480	2285	92.1%	0.2980	0.1032	1.1837	0.1221	41.0%	739	279	37.8%
55-64	Female	1864	2920	156.7%	0.2114	0.1739	0.8996	0.1565	74.0%	394	457	115.9%
65-74	Female	1256	2335	185.9%	0.5135	0.2739	1.0214	0.2798	54.5%	645	653	101.3%
75-84	Female	793	1355	170.9%	0.8689	0.4866	0.9325	0.4538	52.2%	689	615	89.2%
85+	Female	259	535	206.6%	0.5290	0.6858	0.7250	0.4972	94.0%	137	266	194.2%
All Ages	Female	18,947	23,515	124.1%						3,296	2,808	85.2%
Total	Male + Female	38,757	47,025	121.3%						8,076	6,032	74.7%

Appendix A4: Interlake Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	8296	8245	99.4%	0.3196	0.2002	0.6821	0.1366	42.7%	2651	1,126	42.5%
15-24	Male	5191	5115	98.5%	0.0755	0.0606	0.8931	0.0541	71.6%	392	277	70.6%
25-34	Male	10490	12375	118.0%	0.2174	0.1627	1.0486	0.1706	78.4%	2281	2,111	92.5%
35-54	Male	5182	4740	91.5%	0.3003	0.1834	0.8500	0.1559	51.9%	1556	739	47.5%
55-64	Male	3718	5660	152.2%	0.6313	0.4428	0.9005	0.3987	63.2%	2347	2,257	96.2%
65-74	Male	2930	4340	148.1%	1.9560	1.4874	0.9092	1.3524	69.1%	5731	5,869	102.4%
75-79	Male	894	1330	148.8%	4.3110	3.4621	0.9155	3.1695	73.5%	3854	4,215	109.4%
80-84	Male	643	800	124.4%	7.5117	4.7226	0.8480	4.0049	53.3%	4830	3,204	66.3%
85+	Male	387	655	169.3%	10.7674	9.1113	0.7644	6.9651	64.7%	4167	4,562	109.5%
All Ages	Male	37,731	43,260	114.7%						27,809	24,360	87.6%
0-14	Female	7662	7825	102.1%	0.2622	0.1783	0.7258	0.1294	49.3%	2009	1,012	50.4%
15-24	Female	4720	4965	105.2%	0.3434	0.2193	0.7545	0.1655	48.2%	1621	822	50.7%
25-34	Female	4516	6145	136.1%	0.5753	0.3260	0.8227	0.2682	46.6%	2598	1,648	63.4%
35-54	Female	10852	10390	95.7%	0.2715	0.2276	0.7600	0.1730	63.7%	2946	1,797	61.0%
55-64	Female	3603	5800	161.0%	0.6972	0.4909	0.8259	0.4054	58.2%	2512	2,352	93.6%
64-74	Female	2802	4555	162.6%	1.7427	0.9948	0.8998	0.8951	51.4%	4883	4,077	83.5%
75-79	Female	1149	1550	134.9%	3.8120	3.5473	0.8174	2.8997	76.1%	4380	4,494	102.6%
80-84	Female	780	1145	146.8%	4.5282	3.8990	0.7870	3.0684	67.8%	3532	3,513	99.5%
85+	Female	667	1165	174.7%	8.3643	7.8672	0.6740	5.3027	63.4%	5579	6,178	110.7%
All Ages	Female	36,751	43,540	118.5%						30,060	25,894	86.1%
Total	Male + Female	74,482	86,800	116.5%						57,869	50,254	86.8%
SURGICAL												
0-14	Male	8296	8245	99.4%	0.0650	0.0249	0.8701	0.0216	33.3%	539	178	33.1%
15-34	Male	9718	11470	118.0%	0.0542	0.0360	1.0908	0.0393	72.5%	527	451	85.5%
35-44	Male	5963	6020	101.0%	0.0626	0.0489	0.9133	0.0447	71.4%	373	269	72.1%
45-54	Male	5182	4740	91.5%	0.1802	0.0838	0.9927	0.0832	46.2%	934	394	42.2%
55-64	Male	3718	5660	152.2%	0.3163	0.1958	1.0505	0.2057	65.0%	1176	1,164	99.0%
65-74	Male	2930	4340	148.1%	0.8055	0.3651	1.0784	0.3937	48.9%	2360	1,709	72.4%
75-84	Male	1537	2130	138.6%	0.9694	0.6200	0.9648	0.5982	61.7%	1490	1,274	85.5%
85+	Male	387	655	169.3%	0.8114	0.7350	0.7982	0.5867	72.3%	314	384	122.4%
All Ages	Male	37,731	43,260	114.7%						7,713	5,824	75.5%
0-14	Female	7662	7825	102.1%	0.0235	0.0160	0.7834	0.0125	53.2%	180	98	54.4%
15-24	Female	4720	4965	105.2%	0.0233	0.0216	0.9464	0.0205	87.9%	110	102	92.5%
25-34	Female	4516	6145	136.1%	0.0463	0.0389	0.9449	0.0368	79.5%	209	226	108.1%
35-44	Female	5971	5735	96.0%	0.1067	0.0625	0.8549	0.0535	50.1%	637	307	48.1%
45-54	Female	4881	4655	95.4%	0.1541	0.1032	0.9056	0.0934	60.6%	752	435	57.8%
55-64	Female	3603	5800	161.0%	0.3089	0.1739	0.9575	0.1665	53.9%	1113	966	86.8%
65-74	Female	2802	4555	162.6%	0.5385	0.2739	0.9990	0.2737	50.8%	1509	1,247	82.6%
75-84	Female	1929	2695	139.7%	0.9476	0.4866	0.8778	0.4271	45.1%	1828	1,151	63.0%
85+	Female	667	1165	174.7%	0.6852	0.6858	0.8335	0.5716	83.4%	457	666	145.7%
All Ages	Female	36,751	43,540	118.5%						6,795	5,196	76.5%
Total	Male + Female	74,482	86,800	116.5%						14,508	11,020	76.0%

Appendix A5: Central Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	12224	12235	100.1%	0.4175	0.2002	0.9012	0.1804	43.2%	5104	2,208	43.3%
15-24	Male	7541	7095	94.1%	0.0984	0.0606	0.7598	0.0460	46.8%	742	326	44.0%
25-34	Male	13519	15285	113.1%	0.1646	0.1627	0.8777	0.1428	86.7%	2225	2,182	98.1%
35-54	Male	5707	5680	99.5%	0.2951	0.1834	0.9307	0.1707	57.8%	1684	970	57.6%
55-64	Male	3812	6555	172.0%	0.7804	0.4428	0.9281	0.4109	52.7%	2975	2,694	90.5%
65-74	Male	3110	4660	149.8%	1.8405	1.4874	0.9012	1.3405	72.8%	5724	6,247	109.1%
75-79	Male	1238	1335	107.8%	5.4895	3.4621	1.0009	3.4651	63.1%	6796	4,626	68.1%
80-84	Male	830	800	96.4%	10.0976	4.7226	0.9726	4.5933	45.5%	8381	3,675	43.8%
85+	Male	632	645	102.1%	15.2785	9.1113	0.9894	9.0147	59.0%	9656	5,815	60.2%
All Ages	Male	48,613	54,290	111.7%						43,287	28,741	66.4%
0-14	Female	11466	11565	100.9%	0.3332	0.1783	0.8696	0.1550	46.5%	3821	1,793	46.9%
15-24	Female	7037	6760	96.1%	0.3393	0.2193	0.8523	0.1869	55.1%	2388	1,264	52.9%
25-34	Female	5971	7555	126.5%	0.6644	0.3260	1.0277	0.3350	50.4%	3967	2,531	63.8%
35-54	Female	12583	12755	101.4%	0.3321	0.2276	0.8875	0.2020	60.8%	4179	2,577	61.7%
55-64	Female	3853	6660	172.9%	0.7623	0.4909	0.8338	0.4093	53.7%	2937	2,726	92.8%
64-74	Female	3506	4855	138.5%	1.6554	0.9948	0.8528	0.8484	51.2%	5804	4,119	71.0%
75-79	Female	1673	1610	96.2%	3.9450	3.5473	0.8695	3.0842	78.2%	6600	4,966	75.2%
80-84	Female	1210	1140	94.2%	7.5893	3.8990	0.9442	3.6815	48.5%	9183	4,197	45.7%
85+	Female	1138	1295	113.8%	12.2109	7.8672	0.9988	7.8581	64.4%	13896	10,176	73.2%
All Ages	Female	48,437	54,195	111.9%						52,775	34,348	65.1%
Total	Male + Female	97,050	108,485	111.8%						96,062	63,089	65.7%
SURGICAL												
0-14	Male	12224	12235	100.1%	0.0351	0.0249	0.8619	0.0214	61.1%	429	262	61.1%
15-34	Male	13640	14950	109.6%	0.0594	0.0360	0.9805	0.0353	59.5%	810	528	65.2%
35-44	Male	7420	7430	100.1%	0.0899	0.0489	0.9725	0.0476	52.9%	667	353	53.0%
45-54	Male	5707	5680	99.5%	0.1216	0.0838	0.9077	0.0761	62.6%	694	432	62.3%
55-64	Male	3812	6555	172.0%	0.4155	0.1958	0.9441	0.1848	44.5%	1584	1,212	76.5%
65-74	Male	3110	4660	149.8%	0.7383	0.3651	0.9995	0.3649	49.4%	2296	1,700	74.1%
75-84	Male	2068	2135	103.2%	1.2331	0.6200	1.0328	0.6404	51.9%	2550	1,367	53.6%
85+	Male	632	645	102.1%	1.2927	0.7350	1.0359	0.7614	58.9%	817	491	60.1%
All Ages	Male	48,613	54,290	111.7%						9,847	6,346	64.4%
0-14	Female	11466	11565	100.9%	0.0564	0.0160	0.9117	0.0145	25.8%	647	168	26.0%
15-24	Female	7037	6760	96.1%	0.0436	0.0216	0.9190	0.0199	45.6%	307	134	43.8%
25-34	Female	5971	7555	126.5%	0.0521	0.0389	1.0095	0.0393	75.4%	311	297	95.4%
35-44	Female	7248	7180	99.1%	0.1141	0.0625	0.9537	0.0596	52.3%	827	428	51.8%
45-54	Female	5335	5575	104.5%	0.1513	0.1032	0.9503	0.0980	64.8%	807	547	67.7%
55-64	Female	3853	6660	172.9%	0.2790	0.1739	0.9539	0.1659	59.5%	1075	1,105	102.8%
65-74	Female	3506	4855	138.5%	0.5525	0.2739	0.9731	0.2666	48.2%	1937	1,294	66.8%
75-84	Female	2883	2750	95.4%	0.9011	0.4866	1.1146	0.5424	60.2%	2598	1,491	57.4%
85+	Female	1138	1295	113.8%	1.5641	0.6858	1.4690	1.0074	64.4%	1780	1,305	73.3%
All Ages	Female	48,437	54,195	111.9%						10,289	6,769	65.8%
Total	Male + Female	97,050	108,485	111.8%						20,136	13,115	65.1%

