Forecasting Acute Care and Long-Term Care Bed Days in Hawaii: Projections to 2025

Presented by :
Hawaii Health Information Corporation

To:
State Health Planning and Development Agency

June 30, 2003

Preliminary Report

TABLE OF CONTENTS

List of figures and tables:

FOREWARD

Discussions between SHPDA and HHIC regarding bed needs began in 2002. SHPDA recognized the need to update their projections from the acute care projections published in April 1991 and long-term care projections published in March 1991. HHIC, building upon its work supporting hospitals in both health planning and quality improvement, recognized the need of the hospitals and long-term care facilities to have projections reflecting the impact of changes in demographics, technology, and healthcare financing. Of particular concern to both SHPDA and HHIC was the impact of the aging population on Hawaii's healthcare infrastructure.

The approach adopted included literature reviews and surveys to identify existing methodologies, their strengths and weaknesses; application of multiple methods to develop forecasts; and, perhaps most important of all, inclusion key experts in the process to identify the "drivers" of change in utilization and to generate scenarios based on structural changes in healthcare.

The end product was to be a methodology which could be updated frequently based on both quantitative methods and feedback from experts.

HHIC is fortunate to have Lawrence Nitz, Ph.D., UH Professor of Political Science, as a partner in this effort. Dr. Nitz is well-versed in the issues associated with care of the elderly. He provided the forecast for long-term care, incorporating both care homes and nursing facilities into the analysis.

The Preliminary Report which follows presents the synthesis of many steps necessary to deliver a methodology which best supports SHPDA and the providers of healthcare in Hawaii. Additional steps are needed and HHIC looks forward to working with SHPDA and the healthcare community to develop useful forecasts.

Remaining steps in this initial phase of work include:

- Generating projections based on APR-DRG specialty groups (or other grouping methodology);
- Meeting with initial expert group to review preliminary report;
- Participating in SHPDA meetings of key stakeholders and technical experts;
- Modifying the report based on feedback from technical experts;
- Providing web-based mapping of the bed need projections using HHIC's MapInfo software and website, linking with SHPDA's website.

EXECUTIVE SUMMARY

There is much concern about the impact an aging population will have on Hawaii's health care system. It is clear that Hawaii's population is aging and will continue to do so far into the future. Since those 65 and older currently use a disproportionate amount of medical services, this concern is not misplaced.

Hawaii Health Information Corporation (HHIC) was selected by SHPDA to assess how this population might use acute care and long-term care beds (LTC) and to consider various methods to project future bed needs. There is no simple or straightforward method to answer these questions. This report explores two different models to forecast bed utilization: bed days projection for acute care beds for the years 2010 and 2025 and socio-economic estimation for nursing home (NH) & adult residential care home (ARCH) beds for the years 2003 to 2023.

After applying different models, our analysis suggests that there appears to be sufficient physical capacity in the existing system to handle the needs of acute care beds in years 2010 and 2025, provided the trend to outpatient surgery and shorter lengths of hospital stay continue. For NH and ARCH beds, the answer will depend based on a range of outcomes and risks for patients. We used this approach to develop a model that will be able to respond to a range of likely outcomes instead of having one averaged bed number.

<u>Methods</u>

Acute care

Projecting acute care bed days requires estimates of Hawaii's future demographic composition and hospital care needs. The demographic component comprises two parts:

1. What will Hawaii's population be at future points?
2. What will be the age and sex composition of the population?

Population projections for Hawaii come from the US Bureau of the Census.[1]

We develop and present two models for projecting future acute care hospital bed use. Both models make separate projections for surgical and medical days, for men and women, and for different age groups.

The first model, called Current Use Projection, projects future use on the basis of current use patterns. We used hospital data from 2000 to define the current use of acute care beds, by age, sex, and type of hospitalization (medical vs. surgical), and projected that use forward to 2010 and 2025 based on Census projections regarding the age and sex composition of Hawaii's population.

[1] The current 2005-2025 census projections are based upon calculations from the 1990 Census.

The second model, called Trend Analysis, attempts to account for improvements in technology, policy and efficiency that impact hospital use. Specifically, we identify the trends in hospital use for the various age and sex groupings and, using statistical regression, extrapolate those trends to 2010 and 2025. The trend analysis builds into our estimations the assumption that changes in hospital use will be similar to those that occurred over the last six years.

Long-term care

The current inventory of NH and ARCH beds is affected by distinct Hawaii state policies on demonstrated need, on the one hand, and inclusion of proposed beds in the inventory or Medicaid approved beds by the Hawaii State Department of Human Services. For this reason, ratios of beds to population, which may be used in other states, are apt to fail in Hawaii, because they may (a) predict an immediate need for NH beds that far exceeds the current supply or (b) completely ignore the persons whose ADL related disabilities are currently cared for in ARCH facilities.

Thus, to generate a time series of likely LTC needs for Hawaii, a predicting model was developed that attempted to account for several outcomes. These included: current policies which govern the licensing of nursing home facilities, the inclusion of facilities in the roster of Medicaid-eligible entities, and the typical way in which ARCH facilities fill a portion of Hawaii's long-term care institutional needs.

Results

Acute care

The two models provide sharply divergent predictions for 2010 and 2025. The Current Use Projection model estimates increases of 17 percent in medical days and 16 percent in surgical days by 2010. Based on available population estimates for 2025, bed use would increase by 50 percent for medical days and 47 percent for surgical days.

The Trend Analysis Model projects a less dramatic increase in the number of bed days required in 2010 and 2025. Specifically, it estimates that medical days will increase by 11 percent and surgical days will increase by two-tenths of one percent by 2010. For 2025, it estimates an increase in medical days of 10 percent and an increase in surgical days of six percent over 2000 levels.

Long-term care

Observations of Hawaii's facilities provides insight into the key element in projecting NH usage in the state: people in Hawaii nursing homes are much more frail that those in similar facilities elsewhere in the United States. Thus, current acceptable standards for admission to a NH under Medicaid (ADLs) may be lower than current Hawaii residents.

Similar observations can be made for ARCHs. While a number of ARCH facilities operate with Medicaid waivers, ARCH patients are likely initially private pay, and may in fact enter the ARCH with a relatively low level of disability (perhaps 2 ADLs). The patients would enter generally on the assumption that they or their families have the ability to pay for the ARCH services.

These two observations provide guidance for selecting and setting parameters for a LTC projection model. First, the NH or ARCH decision must be considered to be a random event that must take into account the availability of facilities or the likelihood of entry. Second, it must account for the patient's likely assets and income at the time an institutionalization decision is made.