Appendix A6: Nor-Man Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	3492	3470	99.4%	0.5072	0.2002	1.4088	0.2821	55.6%	1771	979	55.3%
15-24	Male	2032	2045	100.6%	0.1373	0.0606	1.4303	0.0866	63.1%	279	177	63.5%
25-34	Male	3977	3575	89.9%	0.3176	0.1627	1.3369	0.2174	68.5%	1263	777	61.5%
35-54	Male	1628	1465	90.0%	0.4416	0.1834	1.5834	0.2904	65.8%	719	425	59.2%
55-64	Male	904	1850	204.6%	0.8296	0.4428	1.4993	0.6638	80.0%	750	1,228	163.7%
65-74	Male	564	1280	227.0%	4.1543	1.4874	1.5332	2.2805	54.9%	2343	2,919	124.6%
75-79	Male	160	305	190.6%	5.4875	3.4621	1.8412	6.3745	116.2%	878	1,944	221.4%
80-84	Male	86	185	215.1%	16.0581	4.7226	1.7858	8.4337	52.5%	1381	1,560	113.0%
85+	Male	73	115	157.5%	22.9863	9.1113	2.0118	18.3304	79.7%	1678	2,108	125.6%
All Ages	Male	12,916	14,290	110.6%						11,062	12,118	109.5%
0-14	Female	3380	3290	97.3%	0.4716	0.1783	1.3618	0.2428	51.5%	1594	799	50.1%
15-24	Female	1964	1970	100.3%	0.7561	0.2193	1.5220	0.3338	44.2%	1485	658	44.3%
25-34	Female	1777	1925	108.3%	0.7991	0.3260	1.1331	0.3694	46.2%	1420	711	50.1%
35-54	Female	3432	3100	90.3%	0.4776	0.2276	1.2662	0.2882	60.4%	1639	893	54.5%
55-64	Female	827	1760	212.8%	1.3374	0.4909	2.1482	1.0545	78.9%	1106	1,856	167.8%
64-74	Female	534	1205	225.7%	3.8502	0.9948	1.4460	1.4385	37.4%	2056	1,733	84.3%
75-79	Female	216	315	145.8%	7.3287	3.5473	1.8053	6.4039	87.4%	1583	2,017	127.4%
80-84	Female	159	195	122.6%	6.3208	3.8990	1.5620	6.0904	96.4%	1005	1,188	118.2%
85+	Female	142	130	91.5%	11.2465	7.8672	1.4470	11.3842	101.2%	1597	1,480	92.7%
All Ages	Female	12,431	13,890	111.7%						13,485	11,335	84.1%
Total	Male + Female	25,347	28,180	111.2%						24,547	23,453	95.5%
SURGICAL												
0-14	Male	3492	3470	99.4%	0.0367	0.0249	1.2072	0.0300	81.9%	128	104	81.4%
15-34	Male	3846	4000	104.0%	0.0991	0.0360	1.2865	0.0464	46.8%	381	185	48.7%
35-44	Male	2163	1620	74.9%	0.1909	0.0489	1.4733	0.0721	37.7%	413	117	28.3%
45-54	Male	1628	1465	90.0%	0.3636	0.0838	1.4164	0.1187	32.6%	592	174	29.4%
55-64	Male	904	1850	204.6%	0.4591	0.1958	1.3506	0.2644	57.6%	415	489	117.9%
65-74	Male	564	1280	227.0%	0.8245	0.3651	1.1757	0.4292	52.1%	465	549	118.2%
75-84	Male	246	490	199.2%	1.0122	0.6200	1.4718	0.9126	90.2%	249	447	179.6%
85+	Male	73	115	157.5%	0.6849	0.7350	1.3564	0.9970	145.6%	50	115	229.3%
All Ages	Male	12,916	14,290	110.6%						2,693	2,181	81.0%
0-14	Female	3380	3290	97.3%	0.0568	0.0160	1.1790	0.0188	33.1%	192	62	32.2%
15-24	Female	1964	1970	100.3%	0.0555	0.0216	1.5133	0.0328	59.0%	109	65	59.2%
25-34	Female	1777	1925	108.3%	0.0861	0.0389	1.3097	0.0510	59.2%	153	98	64.1%
35-44	Female	2008	1595	79.4%	0.1693	0.0625	1.4713	0.0920	54.3%	340	147	43.2%
45-54	Female	1424	1505	105.7%	0.3118	0.1032	1.3017	0.1343	43.1%	444	202	45.5%
55-64	Female	827	1760	212.8%	0.4776	0.1739	1.4464	0.2515	52.7%	395	443	112.1%
65-74	Female	534	1205	225.7%	0.4944	0.2739	1.1074	0.3034	61.4%	264	366	138.5%
75-84	Female	375	510	136.0%	0.4773	0.4866	1.1315	0.5506	115.3%	179	281	156.9%
85+	Female	142	130	91.5%	0.4859	0.6858	0.6803	0.4665	96.0%	69	61	87.9%
All Ages	Female	12,431	13,890	111.7%						2,145	1,723	80.3%
Total	Male + Female	25,347	28,180	111.2%						4,838	3,904	80.7%