The LTC NH and ARCH bed projections are based on a Hawaii-specific modification of a national model of LTC disability, institutionalization and payment. The core of the model is a population of about 35,000 persons for whom employment, retirement and income histories are available. To these data, additional fields relating to NH and non-institutional care usage and the associated levels of frailty have been added, initially from the 1984 National Long Term Care (NLTC) Survey, and supplemented by additional health information from the 1994 NLTC Survey. These data fields were added by matching person characteristics in the income and retirement file with similar characteristics of those in the NLTC Surveys.

Conclusion

Despite an aging population, we are cautiously optimistic about the ability of Hawaii's hospitals meeting acute care needs in the future, if changes are minimal. Even if past trends do not continue, Hawaii could accommodate increased demands on acute care hospitals by treating patients requiring alternative forms of care elsewhere, provided such alternatives are available. Similarly, for planning future LTC bed needs, this will depend on the range of likely outcomes each year and how successful projection models will be able to accommodate and respond to these variations. Future studies are needed to validate the reliability and applicability of the various methods presented in this report and determine how to incorporate both acute care and long-term care needs for long range facilities planning.

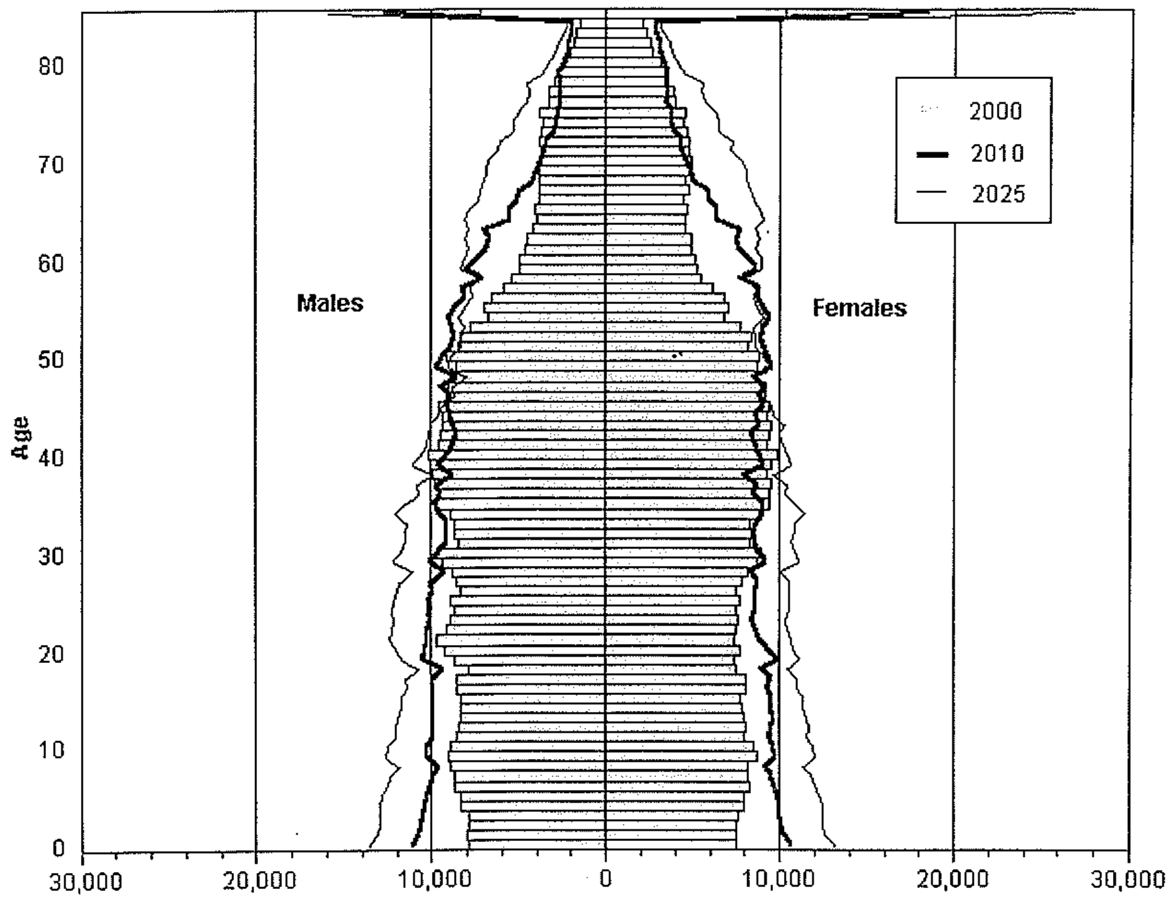
Recommendations

- Revisit hospital use patterns every five years and apply actual population figures, updated population projections, and hospital use to the models.
- Approach forecasted system changes with patience. Any increased pressures that occur will be gradual.
- For projecting LTC beds, admissions should be considered a random event and account for the patient's likely assets and income at the time an institutionalized decision is made.
- Ensure facilities are available for moving surgery from the inpatient to the outpatient setting.
- Examine some of the specific impacts that technologies and policies have upon hospital use.
- When planning for future facilities use, any projection models should be able to accommodate and respond to a range of likely outcomes.

INTRODUCTION

As we look toward the future, our health care system becomes increasingly responsible for the "baby boomers." As this population ages, they put an increasing burden on the health care system. 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 fear, then, is that hospitals and the health system will be overwhelmed by the graying population.

Figure 1: Hawaii Population by Single Years of Age and Sex 2000 and 2025



Hawaii's population will undergo some significant changes by 2025 (Figure 1). Not only is the population expected to expand significantly (up to 1,634,429 from 1,211,536), but the distribution of the population will differ significantly. There will be more people 75 years and older than there were in 2000 (123,754 rather than 75,339—a 64% increase) and they will make up a larger share of the population (7.6% rather than 6.2%). While 2010's figures are less dramatic (88,070 people aged 75 years and older—a 16.9% increase—making up 6.4% of the population) the changes are still significant. Given the clear association between age and need for hospital services, this has the potential to drive up the need for hospital beds.

Looking at population forecasts by age, one sees the expected growth and potential impact of this graying population. This assumes, however, that future use of the acute care system is similar to current patterns of usage. Looking at changes in recent history provide us with a different picture of usage, that it changes and, generally, becomes more efficient over time. Provided that past trends in hospital use continue, the impact upon Hawaii's healthcare system by its aging demographic may well be within its current capacity.

Our task for projecting acute care bed needs, given the population forecasts currently available, was to estimate the number of days that will be required in Hawaii at future points. In this report, we concentrate on 2010 and 2025 as these future points. For LTC beds, the approach was to develop a model to calculate the likelihood that a patient will be more disabled in the next year by projecting the number of new admissions and average daily census. In this report, we concentrate on a twenty-year period from 2003-2023.