Appendix A7: Brandon Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	4975	4180	84.0%	0.3413	0.2002	0.8790	0.1760	51.6%	1698	736	43.3%
15-24	Male	3294	2975	90.3%	0.0753	0.0606	0.7709	0.0467	62.0%	248	139	56.0%
25-34	Male	6493	7035	108.3%	0.1038	0.1627	0.6974	0.1134	109.3%	674	798	118.4%
35-54	Male	2877	3105	107.9%	0.2631	0.1834	1.0572	0.1939	73.7%	757	602	79.5%
55-64	Male	1900	3255	171.3%	0.6247	0.4428	0.9197	0.4072	65.2%	1187	1,326	111.7%
65-74	Male	1544	2460	159.3%	2.0389	1.4874	0.9846	1.4645	71.8%	3148	3,603	114.4%
75-79	Male	592	695	117.4%	3.6875	3.4621	0.8259	2.8593	77.5%	2183	1,987	91.0%
80-84	Male	358	450	125.7%	6.6089	4.7226	0.9865	4.6590	70.5%	2366	2,097	88.6%
85+	Male	257	330	128.4%	14.3035	9.1113	1.0933	9.9612	69.6%	3676	3,287	89.4%
All Ages	Male	22,290	24,485	109.8%						15,937	14,574	91.4%
0-14	Female	4905	3900	79.5%	0.2618	0.1783	0.8719	0.1554	59.4%	1284	606	47.2%
15-24	Female	3331	2860	85.9%	0.2381	0.2193	0.6585	0.1444	60.7%	793	413	52.1%
25-34	Female	3444	3605	104.7%	0.4550	0.3260	0.7662	0.2498	54.9%	1567	901	57.5%
35-54	Female	6940	7005	100.9%	0.2553	0.2276	0.8887	0.2023	79.2%	1772	1,417	80.0%
55-64	Female	2015	3715	184.4%	0.7171	0.4909	0.7943	0.3899	54.4%	1445	1,449	100.3%
64-74	Female	1819	2820	155.0%	1.7367	0.9948	1.0929	1.0871	62.6%	3159	3,066	97.0%
75-79	Female	850	860	101.2%	4.9894	3.5473	1.0612	3.7645	75.4%	4241	3,237	76.3%
80-84	Female	643	620	96.4%	8.1275	3.8990	1.1034	4.3021	52.9%	5226	2,667	51.0%
85+	Female	580	675	116.4%	13.7569	7.8672	1.0676	8.3989	61.1%	7979	5,669	71.1%
All Ages	Female	24,527	26,060	106.3%						27,466	19,425	70.7%
Total	Male + Female	46,817	50,545	108.0%						43,403	33,999	78.3%
SURGICAL												
0-14	Male	4975	4180	84.0%	0.0247	0.0249	0.6074	0.0151	61.1%	123	63	51.3%
15-34	Male	6317	6535	103.5%	0.0298	0.0360	0.6835	0.0246	82.7%	188	161	85.6%
35-44	Male	3470	3475	100.1%	0.0859	0.0489	0.9193	0.0450	52.4%	298	156	52.4%
45-54	Male	2877	3105	107.9%	0.1237	0.0838	0.7609	0.0638	51.5%	356	198	55.6%
55-64	Male	1900	3255	171.3%	0.3484	0.1958	0.9259	0.1813	52.0%	662	590	89.1%
65-74	Male	1544	2460	159.3%	0.8718	0.3651	1.3186	0.4814	55.2%	1346	1,184	88.0%
75-84	Male	950	1145	120.5%	2.1547	0.6200	1.5530	0.9629	44.7%	2047	1,103	53.9%
85+	Male	257	330	128.4%	1.7510	0.7350	2.2129	1.6265	92.9%	450	537	119.3%
All Ages	Male	22,290	24,485	109.8%						5,470	3,992	73.0%
0-14	Female	4905	3900	79.5%	0.0183	0.0160	0.6766	0.0108	58.8%	90	42	46.8%
15-24	Female	3331	2860	85.9%	0.0252	0.0216	0.8000	0.0173	68.7%	84	50	59.0%
25-34	Female	3444	3605	104.7%	0.0589	0.0389	0.6657	0.0259	44.0%	203	93	46.0%
35-44	Female	3890	3570	91.8%	0.0974	0.0625	0.8141	0.0509	52.2%	379	182	48.0%
45-54	Female	3050	3435	112.6%	0.1682	0.1032	0.9045	0.0933	55.5%	513	320	62.5%
55-64	Female	2015	3715	184.4%	0.4888	0.1739	1.1891	0.2068	42.3%	985	768	78.0%
65-74	Female	1819	2820	155.0%	0.6273	0.2739	1.2448	0.3410	54.4%	1141	962	84.3%
75-84	Female	1493	1480	99.1%	1.2981	0.4866	1.6722	0.8137	62.7%	1938	1,204	62.1%
85+	Female	580	675	116.4%	5.1638	0.6858	1.9747	1.3542	26.2%	2995	914	30.5%
All Ages	Female	24,527	26,060	106.3%						8,328	4,536	54.5%
Total	Male + Female	46,817	50,545	108.0%						13,798	8,527	61.8%

Appendix A8: South Westman Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	3630	3915	107.9%	0.2782	0.2002	0.7961	0.1594	57.3%	1,010	624	61.8%
15-24	Male	2422	2150	88.8%	0.1218	0.0606	0.9268	0.0561	46.1%	295	121	40.9%
25-34	Male	4320	5050	116.9%	0.2331	0.1627	0.9210	0.1498	64.3%	1,007	756	75.1%
35-54	Male	2144	1815	84.7%	0.2929	0.1834	1.0178	0.1867	63.7%	628	339	54.0%
55-64	Male	1647	2155	130.8%	0.6770	0.4428	0.8823	0.3907	57.7%	1,115	842	75.5%
65-74	Male	1582	1795	113.5%	1.9949	1.4874	0.9188	1.3667	68.5%	3,156	2,453	77.7%
75-79	Male	633	530	83.7%	3.5671	3.4621	0.9529	3.2992	92.5%	2,258	1,749	77.4%
80-84	Male	451	355	78.7%	7.6053	4.7226	0.9625	4.5455	59.8%	3,430	1,614	47.0%
85+	Male	387	315	81.4%	13.5323	9.1113	0.9164	8.3498	61.7%	5,237	2,630	50.2%
All Ages	Male	17,216	18,080	105.0%						18,136	11,128	61.4%
0-14	Female	3426	3675	107.3%	0.2303	0.1783	0.7549	0.1346	58.4%	789	495	62.7%
15-24	Female	2258	2050	90.8%	0.3074	0.2193	0.6893	0.1512	49.2%	694	310	44.7%
25-34	Female	1790	2470	138.0%	0.6682	0.3260	1.0783	0.3515	52.6%	1,196	868	72.6%
35-54	Female	4477	4180	93.4%	0.3449	0.2276	1.1161	0.2540	73.7%	1,544	1,062	68.8%
55-64	Female	1701	2255	132.6%	0.8142	0.4909	0.8443	0.4145	50.9%	1,385	935	67.5%
64-74	Female	1688	1850	109.6%	1.5586	0.9948	1.0053	1.0000	64.2%	2,631	1,850	70.3%
75-79	Female	821	665	81.0%	3.8563	3.5473	1.0452	3.7075	96.1%	3,166	2,465	77.9%
80-84	Female	594	510	85.9%	7.0202	3.8990	0.9439	3.6804	52.4%	4,170	1,877	45.0%
85+	Female	703	640	91.0%	16.0683	7.8672	1.0615	8.3507	52.0%	11,296	5,344	47.3%
All Ages	Female	17,458	18,295	104.8%						26,871	15,206	56.6%
Total	Male + Female	34,674	36,375	104.9%						45,007	26,334	58.5%
SURGICAL												
0-14	Male	3630	3915	107.9%	0.0380	0.0249	0.7137	0.0178	46.7%	138	69	50.4%
15-34	Male	4254	4645	109.2%	0.0743	0.0360	0.7975	0.0287	38.7%	316	133	42.2%
35-44	Male	2488	2555	102.7%	0.0768	0.0489	0.7789	0.0381	49.6%	191	97	51.0%
45-54	Male	2144	1815	84.7%	0.1185	0.0838	0.7801	0.0654	55.2%	254	119	46.7%
55-64	Male	1647	2155	130.8%	0.2544	0.1958	0.7413	0.1451	57.1%	419	313	74.6%
65-74	Male	1582	1795	113.5%	0.4829	0.3651	0.8092	0.2954	61.2%	764	530	69.4%
75-84	Male	1084	885	81.6%	1.0941	0.6200	0.7834	0.4857	44.4%	1,186	430	36.2%
85+	Male	387	315	81.4%	1.0413	0.7350	0.5748	0.4225	40.6%	403	133	33.0%
All Ages	Male	17,216	18,080	105.0%						3,671	1,825	49.7%
0-14	Female	3426	3675	107.3%	0.0073	0.0160	0.9629	0.0154	210.6%	25	56	225.9%
15-24	Female	2258	2050	90.8%	0.0337	0.0216	0.6825	0.0148	43.9%	76	30	39.9%
25-34	Female	1790	2470	138.0%	0.0570	0.0389	0.7510	0.0292	51.3%	102	72	70.8%
35-44	Female	2451	2470	100.8%	0.1024	0.0625	0.7135	0.0446	43.6%	251	110	43.9%
45-54	Female	2026	1710	84.4%	0.1130	0.1032	0.8475	0.0874	77.3%	229	150	65.3%
55-64	Female	1701	2255	132.6%	0.4309	0.1739	0.8840	0.1537	35.7%	733	347	47.3%
65-74	Female	1688	1850	109.6%	0.3797	0.2739	0.8547	0.2341	61.7%	641	433	67.6%
75-84	Female	1415	1175	83.0%	0.6332	0.4866	0.7389	0.3596	56.8%	896	422	47.2%
85+	Female	703	640	91.0%	0.6572	0.6858	0.4838	0.3318	50.5%	462	212	46.0%
All Ages	Female	17,458	18,295	104.8%						3,415	1,833	53.7%
Total	Male + Female	34,674	36,375	104.9%						7,086	3,658	51.6%