METHODS

ACUTE CARE

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 childbearing age are more likely to be hospitalized than men of similar ages. Thus accurate projections of hospital need must take these factors into consideration.

The population data for each of the six years 1995–2000 and the projected population data to 2025 were obtained from the US Bureau of the Census. Projected population takes into account factors such as immigration and emigration, birth and death rates and interstate migrations. The result of this forecast provides us with estimates of the number of males and females, in five-year groupings, who will live in the state in 2025.

In pursuing our hospital usage analysis we divided the population into different age groups based on within-group similarities in past hospital inpatient utilization. This takes into account the different usage patterns by different age and sex groups for the different types of care. The age and sex groups utilized are the following:

Medical 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):
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+

In addition, we excluded newborns from our calculations.

<u>Current Use Projection</u>
The first model, called Current Use Projection, projects future use on the basis of current patterns of use. We used hospital data from the year 2000 to define the current use of acute care beds (by age and sex), and then projected that use forward to 2025 based on Census

predictions regarding the age and sex composition of the population. Specifically, we looked at the rate of days use per population in each of the age-sex groups for both medical and inpatient surgical care. Once this was obtained, we multiplied that rate by the projected population for that age group and added the results to obtain the total number of inpatient days.

While this model is relatively easy to use in projecting hospital use, it does have drawbacks. This model assumes that future hospital use will be similar to use patterns for 2000. It fails to recognize trends in healthcare that would decrease demand on inpatient beds, such as technologies that reduce length of stay, improvements in surgical methods that move more procedures to the outpatient setting, or even lifestyle shifts in the population. Use of this type of model in the past has generally over-estimated future needs.[2] In previous SHPDA projections of non-federal bed needs,[3] this model overestimated hospital days by 11.7% for 2000 (even though it did not account for usage by age and sex). Since it is assumed that 2000 use rates are not going to get worse, these figures serve as an upper limit to projected needs. Using this model, we project a 16.6% increase in the total number of acute care days in 2010 and a 48.9% increase in 2025.

Table 1: Current Use Projection Model: Hospital Days

Year	Male Surgical Days	Female Surgical Days	Non-Surgical Days	Total Days
1995	145,821	136,831	427,754	710,406
1996	151,320	136,520	410,283	698,123
1997	157,287	145,155	405,294	707,736
1998	127,463	135,766	385,903	649,132
1999	121,260	121,297	380,433	622,990
2000	128,412	129,646	379,787	637,845
2005	136,190	139,917	410,526	686,633
2010	147,014	151,253	445,565	743,832
2015	159,293	163,306	482,135	804,734
2020	173,051	176,558	522,707	872,315
2025	187,389	191,410	571,258	950,058

Trend Analysis Model

In developing our second model, the Trend Analysis Model, we looked at six years (1995–2000) of data on hospital use.[4] These data were obtained from HHIC's inpatient database[5]

[2] Y. Carrière. "The impact of Population Aging and Hospital Days." In E.M. Gee and G.M. Gutman (eds.) *The Overselling of Population Aging*. Oxford University Press, 2000. Cited in David K. Stewart, Robert Tate, et al. "Projecting Hospital Bed Needs for 2020." Manitoba Centre for Health Policy, June 2002. Available at http://www.umanitoba.ca/centres/mchp/reports.htm

[3] David B. Johnson. "State of Hawaii Non-Federal Acute Care Bed Projections by Bed Type, Island and County, 1995-2010." State Health Planning and Development Agency, April 1991.

[4] This model was heavily influenced by a study conducted in Manitoba. See David K. Stewart, Robert Tate, et al, "Projecting Hospital Bed Needs for 2020" Manitoba Centre for Health Policy, June 2002. Available at http://www.umanitoba.ca/centres/mchp/reports.htm

[5] Hawaii Health Information Corporation's Inpatient Database provides data on all inpatient discharges from 1995. This data is validated with the individual hospitals before being placed in the database.

for the inpatient data and from surveys conducted by the American Hospital Association and National Center for Health Statistics for outpatient data.[6] Hospital use was subdivided into three types: 1) medical inpatient cases; 2) inpatient surgery cases; and 3) outpatient surgery cases. These data were then analyzed in conjunction with data on the patient's sex, age group, and the year in which treatment was received.

We developed our medical care estimates by first using exponential regression[7] to model the observed rate of inpatient days per resident over the past 6 years in each of the above age-sex groups. Estimates of age-sex specific rates of inpatient days per capita for following years were then obtained by using the population data for those years along with the 2000 observed values in the resulting regression equations.

The next step was to multiply the estimated medical inpatient days per capita for a particular year by the population estimates for that year in order to develop age-sex specific estimates of inpatient days. Summing these estimates over all age-sex groups gave the total estimates of beds required for medical use. Our analysis is based on estimating the number of acute care hospital days that will be needed.

Table 2: Trend Analysis Model: Hospital Days

Year	Female Surgical Days	Male Surgical Days	Non-Surgical Days	Total Days
1995	136,831	145,821	427754	710,406
1996	136,520	151,320	410283	698,123
1997	145,155	157,287	405294	707,736
1998	135,766	127,463	385903	649,132
1999	121,297	121,260	380433	622,990
2000	129,646	128,412	379787	637,845
2005	130,044	126,542	428425	685,011
2010	131,279	127,261	423114	681,654
2015	133,071	128,669	418315	680,056
2020	135,183	132,245	413153	680,582
2025	138,880	135,859	416407	691,146

The methodology used to estimate inpatient surgical days largely replicates that used for medical days. The only difference is the inclusion of one more "predictor" in the analysis. The additional variable was the number of outpatient surgeries (cases).

[6] Surveys used come from: American Hospital Association. *Hospital Statistics*. Health Forum, LLC, 1990-2002; Centers for Disease Control. "Outpatient Department Summary: National Hospital Ambulatory Medical Care Survey, 1992-2000." *Advance Data from Vital and Health Statistics*. National Center for Health Statistics. 1994-2002, and Centers for Disease Control and Prevention. "Ambulatory Surgery in the United States, 1994-1996." *Advance Data from Vital and Health Statistics*. National Center for Health Statistics. 1996-1998.

[7] Exponential regression was used over the more common least squares regression as it is more suited to our purposes in two ways. First, it does not impose a straight line on data, making it a little more sensitive to recent data as well as variations over time within the data set. Second, all estimates of subsequent hospital use are constrained to be greater than zero.

Data for outpatient surgery were not available at the same level of granularity as for inpatient data. In this instance, we used national ratios of outpatient surgery use by age group as a guideline for distributing Hawaii's outpatient surgery cases by age group. In the end, our projections for outpatient surgery were made by first obtaining the total number of surgeries[8] and looking at the number of surgeries per 1,000 population. The total for this rate has remained fairly steady over from 1995-2000 (ranging from 65 to 70 per 1,000, with most years reporting around 67 per 1,000). Since the rate has remained fairly steady, we took the highest rate of the period and applied that to future periods. This gave us the total number of surgeries. Our estimates for inpatient surgeries were then subtracted from the number of total surgeries and the growth of the ratios were compared with past growth and with national growth rates to check for anomalies.

Table 3: Changes in Surgical Cases: Trend Analysis Model

	Actual 2000 Cases	Estimated 2010 Cases	Percent Change from 2000	Estimated 2025 Cases	Percent Change from 2000
Total Surgery Cases	80,535	96,624	20.0	115,563	43.5
Outpatient Cases	46,250	61,362	32.7	75,887	64.1
Inpatient Cases	34,285	35,262	2.8	39,676	15.7
Average Length of Stay	5.72	5.62	-1.7	4.83	-15.6

After arriving at the values using the above methods of analysis, careful consideration was given by comparing them with current rates for the US and the West region of the US to look for possible plateaus. The West region of the US typically has rates similar to Hawaii, except in the area of ALOS where the West is much lower. The US also has lower ALOS rates than Hawaii (5.0 for US vs. 5.7 for Hawaii), but higher than that of the West. To provide a breakpoint in the projections, we assumed that Hawaii's ALOS would continue to decline as it has in the past, but used the current US ALOS (both overall and by age group) as a guide to what we might expect for Hawaii's future, with Hawaii equaling the current US ALOS in 2020 and bettering it slightly by 2025.

LONG-TERM CARE

The LTC NH and ARCH bed projections are based on a Hawaii-specific modification of a national model of LTC disability, institutionalization and payment. The core of the model is a population of about 35,000 persons for whom employment, retirement and income histories are available. To these data, additional fields relating to NH and non-institutional care usage and the associated levels of frailty have been added, initially from the 1984 National Long Term Care (NLTC) Survey, and supplemented by additional health information from the 1994 NLTC Survey. These data fields were added by matching person characteristics in the income and retirement file with similar characteristics of those in the NLTC Surveys.

[8] The number of inpatient surgeries came from HHIC, Inpatient Database, 1995-2000. Outpatient surgeries came from AHA, *Hospital Statistics*, 1990-2002.

The most important contribution of these surveys is that they permit calculation of transition probabilities of non-institutionalized persons from one disability level to another. That is, we can calculate the likelihood that a patient will be more disabled in the next year. Using a similar procedure to match the Medicare Current Beneficiary Survey (MCBS) to the base file also allows mapping of prior conditions or acute diseases or events onto the resulting disability. Thus, for every matched NH entrant, it is possible to simulate a path leading from an acute condition to a NH entry.

A special adjustment has been made for death. If the population aged, and we looked at a 20-year slice of experience, it would shrink as people died. This would not permit prediction of facilities requirements, because new people will enter the system (by simply becoming older, by migrating to Hawaii, and the like). The population model was customized to permit the continuous growth of Hawaii's population (using the DBEDT official state population projections). Through this mechanism, the original 35,000 sample cases are augmented by about 35,000 cases over a 20-year research cycle.

Model Operations

Each person in the model is exposed once each simulated year to a set of events which are governed by a randomly generated number. Persons are assigned to categories such as no change, increase in disability level, institutionalization, and the like. For most people in most years no spectacular events occur, but the risk of a debilitating event grows with age and with acute care events. Thus for every year there is a predicted number of new NH and new ARCH patients, there is a current census of such patients, and at the end of the year places are made free by those who die. There is no firm cap set in the model to limit NH or ARCH beds, but the chance of getting into a bed is modeled on the current pattern of new admits.

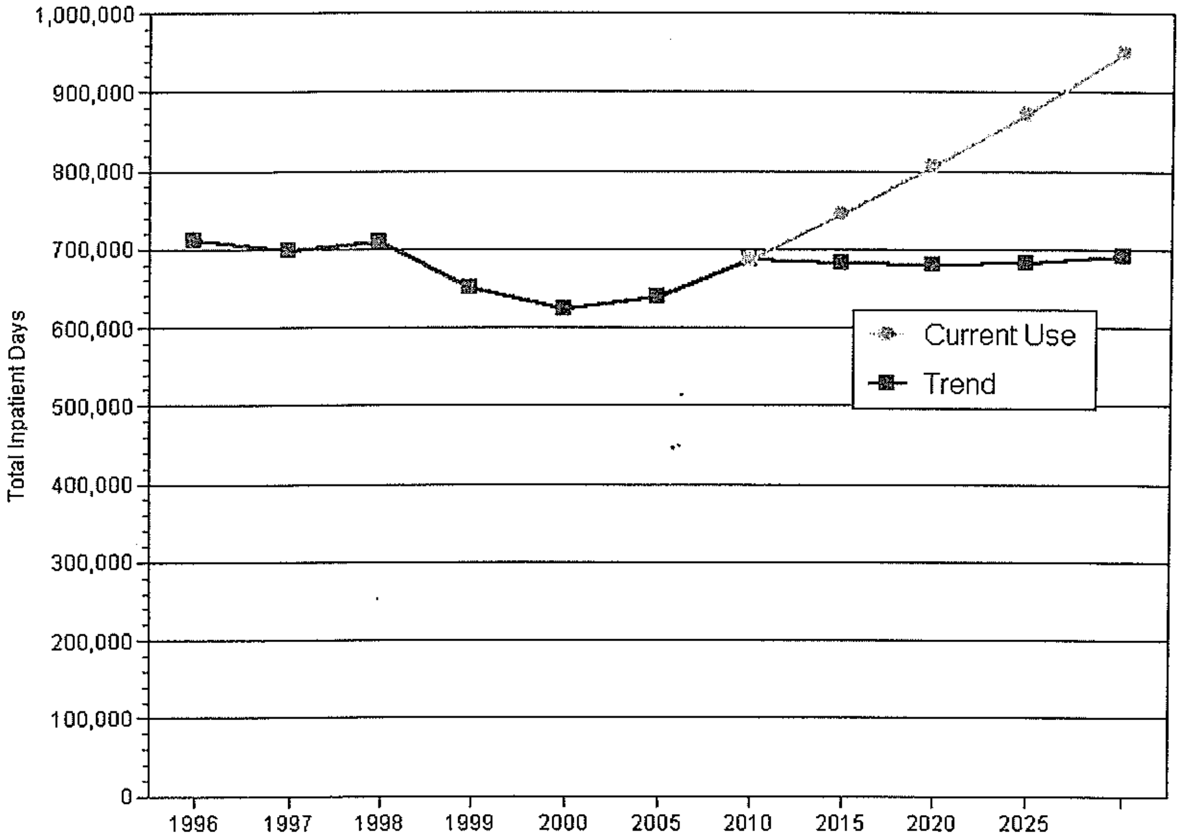
The model is run for 20 years, with each of the 70,000 model persons subjected to the random event processes every year. Typically ten iterations of the model are run, and the results from these iterations are averaged to minimize year-to-year variation driven by the random number system. A single, fixed set of random numbers is used for the entire simulation so that the changes which appear in the model are those due to varying policies, rather than those due to drawing a new set of numbers.