Appendix A9: Marquette Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	3796	3825	100.8%	0.3504	0.2002	0.9057	0.1813	51.8%	1330	694	52.2%
15-24	Male	2703	2215	81.9%	0.0836	0.0606	0.9143	0.0554	66.2%	226	123	54.3%
25-34	Male	4889	5400	110.5%	0.2289	0.1627	1.3989	0.2275	99.4%	1119	1,229	109.8%
35-54	Male	2349	2020	86.0%	0.3487	0.1834	1.1898	0.2182	62.6%	819	441	53.8%
55-64	Male	1782	2485	139.5%	1.0730	0.4428	1.1336	0.5019	46.8%	1912	1,247	65.2%
65-74	Male	1754	1925	109.7%	2.2161	1.4874	1.0682	1.5888	71.7%	3887	3,059	78.7%
75-79	Male	664	585	88.1%	4.7771	3.4621	1.0227	3.5408	74.1%	3172	2,071	65.3%
80-84	Male	481	395	82.1%	8.6923	4.7226	0.9865	4.6590	53.6%	4181	1,840	44.0%
85+	Male	365	345	94.5%	15.4630	9.1113	0.9441	8.6019	55.6%	5644	2,968	52.6%
All Ages	Male	18,783	19,195	102.2%						22,290	13,671	61.3%
0-14	Female	3668	3605	98.3%	0.2966	0.1783	0.9781	0.1744	58.8%	1088	629	57.8%
15-24	Female	2448	2150	87.8%	0.2925	0.2193	0.8033	0.1762	60.2%	716	379	52.9%
25-34	Female	1963	2685	136.8%	0.6857	0.3260	1.0059	0.3279	47.8%	1346	881	65.4%
35-54	Female	4914	4595	93.5%	0.4554	0.2276	1.2143	0.2764	60.7%	2238	1,270	56.8%
55-64	Female	1805	2475	137.1%	0.6404	0.4909	1.0949	0.5375	83.9%	1156	1,330	115.1%
64-74	Female	1754	2090	119.2%	1.8221	0.9948	1.0231	1.0177	55.9%	3196	2,127	66.6%
75-79	Female	949	775	81.7%	3.5627	3.5473	0.9858	3.4970	98.2%	3381	2,710	80.2%
80-84	Female	715	625	87.4%	5.9077	3.8990	1.0170	3.9652	67.1%	4224	2,478	58.7%
85+	Female	692	745	107.7%	12.8642	7.8672	1.0305	8.1072	63.0%	8902	6,040	67.8%
All Ages	Female	18,908	19,745	104.4%						26,247	17,844	68.0%
Total	Male + Female	37,691	38,940	103.3%						48,537	31,514	64.9%
SURGICAL												
0-14	Male	3796	3825	100.8%	0.0227	0.0249	0.6429	0.0160	70.6%	86	61	71.1%
15-34	Male	4773	4810	100.8%	0.0394	0.0360	0.7998	0.0288	73.2%	188	139	73.7%
35-44	Male	2819	2805	99.5%	0.0862	0.0489	0.8979	0.0439	50.9%	243	123	50.7%
45-54	Male	2349	2020	86.0%	0.0954	0.0838	0.8441	0.0707	74.2%	224	143	63.8%
55-64	Male	1782	2485	139.5%	0.3451	0.1958	0.8798	0.1723	49.9%	615	428	69.6%
65-74	Male	1754	1925	109.7%	0.5901	0.3651	0.9241	0.3374	57.2%	1035	649	62.7%
75-84	Male	1145	980	85.6%	0.9284	0.6200	0.7904	0.4901	52.8%	1063	480	45.2%
85+	Male	365	345	94.5%	1.0192	0.7350	0.6514	0.4788	47.0%	372	165	44.4%
All Ages	Male	18,783	19,195	102.2%						3,826	2,189	57.2%
0-14	Female	3668	3605	98.3%	0.0305	0.0160	0.8194	0.0131	42.8%	112	47	42.1%
15-24	Female	2448	2150	87.8%	0.0437	0.0216	0.8787	0.0190	43.5%	107	41	38.2%
25-34	Female	1963	2685	136.8%	0.0642	0.0389	0.8688	0.0338	52.7%	126	91	72.0%
35-44	Female	2676	2650	99.0%	0.1409	0.0625	0.9632	0.0602	42.7%	377	160	42.3%
45-54	Female	2238	1945	86.9%	0.2046	0.1032	0.8440	0.0871	42.5%	458	169	37.0%
55-64	Female	1805	2475	137.1%	0.2260	0.1739	0.8427	0.1465	64.8%	408	363	88.9%
65-74	Female	1754	2090	119.2%	0.6072	0.2739	0.8740	0.2394	39.4%	1065	500	47.0%
75-84	Female	1664	1400	84.1%	0.7728	0.4866	0.7930	0.3859	49.9%	1286	540	42.0%
85+	Female	692	745	107.7%	0.5491	0.6858	0.5233	0.3589	65.4%	380	267	70.4%
All Ages	Female	18,908	19,745	104.4%						4,319	2,178	50.4%
Total	Male + Female	37,691	38,940	103.3%						8,145	4,367	53.6%

Appendix A10: Parkland Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	RHA-age-sex Regression (adjustment) Coefficient	2020 Estimated Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL												
0-14	Male	4710	4570	97.0%	0.6611	0.2002	1.8099	0.3624	54.8%	3114	1,656	53.2%
15-24	Male	3084	2715	88.0%	0.2461	0.0606	1.3133	0.0795	32.3%	759	216	28.4%
25-34	Male	5400	6255	115.8%	0.1909	0.1627	1.0979	0.1786	93.5%	1031	1,117	108.3%
35-54	Male	2714	2335	86.0%	0.3876	0.1834	1.0745	0.1971	50.8%	1052	460	43.7%
55-64	Male	2085	2655	127.3%	0.6043	0.4428	1.2032	0.5327	88.2%	1260	1,414	112.3%
65-74	Male	1960	2150	109.7%	2.7913	1.4874	1.1971	1.7806	63.8%	5471	3,828	70.0%
75-79	Male	809	685	84.7%	5.1298	3.4621	1.0781	3.7323	72.8%	4150	2,557	61.6%
80-84	Male	548	450	82.1%	7.5073	4.7226	1.0478	4.9482	65.9%	4114	2,227	54.1%
85+	Male	413	390	94.4%	15.1840	9.1113	1.1790	10.7419	70.7%	6271	4,189	66.8%
All Ages	Male	21,723	22,205	102.2%						27,222	17,665	64.9%
0-14	Female	4331	4325	99.9%	0.5745	0.1783	1.7784	0.3170	55.2%	2488	1,371	55.1%
15-24	Female	2913	2620	89.9%	0.4796	0.2193	1.2048	0.2643	55.1%	1397	692	49.6%
25-34	Female	2357	2985	126.6%	0.7348	0.3260	1.1056	0.3605	49.1%	1732	1,076	62.1%
35-54	Female	5491	5245	95.5%	0.3910	0.2276	1.1657	0.2653	67.9%	2147	1,392	64.8%
55-64	Female	2018	2640	130.8%	0.8865	0.4909	1.2523	0.6148	69.3%	1789	1,623	90.7%
64-74	Female	2029	2310	113.8%	1.9162	0.9948	1.0642	1.0587	55.2%	3888	2,446	62.9%
75-79	Female	984	835	84.9%	4.5874	3.5473	1.0635	3.7725	82.2%	4514	3,150	69.8%
80-84	Female	763	575	75.4%	5.2831	3.8990	1.1004	4.2905	81.2%	4031	2,467	61.2%
85+	Female	767	760	99.1%	11.6623	7.8672	1.1878	9.3449	80.1%	8945	7,102	79.4%
All Ages	Female	21,653	22,295	103.0%						30,931	21,319	68.9%
Total	Male + Female	43,376	44,500	102.6%						58,153	38,984	67.0%
SURGICAL												
0-14	Male	4710	4570	97.0%	0.0660	0.0249	1.2538	0.0312	47.2%	311	143	45.8%
15-34	Male	5533	5895	106.5%	0.0540	0.0360	0.9255	0.0333	61.7%	299	197	65.7%
35-44	Male	2951	3075	104.2%	0.0756	0.0489	0.8692	0.0425	56.3%	223	131	58.6%
45-54	Male	2714	2335	86.0%	0.1743	0.0838	0.8650	0.0725	41.6%	473	169	35.8%
55-64	Male	2085	2655	127.3%	0.2892	0.1958	1.0397	0.2036	70.4%	603	540	89.6%
65-74	Male	1960	2150	109.7%	0.6255	0.3651	0.8525	0.3112	49.8%	1226	669	54.6%
75-84	Male	1357	1135	83.6%	0.9985	0.6200	0.8731	0.5413	54.2%	1355	614	45.3%
85+	Male	413	390	94.4%	0.9128	0.7350	0.9266	0.6811	74.6%	377	266	70.5%
All Ages	Male	21,723	22,205	102.2%						4,867	2,729	56.1%
0-14	Female	4331	4325	99.9%	0.0473	0.0160	1.1003	0.0176	37.1%	205	76	37.0%
15-24	Female	2913	2620	89.9%	0.0330	0.0216	0.8818	0.0191	57.9%	96	50	52.1%
25-34	Female	2357	2985	126.6%	0.0764	0.0389	1.0283	0.0400	52.4%	180	119	66.4%
35-44	Female	2885	3010	104.3%	0.1050	0.0625	0.8710	0.0545	51.9%	303	164	54.1%
45-54	Female	2606	2235	85.8%	0.1857	0.1032	0.8693	0.0897	48.3%	484	200	41.4%
55-64	Female	2018	2640	130.8%	0.2582	0.1739	0.8743	0.1520	58.9%	521	401	77.0%
65-74	Female	2029	2310	113.8%	0.5007	0.2739	0.9492	0.2600	51.9%	1016	601	59.1%
75-84	Female	1747	1410	80.7%	1.0063	0.4866	0.9017	0.4388	43.6%	1758	619	35.2%
85+	Female	767	760	99.1%	1.3168	0.6858	0.8726	0.5984	45.4%	1010	455	45.0%
All Ages	Female	21,653	22,295	103.0%						5,573	2,685	48.2%
Total	Male + Female	43,376	44,500	102.6%						10,440	5,414	51.9%

Appendix A11: Winnipeg Residents: Estimated Non-Surgical and Surgical Inpatient Days in 2020: Trend Analysis Model

Age Group	Gender	1998 Population	2020 Population	2020 Population as a % of 1998 Population	1998 Observed Days per Resident	2020 Estimated Non-Winnipeg Days per Resident	2020 Days per Resident as a % of 1998 Days per Resident	1998 Observed Inpatient Days	2020 Estimated Inpatient Days	2020 Inpatient Days as a % of 1998 Inpatient Days
NON-SURGICAL										
0-14	Male	64868	47885	73.8%	0.3188	0.1639	51.4%	20680	7847	37.9%
15-24	Male	42017	35965	85.6%	0.1593	0.1006	63.1%	6695	3616	54.0%
25-34	Male	102520	76915	75.0%	0.2092	0.1598	76.4%	21444	12290	57.3%
35-54	Male	42791	41935	98.0%	0.2975	0.1621	54.5%	12731	6798	53.4%
55-64	Male	26236	47895	182.6%	0.5540	0.2884	52.0%	14536	13811	95.0%
65-74	Male	20562	34765	169.1%	1.4276	0.7646	53.6%	29355	26581	90.6%
75-79	Male	7557	9405	124.5%	3.1162	2.1724	69.7%	23549	20432	86.8%
80-84	Male	4494	5330	118.6%	5.5056	3.4874	63.3%	24742	18588	75.1%
85+	Male	3095	4270	138.0%	9.4320	9.3701	99.3%	29192	40010	137.1%
All Ages	Male	314,140	304,365	96.9%				182,924	149,973	82.0%
0-14	Female	61795	44635	72.2%	0.3077	0.1533	49.8%	19014	6842	36.0%
15-24	Female	41782	34215	81.9%	0.3399	0.1799	52.9%	14201	6154	43.3%
25-34	Female	48028	40195	83.7%	0.5272	0.2634	50.0%	25318	10586	41.8%
35-54	Female	99437	81990	82.5%	0.3472	0.2715	78.2%	34520	22263	64.5%
55-64	Female	27857	49610	178.1%	0.5615	0.5002	89.1%	15642	24815	158.6%
64-74	Female	25764	40400	156.8%	1.2833	0.7368	57.4%	33064	29767	90.0%
75-79	Female	11771	11950	101.5%	2.7318	1.7447	63.9%	32156	20850	64.8%
80-84	Female	8386	8080	96.4%	4.8866	3.8023	77.8%	40979	30722	75.0%
85+	Female	7957	9425	118.4%	8.9139	11.4808	128.8%	70928	108206	152.6%
All Ages	Female	332,777	320,500	96.3%				285,822	260,204	91.0%
Total	Male + Female	646,917	624,865	96.6%				468,746	410,177	87.5%
SURGICAL										
0-14	Male	64868	47885	73.8%	0.0284	0.0166	58.5%	1844	796	43.1%
15-34	Male	89904	75615	84.1%	0.0546	0.0304	55.7%	4909	2302	46.9%
35-44	Male	54633	37265	68.2%	0.0737	0.0436	59.1%	4024	1623	40.3%
45-54	Male	42791	41935	98.0%	0.1611	0.0895	55.6%	6892	3754	54.5%
55-64	Male	26236	47895	182.6%	0.3715	0.2096	56.4%	9747	10039	103.0%
65-74	Male	20562	34765	169.1%	0.7929	0.4406	55.6%	16303	15318	94.0%
75-84	Male	12051	14735	122.3%	1.8386	0.9220	50.1%	22157	13586	61.3%
85+	Male	3095	4270	138.0%	3.1787	1.6803	52.9%	9838	7175	72.9%
All Ages	Male	314,140	304,365	96.9%				75,714	54,592	72.1%
0-14	Female	61795	44635	72.2%	0.0172	0.0107	62.2%	1060	476	44.9%
15-24	Female	41782	34215	81.9%	0.0309	0.0165	53.3%	1290	563	43.6%
25-34	Female	48028	40195	83.7%	0.0553	0.0288	52.1%	2655	1159	43.6%
35-44	Female	54844	38585	70.4%	0.0907	0.0507	55.8%	4976	1955	39.3%
45-54	Female	44593	43405	97.3%	0.1799	0.0931	51.7%	8021	4039	50.4%
55-64	Female	27857	49610	178.1%	0.3421	0.1744	51.0%	9529	8653	90.8%
65-74	Female	25764	40400	156.8%	0.6605	0.3462	52.4%	17018	13985	82.2%
75-84	Female	20157	20030	99.4%	1.4649	0.9979	68.1%	29528	19988	67.7%
85+	Female	7957	9425	118.4%	2.5082	1.7244	68.8%	19958	16253	81.4%
All Ages	Female	332,777	320,500	96.3%				94,035	67,070	71.3%
Total	Male + Female	646,917	624,865	96.6%				169,749	121,662	71.7%