RESULTS

ACUTE CARE

The two models provide divergent predictions for Hawaii. The Current Use Projection model estimates increases of 17 percent in medical days and 16 percent in surgical days by 2010. By 2025, the Current Use Projection model estimates increases of 50 percent in medical days and 47 percent in surgical days. In other words, if we look strictly at the rate at which individuals used hospitals in 2000 and combine this with population estimates for 2010 and 2025, we project quite substantial increases in hospital use across the state, largely due to the aging of the population. 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. Efforts to more appropriately and efficiently discharge patients might well reduce the increases in bed days this model estimates. This assumes, however, that capacity is available in alternative settings, including personal care homes, through home care, and in rehabilitation facilities.

Figure 2: Total Inpatient Days, Current Use vs. Trend

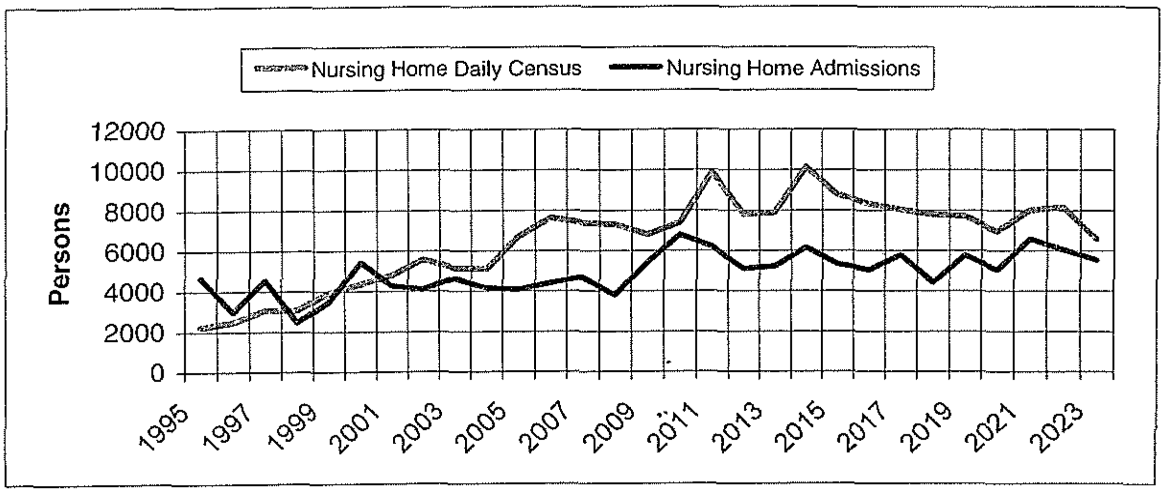


The Trend Analysis Model projects a less dramatic increase in the number of bed days required in 2010 and 2025. Specifically, it indicates that medical days will increase by 11 percent by 2010 and10 percent by 2025 over 2000 levels. Surgical days will increase by two-tenths of one percent by 2010 and six percent by 2025 over 2000 levels. These smaller increases stem partially from predictions that the decline in the average length of stay for inpatient surgeries that has occurred in the past 5 years will continue and become similar to mainland ALOS and that inpatient surgery will continue to move to the outpatient setting. From 1995 to 2000 there was a drop in the hospital days in Hawaii, although the rate per population at which people were discharged from hospital treatment was largely unchanged. This was achieved by falling lengths of stay and a move to outpatient surgery. This suggests that the lower growth rate in hospital bed use we are forecasting can likely be achieved.

LONG-TERM CARE

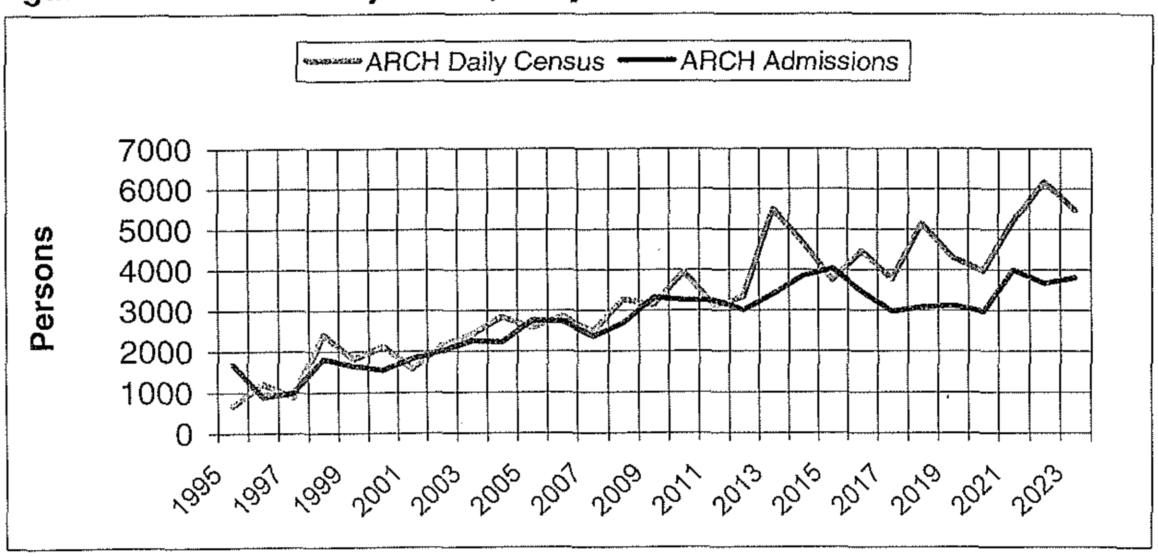
Observation of Hawaii's facilities provides insight into the key element in projecting NH usage in the state: people in Hawaii nursing homes are much more frail than those in similar facilities anywhere else in the United States. In effect, even if a 2-ADL standard were acceptable for admission to a NH under Medicaid, the current residents may be at 4 or 5 ADLs, and there may be folks with 3 or 4 ADLs on waiting lists. Thus the likelihood of a 2-ADL patient being admitted to a NH facility is much lower than that of the 3, 4, or 5 ADL patient. Any prediction model should take this into account.