APPENDIX B: SURGICAL INPATIENT DATA: AVERAGE LENGTH OF STAY, 1997/98 & 2020 ESTIMATED, TREND ANALYSIS MODEL

			Population			Total Cases (In & Out)			Total Cases per Capita			% Outpatient Surg.		Outpatient Cases			Inpatient Cases			Inpatient cases per capita			Inpatient Days			ALOS	
Region	Age Group	Sex	97/98 Popn.	20/21 Estimated Popn.	20/21 Estimate as a % of 97/98	97/98 Total Surgery (cases)	20/21 Estimated Total Surgery (cases)	20/21 Estimate as a % of 97/98	97/98 Total Surgery per Capita	20/21 Total Surgery per Capita	20/21 Estimate as a % of 97/98	97/98 Observed % Outpatient	% Outpatn. used to estimate 20/21 Inpatn. days	97/98 Outpatient Cases	20/21 Outpatient Cases	20/21 Estimate as a % of 97/98	97/98 Inpatient Cases	20/21 Inpatient Cases	20/21 Estimate as a % of 97/98	97/98 Inpatient Surgery per Capita	20/21 Estimated Inpatient Surgery per Capita	20/21 Estimate as a % of 97/98	97/98 Inpatient Days	20/21 Estimated Inpatient Days	20/21 Estimate as a % of 97/98	97/98 Average LOS	20/21 Average LOS
Manitoba	0-14	M	125,307	110,410	88.1%	3,422	2,347	68.6%	0.027	0.021	77.8%	70.6%	82.5%	2,415	1,937	80.2%	1,007	410	40.7%	0.008	0.004	46.2%	5,285	2,351	44.5%	5.25	5.73
Manitoba	15-34	M	158,846	153,520	96.6%	6,001	5,077	84.6%	0.038	0.033	87.5%	71.3%	82.5%	4,281	4,190	97.9%	1,720	887	51.6%	0.011	0.006	53.3%	9,342	5,108	54.7%	5.43	5.76
Manitoba	35-44	M	92,648	75,740	81.8%	4,725	5,243	111.0%	0.051	0.069	135.7%	73.7%	84.4%	3,484	4,424	127.0%	1,241	819	66.0%	0.013	0.011	80.7%	7,391	3,505	47.4%	5.96	4.28
Manitoba	45-54	M	73,577	72,630	98.7%	4,817	7,868	163.3%	0.065	0.108	165.5%	66.3%	81.0%	3,196	6,373	199.4%	1,621	1,495	92.2%	0.022	0.021	93.4%	12,206	6,327	51.8%	7.53	4.23
Manitoba	55-64	M	47,455	82,520	173.9%	4,747	13,689	288.4%	0.100	0.166	165.8%	57.8%	73.4%	2,746	10,047	365.9%	2,001	3,641	182.0%	0.042	0.044	104.7%	17,295	16,818	97.2%	8.64	4.62
Manitoba	65-74	M	37,526	60,160	160.3%	6,125	14,840	242.3%	0.163	0.247	151.1%	53.2%	70.1%	3,259	10,402	319.2%	2,866	4,438	154.9%	0.076	0.074	96.6%	28,078	24,589	87.6%	9.80	5.54
Manitoba	75-84	M	22,136	26,815	121.1%	5,185	10,451	201.6%	0.234	0.390	166.4%	53.0%	70.5%	2,749	7,364	267.9%	2,436	3,087	126.7%	0.110	0.115	104.6%	34,515	21,075	61.1%	14.17	6.83
Manitoba	85+	M	6,088	7,870	129.3%	1,410	2,868	203.4%	0.232	0.364	157.3%	53.0%	69.3%	748	1,989	265.9%	662	879	132.8%	0.109	0.112	102.7%	13,151	9,821	74.7%	19.87	11.17
Manitoba	0-14	F	119,175	103,710	87.0%	2,253	1,675	74.3%	0.019	0.016	85.4%	69.0%	79.2%	1,554	1,326	85.3%	699	348	49.8%	0.006	0.003	57.3%	3,092	1,419	45.9%	4.42	4.07
Manitoba	15-24	F	76,693	69,500	90.6%	3,579	4,149	115.9%	0.047	0.060	127.9%	78.5%	86.3%	2,810	3,581	127.4%	769	568	73.9%	0.010	0.008	81.5%	2,654	1,327	50.0%	3.45	2.34
Manitoba	25-34	F	79,495	80,635	101.4%	5,976	6,717	112.4%	0.075	0.083	110.8%	79.4%	86.9%	4,744	5,840	123.1%	1,232	878	71.2%	0.015	0.011	70.2%	5,014	2,732	54.5%	4.07	3.11
Manitoba	35-44	F	92,119	75,835	82.3%	7,828	6,691	85.5%	0.085	0.088	103.8%	73.1%	83.7%	5,720	5,600	97.9%	2,108	1,090	51.7%	0.023	0.014	62.8%	9,242	4,284	46.4%	4.38	3.93
Manitoba	45-54	F	73,726	73,760	100.0%	6,905	7,052	102.1%	0.094	0.096	102.1%	65.8%	79.2%	4,545	5,583	122.8%	2,360	1,469	62.2%	0.032	0.020	62.2%	13,766	7,171	52.1%	5.83	4.88
Manitoba	55-64	F	48,653	84,690	174.1%	5,477	17,921	327.2%	0.113	0.212	188.0%	63.0%	77.7%	3,450	13,917	403.4%	2,027	4,004	197.5%	0.042	0.047	113.5%	16,293	14,753	90.5%	8.04	3.68
Manitoba	65-74	F	43,168	67,195	155.7%	6,266	19,144	305.5%	0.145	0.285	196.3%	58.8%	75.4%	3,684	14,430	391.7%	2,582	4,714	182.6%	0.060	0.070	117.3%	26,614	21,326	80.1%	10.31	4.52
Manitoba	75-84	F	33,740	35,180	104.3%	6,285	13,262	211.0%	0.186	0.377	202.4%	60.0%	76.0%	3,773	10,075	267.0%	2,512	3,187	126.9%	0.074	0.091	121.7%	41,657	27,359	65.7%	16.58	8.58
Manitoba	85+	F	13,401	16,190	120.8%	2,228	4,257	191.1%	0.166	0.263	158.1%	53.2%	71.1%	1,185	3,026	255.3%	1,043	1,231	118.0%	0.078	0.076	97.7%	28,033	20,892	74.5%	26.88	16.97
Manitoba	Total		1,143,753	1,196,360	104.6%	83,229	143,251	172.1%	0.073	0.120	164.5%			54,343	110,104	202.6%	28,886	33,146	114.7%				273,628	190,857	69.8%	9.47	5.76
Non-Wpg.	0-14	M	60,439	62,525	103.5%	1,822	1,493	81.9%	0.030	0.024	79.2%	64.8%	79.1%	1,180	1,181	100.1%	642	311	48.5%	0.011	0.005	46.9%	3,441	1,555	45.2%	5.36	4.99
Non-Wpg.	15-34	M	68,942	77,905	113.0%	2,915	2,824	96.9%	0.042	0.036	85.7%	69.9%	80.9%	2,039	2,286	112.1%	876	538	61.4%	0.013	0.007	54.3%	4,433	2,807	63.3%	5.06	5.22
Non-Wpg.	35-44	M	38,015	38,475	101.2%	2,188	2,805	128.2%	0.058	0.073	126.7%	73.2%	83.8%	1,602	2,351	146.8%	586	454	77.4%	0.015	0.012	76.5%	3,367	1,882	55.9%	5.75	4.15
Non-Wpg.	45-54	M	30,786	30,695	99.7%	2,224	3,436	154.5%	0.072	0.112	154.9%	65.4%	80.5%	1,455	2,764	190.0%	769	671	87.3%	0.025	0.022	87.6%	5,314	2,572	48.4%	6.91	3.83
Non-Wpg.	55-64	M	21,219	34,625	163.2%	2,213	6,445	291.3%	0.104	0.186	178.5%	57.2%	74.0%	1,266	4,770	376.8%	947	1,675	176.9%	0.045	0.048	108.4%	7,548	6,779	89.8%	7.97	4.05
Non-Wpg.	65-74	M	16,964	25,395	149.7%	2,794	6,205	222.1%	0.165	0.244	148.4%	53.0%	70.7%	1,480	4,387	296.4%	1,314	1,818	138.4%	0.077	0.072	92.4%	11,775	9,271	78.7%	8.96	5.10
Non-Wpg.	75-84	M	10,085	12,080	119.8%	2,432	5,038	207.1%	0.241	0.417	172.9%	53.8%	70.7%	1,309	3,559	271.9%	1,123	1,478	131.6%	0.111	0.122	109.9%	12,358	7,490	60.6%	11.00	5.07
Non-Wpg.	85+	M	2,993	3,600	120.3%	684	1,201	175.6%	0.229	0.334	146.0%	55.3%	71.8%	378	862	228.1%	306	339	110.7%	0.102	0.094	92.0%	3,313	2,646	79.9%	10.83	7.81
Non-Wpg.	0-14	F	57,380	59,075	103.0%	1,220	1,130	92.6%	0.021	0.019	89.9%	63.2%	76.8%	771	867	112.5%	449	262	58.4%	0.008	0.004	56.8%	2,032	943	46.4%	4.53	3.59
Non-Wpg.	15-24	F	34,911	35,285	101.1%	1,824	2,326	127.5%	0.052	0.066	126.2%	76.5%	84.3%	1,396	1,962	140.5%	428	364	85.1%	0.012	0.010	84.2%	1,364	764	56.0%	3.19	2.10
Non-Wpg.	25-34	F	31,467	40,440	128.5%	2,700	3,740	138.5%	0.086	0.092	107.8%	76.2%	85.1%	2,058	3,184	154.7%	642	556	86.6%	0.020	0.014	67.4%	2,359	1,574	66.7%	3.67	2.83
Non-Wpg.	35-44	F	37,275	37,250	99.9%	3,540	3,549	100.3%	0.095	0.095	100.3%	70.9%	82.4%	2,511	2,925	116.5%	1,029	624	60.7%	0.028	0.017	60.7%	4,266	2,329	54.6%	4.15	3.73
Non-Wpg.	45-54	F	29,133	30,355	104.2%	3,051	3,259	106.8%	0.105	0.107	102.5%	64.8%	77.1%	1,977	2,512	127.1%	1,074	746	69.5%	0.037	0.025	66.7%	5,745	3,131	54.5%	5.35	4.20
Non-Wpg.	55-64	F	20,796	35,080	168.7%	2,573	8,025	311.9%	0.124	0.229	184.9%	62.3%	76.4%	1,603	6,133	382.6%	970	1,891	195.0%	0.047	0.054	115.6%	6,764	6,101	90.2%	6.97	3.23
Non-Wpg.	65-74	F	17,404	26,795	154.0%	2,719	6,978	256.6%	0.156	0.260	166.7%	59.7%	75.0%	1,622	5,233	322.6%	1,097	1,745	159.1%	0.063	0.065	103.3%	9,596	7,340	76.5%	8.75	4.21
Non-Wpg.	75-84	F	13,583	15,150	111.5%	2,512	5,926	235.9%	0.185	0.391	211.5%	61.0%	77.2%	1,533	4,577	298.5%	979	1,349	137.8%	0.072	0.089	123.5%	12,129	7,372	60.8%	12.39	5.47
Non-Wpg.	85+	F	5,444	6,765	124.3%	947	1,962	207.2%	0.174	0.290	166.8%	58.1%	75.4%	550	1,479	269.0%	397	483	121.7%	0.073	0.071	97.9%	8,075	4,639	57.5%	20.34	9.61
Non-Wpg.	Total		496,836	571,495	115.0%	38,358	66,340	172.9%	0.077	0.116	150.4%			24,730	51,034	206.4%	13,628	15,306	112.3%				103,879	69,195†	66.6%	7.62	4.52
Winnipeg	0-14	M	64,868	47,885	73.8%	1,600	854	53.4%	0.025	0.018	72.3%	77.2%	88.4%	1,235	755	61.2%	365	99	27.1%	0.006	0.002	36.7%	1,844	796	43.1%	5.05	8.04
Winnipeg	15-34	M	89,904	75,615	84.1%	3,086	2,253	73.0%	0.034	0.030	86.8%	72.7%	84.5%	2,242	1,904	84.9%	844	349	41.3%	0.009	0.005	49.1%	4,909	2,302	46.9%	5.82	6.60
Winnipeg	35-44	M	54,633	37,265	68.2%	2,537	2,438	96.1%	0.046	0.065	140.9%	74.2%	85.0%	1,882	2,073	110.1%	655	365	55.8%	0.012	0.010	81.8%	4,024	1,623	40.3%	6.14	4.44
Winnipeg	45-54	M	42,791	41,935	98.0%	2,593	4,433	170.9%	0.061	0.106	174.4%	67.1%	81.4%	1,741	3,609	207.3%	852	824	96.7%	0.020	0.020	98.6%	6,892	3,754	54.5%	8.09	4.56
Winnipeg	55-64	M	26,236	47,895	182.6%	2,534	7,243	285.8%	0.097	0.151	156.6%	58.4%	72.9%	1,480	5,277	356.6%	1,054	1,966	186.6%	0.040	0.041	102.2%	9,747	10,039	103.0%	9.25	5.11
Winnipeg	65-74	M	20,562	34,765	169.1%	3,331	8,635	259.2%	0.162	0.248	153.3%	53.4%	69.7%	1,779	6,015	338.1%	1,552	2,620	168.8%	0.075	0.075	99.9%	16,303	15,318	94.0%	10.50	5.85
Winnipeg	75-84	M	12,051	14,735	122.3%	2,753	5,413	196.6%	0.228	0.367	160.8%	52.3%	70.3%	1,440	3,805	264.2%	1,313	1,609	122.5%	0.109	0.109	100.2%	22,157	13,586	61.3%	16.88	8.45
Winnipeg	85+	M	3,095	4,270	138.0%	726	1,667	229.6%	0.235	0.390	166.4%	51.0%	67.6%	370	1,127	304.5%	356	540	151.8%	0.115	0.127	110.0%	9,838	7,175	72.9%	27.63	13.28
Winnipeg	0-14	F	61,795	44,635	72.2%	1,033	545	52.8%	0.017	0.012	73.0%	75.8%	84.2%	783	459	58.6%	250	86	34.4%	0.004	0.002	47.6%	1,060	476	44.9%	4.24	5.54
Winnipeg	15-24	F	41,782	34,215	81.9%	1,755	1,823	103.9%	0.042	0.053	126.9%	80.6%	88.8%	1,414	1,619	114.5%	341	204	59.8%	0.008	0.006	73.0%	1,290	563	43.6%	3.78	2.76
Winnipeg	25-34	F	48,028	40,195	83.7%	3,276	2,978	90.9%	0.068	0.074	108.6%	82.0%	89.2%	2,686	2,656	98.9%	590	322	54.5%	0.012	0.008	65.2%	2,655	1,159	43.6%	4.50	3.60
Winnipeg	35-44	F	54,844	38,585	70.4%	4,288	3,141	73.3%	0.078	0.081	104.1%	74.8%	85.2%	3,209	2,675	83.4%	1,079	466	43.2%	0.020	0.012	61.4%	4,976	1,955	39.3%	4.61	4.20
Winnipeg	45-54	F	44,593	43,405	97.3%	3,854	3,793	98.4%	0.086	0.087	101.1%	66.6%	81.0%	2,568	3,071	119.6%	1,286	722	56.2%	0.029	0.017	57.7%	8,021	4,039	50.4%	6.24	5.59
Winnipeg	55-64	F	27,857	49,610	178.1%	2,904	9,897	340.8%	0.104	0.199	191.4%	63.6%	78.7%	1,847	7,784	421.5%	1,057	2,112	199.9%	0.038	0.043	112.2%	9,529	8,653	90.8%	9.02	4.10
Winnipeg	65-74	F	25,764	40,400	156.8%	3,547	12,166	343.0%	0.138	0.301	218.7%	58.1%	75.6%	2,062	9,197	446.0%	1,485	2,969	200.0%	0.058	0.073	127.5%	17,018	13,985	82.2%	11.46	4.71
Winnipeg	75-84	F	20,157	20,030	99.4%	3,773	7,336	194.4%	0.187	0.366	195.7%	59.4%	74.9%	2,240	5,498	245.5%	1,533	1,838	119.9%	0.076	0.092	120.7%	29,528	19,988	67.7%	19.26	10.87
Winnipeg	85+	F	7,957	9,425	118.4%	1,281	2,294	179.1%	0.161	0.243	151.2%	49.6%	67.4%	635	1,546	243.5%	646	748	115.8%	0.081	0.079	97.8%	19,958	16,253	81.4%	30.89	21.72
Winnipeg	Total		646,917	624,865	96.6%	44,871	76,911	171.4%	0.069	0.123	177.5%			29,613	59,071	199.5%	44,871	76,911	171.4%				169,749	121,662	71.7%	11.13	6.82