Figure 3: Nursing Home Bed Projections, Daily Census vs. Admissions



Similar observations can be made for ARCHs. While a number of ARCH facilities operate with Medicaid waivers, ARCH patients are likely initially private pay, and may in fact enter the ARCH with a relatively low level of disability (perhaps 2 ADLs). The patients would enter generally on the assumption that they or their families have the ability to pay for the ARCH services.

Figure 4: ARCH Bed Projections, Daily Census vs. Admissions



DISCUSSION

One of the issues concerning both acute care models is the accuracy of the population projections. These projections were based upon the 1990 Census and population growth rates of the late 1980s and early 1990s. Clearly this growth slowed significantly during the later part of the 1990s. Since both models consider the total population growth as well as changes in demographic composition, significant variances in population would affect projections of future bed needs. Yet despite this limitation, these projections currently are the best available and do capture the aging of our population.

Additionally, population projections only identify changes in the age and sex composition of the population, but other changes in the make up of the population (e.g., ethnicity and 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.

For the LTC projection model, the limitations of the time series generated are fairly obvious: they are results of simulated behavior. There is variation from year to year that might seem extreme. Points could be smoothed by averaging over several years. The advantage of the variability over a smoothed series, however, is that it makes clear the need for future facilities planning to be able to respond to a range of likely outcomes, and not depend on one averaged or massaged number as the ultimate truth.

When considering the Trend Analysis Model, there are some assumptions that may or may not hold. One assumption is that trends in the use of outpatient surgery over inpatient surgery will continue. This assumption was maintained despite a recent dip in that trend, which accompanied a dip in outpatient visits for Hawaii in general. The basis of our assumption is driven by patterns elsewhere in the US. In much of the US, the move towards outpatient surgery has grown unabated. As techniques and technology improve, we feel that more procedures that are currently done on an inpatient basis will be done on an outpatient basis.

There is also a lack of outpatient surgery data at the level of age-sex groups for the state. As a result, this part of the analysis is the least certain. Instead of being able to get precise ratios at the various age-sex groupings, we had to estimate them based upon US data. As was pointed out in the methods, in the end we ended up estimating total surgeries and deriving the outpatient surgeries from our inpatient estimates. More granular data in this area would allow us to better ascertain the relationship between inpatient and outpatient surgery. Note that HHIC is currently collecting ambulatory surgery data from the hospitals, although the database is not yet sufficiently developed to enable use of the information for forecasting. Another approach to be pursued is to obtain outpatient surgery information, aggregated into age-sex groups, directly from the health plans.

We also assume that there is more room for improvement in Hawaii's ALOS. Currently our rate is much higher than that of the US, though we see no significant differences that can account for this. As Hawaii's ALOS has been decreasing over time, we assume that this trend will continue. It is possible, however, that there is something that we have not considered that keeps Hawaii's ALOS higher than the average. Again, since the Trend

Analysis Model's figures are derived in part from the assumption that ALOS will decrease, if gains in ALOS are not realized, projected numbers could be off.

A last assumption is where rate plateaus are reached among the various age groups. We used current US ALOS at the age group level as a control to keep age group rates from falling out of the norm. Significant improvements or lack of improvement at these age group levels may also impact our estimates. Again, the basis of this assumption is the decline in the ALOS that we observed in the data from 1995-2000 at the age group level.

Despite these assumptions, we feel optimistic that the Trend Analysis Model captures the trends that we can expect to see over the coming years. As we obtain more years of hospital data and new population projections, we feel that this model provides a better picture of future bed needs in Hawaii than does Current Use Projection. We also feel that using a model to project LTC bed needs is a more representative method to accommodate Hawaii's unique demographics and geography. As a result, we are cautiously optimistic about the ability of Hawaii's hospitals meeting acute care and LTC needs despite an aging population. Even if past trends do not continue, with reasonable assumptions taken into consideration and effective planning, Hawaii could accommodate increased demands on acute care hospitals and LTC facilities by treating patients requiring alternative forms of care—e.g., assisted living, home care, rehabilitation facilities, etc.—provided such alternatives are available. Future studies are needed to assess the reliability and applicability of the various methods presented in this report and determine how to incorporate both acute care and long-term care needs for long range facilities planning.

RECOMMENDATIONS

- Revisit hospital use patterns every five years and apply actual population figures, updated population projections, and hospital use to the 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 revisits 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 with patience. Any increased pressures that occur will be gradual.

  Hawaii has already accommodated a 7 percent increase in the elderly (65 and older) population between 1995 and 2000, a period when bed counts declined slightly.

- For projecting LTC beds, admissions should be considered a random event and account for the patient's likely assets and income at the time an institutionalized decision is made.

  This allows calculations to be continuous and account for the probabilities of transitions of non-institutionalized persons from one disability level to another. In other words, to calculate the likelihood that a patient will be more disabled in the next year.

- 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.

- Examine some of the specific impacts that technologies and policies have upon hospital use.

  While the trend analysis model assumes future improvements in technology, policy, and efficiency, it does not look specifically at the impacts of technologies and policies on hospital use. To gain a better appreciation of the impacts of future technologies and policies, examination of the effects of current technologies and policies on hospital use would be useful.

- When planning for future facilities use, any projection models should be able to accommodate and respond to a range of likely outcomes.

REFERENCES

Advance Data from Vital and Health Statistics. National Center for Health Statistics. 1994-2002; 1996-1998.

Centers for Disease Control and Prevention. "Ambulatory Surgery in the United States, 1994-1996."

CDC. "Outpatient Department Summary: National Hospital Ambulatory Medical Care Survey, 1992-2000."

Hospital Statistics. Health Forum, LLC, 1990-2002.

Johnson, DB. "State of Hawaii Non-Federal Acute Care Bed Projections by Bed Type, Island and County, 1995-2010." State Health Planning and Development Agency, April 1991.

Stewart, DK, Tate R, Finlayson G, et al. "Projecting Hospital Bed Needs for 2020." Manitoba Centre for Health Policy, June 2002. Available at http://www.umanitoba.ca/centres/mchp/reports.htm.

Y. Carrière. "The impact of Population Aging and Hospital Days." In E.M. Gee and G.M. Gutman (eds.) *The Overselling of Population Aging.* Oxford University Press, 2000. Cited in David K. Stewart, Robert Tate, et al.

Appendix A: Surgical and Non-Surgical Estimates for 2010 and 2025, Current Use Model

Age Group	Discharges	Days stay	ALOS	Population	Discharges per 1,000 Population	Days per 1,000 Population	Estimated Discharges	Estimated Days stay	Estimated ALOS	Estimated Population	Estimated Discharges per 1,000 Population	Estimated Days per 1,000 Population	Estimated Discharges	Estimated Days stay	Estimated ALOS	Estimated Population	Estimated Discharges per 1,000 Population	Estimated Days per 1,000 Population
	Female Surgical, 2000						**Female Surgical, 2010**						**Female Surgical, 2025**					
0-14	491	4,988	10.16	119,660	4.10	41.68	521	6,109	11.73	146,554	3.55	41.68	640	7,513	11.73	180,228	3.55	41.69
15-24	1,668	6,062	3.63	76,502	21.80	79.24	1,993	7,224	3.62	91,169	21.86	79.24	2,353	8,529	3.62	107,639	21.86	79.24
25-34	3,656	13,214	3.61	82,752	44.18	159.68	4,154	13,934	3.35	87,263	47.60	159.68	5,114	17,156	3.35	107,438	47.60	159.68
35-44	3,509	13,982	3.98	94,600	37.09	147.80	3,142	12,813	4.08	86,689	36.25	147.80	3,716	15,151	4.08	102,512	36.25	147.80
45-54	2,655	17,018	6.41	85,326	31.12	199.45	2,668	18,165	6.81	91,077	29.29	199.45	2,620	17,839	6.81	89,441	29.29	199.45
55-64	2,089	18,738	8.97	54,763	38.15	342.17	2,808	27,459	9.78	80,251	34.99	342.16	3,046	29,789	9.78	87,060	34.99	342.17
65-74	2,405	20,659	8.59	46,840	51.35	441.05	2,648	21,781	8.23	49,385	53.62	441.04	4,124	33,924	8.23	76,916	53.62	441.05
75-84	2,164	24,760	11.44	32,129	67.35	770.64	2,143	25,535	11.92	33,135	64.66	770.64	2,937	35,001	11.92	45,418	64.66	770.64
85+	778	10,225	13.14	10,294	75.58	993.30	1,323	18,232	13.78	18,355	72.07	993.30	1,923	26,508	13.78	26,687	72.07	993.29
	Male Surgical, 2000						**Male Surgical, 2010**						**Male Surgical, 2025**					
0-14	818	6,778	8.29	126,589	6.46	53.54	991	8,211	8.29	153,350	6.46	53.54	1,214	10,061	8.29	187,899	6.46	53.54
15-34	2,087	10,757	5.15	176,316	11.84	61.01	2,328	12,000	5.15	196,697	11.84	61.01	2,787	14,366	5.15	235,464	11.84	61.01
35-44	1,712	10,876	6.35	96,577	17.73	112.61	1,624	10,315	6.35	91,591	17.73	112.62	1,853	11,772	6.35	104,530	17.73	112.62
45-54	2,268	18,020	7.95	85,653	26.48	210.38	2,399	19,057	7.94	90,584	26.48	210.38	2,277	18,090	7.94	85,984	26.48	210.39
55-64	2,452	22,555	9.20	52,198	46.97	432.10	3,465	31,875	9.20	73,767	46.97	432.10	3,729	34,303	9.20	79,386	46.97	432.10
65-74	2,716	27,437	10.10	38,422	70.69	714.10	2,836	28,653	10.10	40,125	70.68	714.09	4,678	47,257	10.10	66,178	70.69	714.09
75-84	2,213	23,239	10.50	25,646	86.29	906.15	2,067	21,705	10.50	23,953	86.29	906.15	3,082	32,367	10.50	35,719	86.28	906.16
85+	604	8,750	14.49	7,270	83.08	1,203.58	1,049	15,198	14.49	12,627	83.08	1,203.61	1,323	19,173	14.49	15,930	83.05	1,203.58
	Non-Surgical, 2000						**Non-Surgical, 2010**						**Non-Surgical, 2025**					
0-14	5,116	17,574	3.44	246,249	20.78	71.37	6,228	21,391	3.43	299,904	20.77	71.33	7,643	26,252	3.43	368,127	20.76	71.31
15-34	20,499	61,265	2.99	335,570	61.09	364.61	22,899	68,381	2.99	375,129	61.04	182.29	27,589	82,365	2.99	450,541	61.24	182.81
35-54	20,154	94,409	4.68	362,156	55.65	260.69	16,488	74,041	4.49	359,941	45.81	205.70	17,535	78,630	4.48	382,467	45.85	205.59
55-64	9,082	51,621	5.68	106,961	84.91	482.62	11,305	62,053	5.49	154,018	73.40	402.90	12,211	67,033	5.49	166,446	73.37	402.73
65-74	8,247	53,019	6.43	85,262	96.73	621.84	10,477	64,389	6.15	89,510	117.05	719.35	16,818	103,449	6.15	143,094	117.53	722.95
75-84	8,384	58,611	6.99	57,775	145.11	1,014.47	11,450	79,157	6.91	57,088	200.57	1,386.58	16,015	110,273	6.89	81,137	197.38	1,359.09
85+	5,736	43,288	7.55	17,564	326.58	2,464.59	10,098	76,153	7.54	30,982	325.94	2,457.98	13,746	103,256	7.51	42,617	322.56	2,422.89
	Total, 2000						**Total, 2010**						**Total, 2025**					
0-14	6,425	29,340	4.57	246,249	26.09	119.15	7,739	35,711	4.61	299,904	25.81	119.07	9,498	43,826	4.61	368,127	25.80	119.05
15-34	27,910	91,298	3.27	335,570	83.17	272.07	31,374	101,539	3.24	375,129	83.63	270.68	37,844	122,416	3.23	450,541	84.00	271.71
35-54	30,298	154,305	5.09	362,156	83.66	426.07	26,321	134,391	5.11	359,941	73.13	373.37	28,000	141,482	5.05	382,467	73.21	369.92
55-64	13,623	92,914	6.82	106,961	127.36	868.67	17,578	121,387	6.91	154,018	114.13	788.14	18,987	131,125	6.91	166,446	114.07	787.79
65-74	13,368	101,115	7.56	85,262	156.79	1,185.93	15,961	114,823	7.19	89,510	178.32	1,282.79	25,620	184,630	7.21	143,094	179.04	1,290.27
75-84	12,761	106,610	8.35	57,775	220.87	1,845.26	15,660	126,397	8.07	57,088	274.31	2,214.07	22,034	177,641	8.06	81,137	271.57	2,189.39
85+	7,118	62,263	8.75	17,564	405.26	3,544.92	12,470	109,583	8.79	30,982	402.49	3,536.99	16,993	148,937	8.76	42,617	398.73	3,494.78

Appendix B: Surgical and Non-Surgical Estimates for 2010 and 2025, Trend Analysis Model