† This value is .8% less than the sum of days for non-Winnipeg RHAs as reported in Table 3. This difference results from rounding that occurs during the RHA specific adjustments that are made in this model.

APPENDIX C: METHODS

Introduction

The objective of this research project was to estimate the number of days of inpatient hospital care that would be used in each Regional Health Authority (RHA) in Manitoba in 2020. Estimates were first made of the number of hospital days that would be needed to accommodate the residents of each RHA. The population-based estimate of use was then combined with historical use patterns (where RHA residents were actually hospitalized) to obtain an estimate of the number of bed-days that would be used in each RHA in 2020.

The estimates of bed-day use involve applying projected hospital utilization to population projections developed by the Manitoba Bureau of Statistics (MBS). A description of the methods used by MBS to develop these estimates is available from their office.

Two methods of estimating utilization have been developed and are presented here. The Current Use Projection Model assumes that utilization in 2020 will be the same as it was in 1996/97 to 1998/99, and that only the population distribution will change. The Trend Analysis Model considers the trends in hospital use that have occurred over the past 10 years, and assumes that these trends will continue into the future. The trends along with the changes in population distribution affect the projected hospital bed use for 2020.

Unit of Analysis

Because this project is designed to make estimates of the number of inpatient days that will be needed in 2020, the basic unit of analysis is a person, specifically the number of inpatient days she or he will require in 2020. Both models use a stratification of the population to make more precise estimates. Four levels of stratification are used, and are shown graphically in Appendix Figure C1. Because the population of some of the non-Winnipeg RHAs was relatively small, it was determined that more stable estimates would be obtained by aggregating all hospitalizations for people living outside of Winnipeg into a "non-Winnipeg" group. (Adjustments were subsequently made to reflect different utilization patterns by residents of different regions.) Non-Winnipeg groups and Winnipeg groups were next divided into surgical cases and "non-surgical" cases (non-surgical cases include medical, obstetric and psychiatric cases). This separation was made to recognize the different characteristics of hospital stays for these types of cases. And finally, since hospital care is sometimes quite different by sex and age, it was decided that the analyses would be stratified for these two characteristics—that is, estimates would be developed for separate age groups within each sex.