Age Group	Female Surgical, 2000						Female Surgical, 2010						Female Surgical, 2025					
	Discharges	Days stay	ALOS	Population	Discharges per 1,000 Population	Days per 1,000 Population	Estimated Discharges	Estimated Days stay	Estimated ALOS	Estimated Population	Estimated Discharges per 1,000 Population	Estimated Days per 1,000 Population	Estimated Discharges	Estimated Days stay	Estimated ALOS	Estimated Population	Estimated Discharges per 1,000 Population	Estimated Days per 1,000 Population
0-14	491	4,988	10.16	119,660	4.10	41.68	553	4,841	8.76	146,554	3.77	33.03	581	5,094	8.76	180,228	3.23	28.26
15-24	1,668	6,062	3.63	76,502	21.80	79.24	1,807	6,739	3.73	91,169	19.83	73.91	1,908	6,706	3.51	107,639	17.73	62.30
25-34	3,656	13,214	3.61	82,752	44.18	159.68	3,387	11,525	3.40	87,263	38.82	132.08	3,267	10,152	3.11	107,438	30.41	94.49
35-44	3,509	13,982	3.98	94,600	37.09	147.80	2,799	11,117	3.97	86,689	32.29	128.24	2,869	10,011	3.49	102,512	27.98	97.66
45-54	2,655	17,018	6.41	85,326	31.12	199.45	2,564	14,752	5.75	91,077	28.15	161.98	2,166	11,671	5.39	89,441	24.22	130.49
55-64	2,089	18,738	8.97	54,763	38.15	342.17	2,654	21,856	8.23	80,251	33.07	272.34	2,479	19,119	7.71	87,060	28.47	219.61
65-74	2,405	20,659	8.59	46,840	51.35	441.05	2,341	20,214	8.63	49,385	47.41	409.31	3,273	26,492	8.10	76,916	42.55	344.43
75-84	2,164	24,760	11.44	32,129	67.35	770.64	2,224	22,701	10.21	33,135	67.12	685.11	3,029	26,992	8.91	45,418	66.70	594.30
85+	778	10,225	13.14	10,294	75.58	993.30	1,461	17,533	12.00	18,355	79.60	955.22	2,284	22,643	9.91	26,687	85.60	848.46
	Male Surgical, 2000						**Male Surgical, 2010**						**Male Surgical, 2025**					
0-14	818	6,778	8.29	126,589	6.46	53.54	966	8,140	8.42	153,350	6.30	53.08	1,154	9,718	8.42	187,899	6.14	51.72
15-34	2,087	10,757	5.15	176,316	11.84	61.01	1,846	9,005	4.88	196,697	9.39	45.78	1,706	7,600	4.46	235,464	7.24	32.27
35-44	1,712	10,876	6.35	96,577	17.73	112.61	1,547	8,708	5.63	91,591	16.89	95.07	1,762	8,302	4.71	104,530	16.86	79.42
45-54	2,268	18,020	7.95	85,653	26.48	210.38	2,245	15,939	7.10	90,584	24.78	175.96	1,936	12,025	6.21	85,984	22.51	139.85
55-64	2,452	22,555	9.20	52,198	46.97	432.10	3,052	26,077	8.54	73,767	41.38	353.51	2,723	21,145	7.77	79,386	34.30	266.35
65-74	2,716	27,437	10.10	38,422	70.69	714.10	2,767	26,462	9.56	40,125	68.96	659.49	4,384	38,451	8.77	66,178	66.25	581.03
75-84	2,213	23,239	10.50	25,646	86.29	906.15	2,000	20,145	10.07	23,953	83.51	841.02	2,786	24,739	8.88	35,719	77.99	692.60
85+	604	8,750	14.49	7,270	83.08	1,203.58	1,046	12,786	12.23	12,627	82.83	1,012.62	1,369	13,879	10.14	15,930	85.96	871.26
	Non-Surgical, 2000						**Non-Surgical, 2010**						**Non-Surgical, 2025**					
0-14	5,116	17,574	3.44	246,249	20.78	71.37	5,665	18,608	3.28	299,904	18.89	62.04	5,716	17,476	3.06	368,127	15.53	47.47
15-34	20,499	61,265	5.97	335,570	61.09	364.61	20,950	99,558	4.75	375,129	55.85	265.40	21,716	74,099	3.41	450,541	48.20	164.47
35-54	20,154	94,409	4.68	362,156	55.65	260.69	18,795	73,920	3.93	359,941	52.22	205.37	19,245	59,039	3.07	382,467	50.32	154.36
55-64	9,082	51,621	5.68	106,961	84.91	482.62	12,465	62,464	5.01	154,018	80.93	405.57	12,535	51,727	4.13	166,446	75.31	310.77
65-74	8,247	53,019	6.43	85,262	96.73	621.84	9,014	49,850	5.53	89,510	100.71	556.92	15,638	70,122	4.48	143,094	109.29	490.04
75-84	8,384	58,611	6.99	57,775	145.11	1014.47	8,504	49,141	5.78	57,088	148.97	860.80	12,590	57,687	4.58	81,137	155.17	710.98
85+	5,736	43,288	7.55	17,564	326.58	2,464.59	10,712	69,573	6.49	30,982	345.76	2,245.61	16,053	86,257	5.37	42,617	376.67	2,023.99
	Total, 2000						**Total, 2010**						**Total, 2025**					
0-14	6,425	29,340	4.57	246,249	26.09	119.15	7,184	31,588	4.40	299,904	23.95	105.33	7,451	32,288	4.33	368,127	20.24	87.71
15-34	27,910	91,298	3.27	335,570	83.17	272.07	27,991	126,827	4.53	375,129	74.62	338.09	28,597	98,556	3.45	450,541	63.47	218.75
35-54	30,298	154,305	5.09	362,156	83.66	426.07	27,951	124,436	4.45	359,941	77.65	345.71	27,977	101,049	3.61	382,467	73.15	264.20
55-64	13,623	92,914	6.82	106,961	127.36	868.67	18,171	110,398	6.08	154,018	117.98	716.78	17,737	91,991	5.19	166,446	106.56	552.67
65-74	13,368	101,115	7.56	85,262	156.79	1185.93	14,123	96,525	6.83	89,510	157.78	1078.38	23,295	135,066	5.80	143,094	162.80	943.90
75-84	12,761	106,610	8.35	57,775	220.87	1845.26	12,729	91,987	7.23	57,088	222.97	1611.32	18,405	109,418	5.94	81,137	226.84	1348.56
85+	7,118	62,263	8.75	17,564	405.26	3544.92	13,219	99,893	7.56	30,982	426.68	3224.22	19,706	122,778	6.23	42,617	462.41	2880.97