Based on our observations of within-group similarities in past hospital inpatient utilization the following age-sex groups were used in our analyses:

Non-Surgical care:
Females & Males: ages 0-14, 15-24, 25-34, 35-54, 55-64, 65-74, 75-79, 80-84 & 85+

Surgical care:
Females: ages 0-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84 & 85+
Males: ages 0-14, 15-34, 35-44, 45-54, 55-64, 65-74, 75-84 & 85+

Therefore, analyses were conducted for a total of 70 separate strata, in the first stage. Each of the 35 strata that were developed for the non-Winnipeg strata were subsequently adjusted to make them specific to each of the 10 northern and rural RHAs (Burntwood and Churchill were combined due to the small population in those regions) that were included in this group. In total, estimates of bed-day requirements were developed for each of the 385 (35 in Winnipeg plus 350 in the 10 rural RHAs) different RHA / sex / age group / surgical or non-surgical groups.

Current Use Projection Model

The Current Use Projection Model involved applying the RHA/sex/age group/surgical or non-surgical specific utilization (inpatient days per person) that was observed over the most recent three years (1996/97 – 1998/99) to the Manitoba Bureau of Statistics 2020 population estimates. This gave the "Current Use Projection" estimates. The projections for each group, surgical and non-surgical cases, were summed over age and sex groups for each region to provide an estimate of the number of inpatient bed days that would be required by residents of each region in 2020.

Trend Analysis Model

The Trend Analysis Model incorporates historical hospital utilization trends into the projections. An examination of these patterns within the 70 strata over the past 10 years revealed that almost all sex and age groups in Manitoba have experienced a declining rate of hospital days per capita for both surgical and non-surgical cases. And, the patterns have followed an exponential decline – relatively sharp decreases in the earlier years followed by a small decline (or levelling off) in the most recent years. This non-linear pattern can be modelled with the Poisson distribution, with a rate (bed-days per capita) as the dependent variable and the year of observation as one of the main independent variables. Furthermore, any straight line predictive model for bed days per capita with a negative coefficient for 'year' would eventually provide estimates that would be less than zero.

The same RHA/sex/age group/surgical or non-surgical stratification was used for the Trend Analysis Model. An investigation of factors thought to contribute to the number of hospital days that would be used by the population of each RHA led to the development of the following list of items for which reliable data were available:

1. the proportion of hospital stays which were long-stay cases (long-stays were defined as those greater than 30 days)
2. for surgical cases, the ratio of the number of outpatient surgery cases to the number of inpatient surgery cases
3. the year the patient received hospital care. "Year" can be viewed as a proxy for many difficult-to-measure system factors related to patient care – for example: technological advancements, patient care practices, population health status.

Ten years of hospital discharge data (1989/90 to 1998/99) were used. The hospital claims data consist of fiscal year patient discharge records (April 1 of each year to March 31 of the following year; a computerized record is generated only upon the patient's discharge from hospital). If a patient's stay extended over the end of one or more fiscal years the appropriate number of days stay during each of the separate fiscal years were counted. For example, if a patient entered hospital 10 days before the end of a fiscal year and was discharged 40 days later, ten of the inpatient days were counted in the first fiscal year with the remaining 30 days of this stay attributed to the following fiscal year, rather than all 40 days being included in the fiscal year of discharge.

Projections of Bed-Day Requirements for Non-Surgical Inpatient Care – Trend Analysis Model

Non-surgical inpatient days were estimated by first using Poisson regression to model the observed rate of inpatient days per capita over the past 10 years in each of the strata. Two variables were used to "predict" inpatient days per resident: 1) fiscal year and 2) the proportion of total inpatient days that were long-stay days (long-stays were defined as stays of greater than 30 days). For example, if for an age and sex group in a particular region for a given fiscal year there were only two inpatient admissions: the first patient was in hospital 25 days while the second patient stayed 75 days, the proportion of days which were long-stay days would be: $75 / (25+75) = 0.75$.

Estimates of age-sex specific rates of inpatient days per capita for 2020 were then obtained by substituting '2020' for year and the 1997/98 observed values of the proportion of long-stay days into the equation. If the regression coefficient for one of the "predictor" (i.e., independent) variables was not statistically significant (p-value > 0.05) in any of the age-sex models, then a regression equation was obtained that included only the variable that was statistically significant. If neither of the independent variables was statistically significant then the average observed rates per capita over the most recent three years were used as estimates for 2020.

Projection of Bed-Day Requirements for Surgical Inpatient Care – Trend Analysis Model

The methodology to estimate inpatient surgical days replicates that used for non-surgical days with the addition of a "predictor" variable to the Poisson regressions. The ratio of the number of outpatient surgery cases to the number of inpatient surgery cases was used in addition to year and proportion of inpatient surgery days that were long-stay days to predict inpatient surgery days per capita. Estimated days per capita for 2020 were then obtained by using the year 2020, the 1997/98 observed values of percentage of long-stay days and the estimated 2020 values of the surgical outpatient to inpatient ratios into the regression equations.

Estimates for the outpatient to inpatient ratios were obtained by fitting linear regression models, with year as the only predictor variable, to the Winnipeg/non-Winnipeg, age- and sex-specific data over the past ten years. Substituting the value '2020' for year into the regression equations provided the estimates. If, however, an area-age-sex 2020 estimate of the outpatient: inpatient ratio was more than twice the observed 1998/99 ratio then twice the 1998/99 ratio was used as the 2020 estimate instead of the regression estimate.

Projection of Outpatient Surgery Cases – Trend Analysis Model

The number of outpatient surgery cases was estimated by first estimating total surgery (inpatient + outpatient) and then applying the estimated outpatient: inpatient ratios that were developed when estimating the inpatient surgery days. Similar to the inpatient days estimates, the total number of surgeries per resident (by age and sex and Winnipeg/non-Winnipeg) over the past 10 years was used in Poisson regression models with year as the only independent variable. The per capita total surgery estimates were then multiplied by the 2020 population estimates. These were in turn multiplied by the estimated proportions of total surgery that will be outpatient surgery to arrive at the estimated number of outpatient surgeries in 2020.

Adjustments Applied to Non-Winnipeg Estimates – Trend Analysis Model

Since regression models were derived only for Winnipeg residents and for non-Winnipeg residents another step was needed to obtain estimates for residents of each of the non-Winnipeg RHAs. Estimates specific to each non-Winnipeg RHA were obtained by comparing each separate RHA data to the non-Winnipeg RHA data and making corresponding adjustments to the non-Winnipeg estimates. Age-group and sex specific rates of inpatient days over the past ten years in each non-Winnipeg RHA were modelled, using Poisson regression, against the overall non-Winnipeg rates to arrive at non-

Winnipeg RHA-age-sex specific coefficients with which to adjust the estimated 2020 non-Winnipeg inpatient days per capita rates. For example, the regression coefficient for non-surgical utilization among South Westman males aged 0-14 was 0.7428. Thus the 2020 estimated rate per capita for South Westman males aged 0-14 was computed as 0.7428 times the estimated non-Winnipeg rate. Similar calculations were made across all non-Winnipeg RHAs, age groups and sexes.

Estimates of Bed-Days Within RHAs – Both Models

The estimates of inpatient days that will be required by the residents of a region do not necessarily mean that all of these days will be spent in a hospital within the region. It was therefore necessary to determine the region in which the care would occur. The inpatient days that are projected to be needed in a given region is calculated as:

(Inpatient days projected for residents of a region) – (inpatient days for residents that occur outside of their region) + (inpatient days of residents of another region who receive care in the region) + (inpatient days of individuals from outside of Manitoba who receive care in the region).

Using three years (1997/98 – 1999/00) of hospital discharge claims we determined what proportion of all days used by residents were used in each RHA's hospitals. For example, let us say residents of the Central RHA used 100 days with 80 of these days in hospitals in Central RHA and 12 days in Winnipeg hospitals, six days in Brandon hospitals and the remaining two days in South Westman hospitals. We used these proportions (for our Central RHA example: 80% in Central hospitals, 12% in Winnipeg, 6% in Brandon and 2% in South Westman) to assign the 2020 estimated days by the residents of each RHA to days used in the hospitals of each RHA. The proportions (and assignments) were calculated separately for each RHA, surgical/non-surgical, age group and sex estimate. The results were then summed over all age groups and both sexes for each RHA and surgical/non-surgical.

Finally, estimates of the number of days used by non-Manitobans in all of the hospitals in each RHA was added to the RHA hospital days projections. This involved taking three years (1997/98 – 1999/00) of hospital claims and computing the average annual number of days used by non-Manitobans (all ages and both sexes combined) in the hospitals of each RHA. Separate estimates were derived for non-surgical and surgical days. These average annual days were then added to the above 2020 RHA (hospital) estimates.

Appendix Figure C1. Stratification Strategy for Hospital Bed Use Projections