Hospital utilisation expectancies in New Zealand, 1980-98

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Abstract

The need to synthesise mortality and morbidity information to achieve a more global and relevant measure of population health status is well recognised, with health expectancy indices being the most common approach used to date. Using New Zealand hospital discharge and mortality data over the 1980-98 period, we introduce readers to a newly developed health index, the Hospital Utilisation Expectancy (HUE). We describe how HUE changes with age and over time. New Zealand national and regional trends are described. The methodological strengths of the measure and its applications in the health sector are discussed.

Background

In recent years, attempts have been made to synthesise mortality and morbidity indices to achieve a more global and relevant measure of population health status than using either on its own. Research on population health status indices has concentrated on quantifying the relationship between mortality and morbidity in order to predict future health trends.

Health expectancy (HE) (Robine and Michel 1992, Bone et al 1995) and Disability Adjusted Life Years (DALY) (Murray and Lopez 1996) are two macro-level indices developed over the last decade. They are being used ever more frequently by governments and health planners to describe the health status of the population.

Of the two methods, the HE is less data demanding yet is strongly driven by empirical data. Since 1993 OECD has included HE in its official health statistics and the *World Health Report*, 1997 (WHO 1997) emphasised HE as a key indicator of population health. HEs have been reported for New Zealand in three publications, using different methodologies (Davis et al 1999, Graham and Davis 1990, Tobias and Cheung 1999).

The feasibility of combining level of mortality with data on public hospitalisations was first explored by New Zealand researchers (Cheung 1999, Pool and Cheung 1999, Tobias and Christie 2000). Such a population health tool would have many technical advantages (see Cheung 1999 and also Methodological Discussion later in this article). The resultant index, called Hospital Utilisation Expectancy (HUE), is an extension of conventional Health Expectancies in which mortality and morbidity data are combined into a single measure (Cheung 1999, Pool et al 2000). This paper reports on a study that obtained national and regional HUE estimates for New Zealand over the 1980-98 period.

Conceptually, the hospital utilisation component in the HUE is a proxy for the quality of life as is done in HE counterparts. In a sense, time in hospital represents a severe loss of quality of life. In practice, hospital bed day rates reflect the cross-sectional probability of being hospitalised at a certain age. These rates thus not only capture health status, but also interactions with other factors that determine hospital use. For example, as will be shown in this article, a high HUE does not necessarily reflect poorer health status. Therefore, instead of being purely an indicator of health status, HUE incorporates the *relationship* between health status (in particular, mortality) and hospital utilisation (itself a variable with many determinants and influences).

Data sources and methods

In our study, data for the hospital utilisation component were obtained from New Zealand Health Information Services hospital discharge dataset that has been collected in New Zealand since the 1880s and that allows regional analyses from the late 1970s onwards. Data for the mortality component were obtained from New Zealand Health Information Services counts of the official mortality registration. Rates were calculated using Census population counts for Census years (from Statistics New Zealand) and inter-censal estimates.

An 18-year period between 1980-1998 was chosen for our study. Some important policy and data collection changes took place during this period which influenced the way hospital discharge data were prepared, analysed and interpreted (Katzenellenbogen et al, in press (a)). Because of these changes, longitudinal comparisons of discharge data are invalid without some adjustments to the data. Adjustments were done in a series of steps that filtered out certain categories of discharge, so that the study relates to medical-surgical inpatient discharges only (Katzenellenbogen et al in press (b)).

For each age group, age-specific rates of hospital discharges are combined with the age group specific average length of hospital stay to calculate the period prevalence of hospital utilisation in the population. This set of period prevalence rates is then incorporated into the life table using Sullivan's observed prevalence life table method (Sullivan 1971). This allows the disaggregation of life expectancy into time either in or outside public hospitals. Since the former is expected to be only a fraction of life expectancy at each age, the focus is on the time spent in hospitals instead of trying to capture states of positive health (which is the normal focus of the general family of health expectancy methods).

The resultant HUE yields the number of days while still surviving, that a person of a particular age can expect to spend in hospital (Cheung 1999, Pool et al 2000). The number of days is selected as the unit of measurement because the results tend to be artificially suppressed to insignificance when expressed in number of years.

We focus on the 1980-98 period. However, it should be noted that New Zealand national HUEs have previously been calculated back to 1951, thus giving an historical and cohort perception on the changing mortality/morbidity interaction (Cheung 1999).

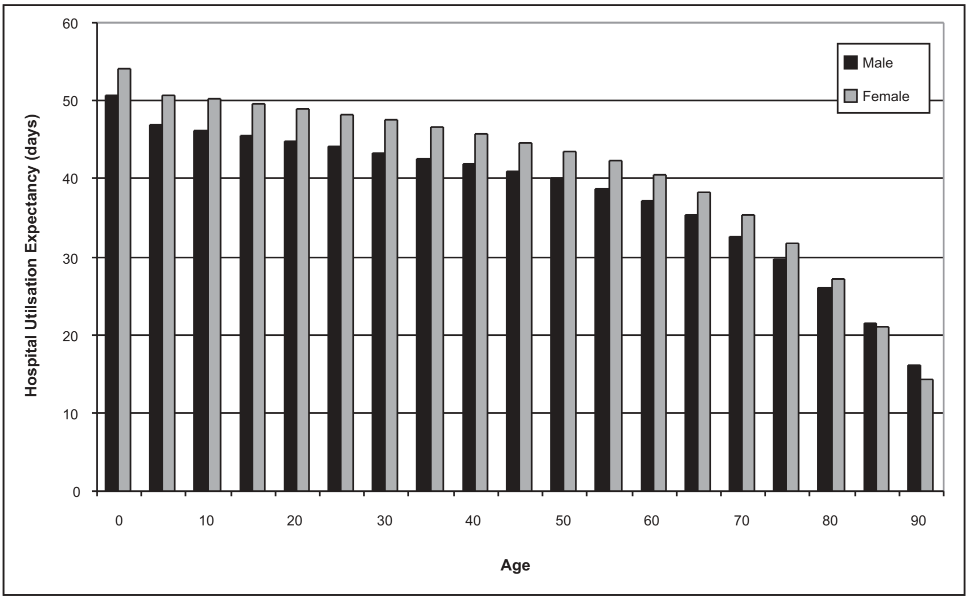
In this article, some results of cross-sectional analyses are shown for 1982, 1989 and 1996. These years were selected to represent the beginning, middle and end years of the time period being studied. The choice of 1982 is based on the need for quality records on children achieved by the introduction of registration of newborns and deliveries in the hospital discharge dataset from 1981. In addition, mortality information was complete up to 1996.

Results

Hospital utilisation expectancy in 1996

HUE at age x (denoted by HUEx) gives the expected number of days in hospital at ages x onwards to the end of life, taking account of mortality. Figure 1 shows HUEs by age and gender for the New Zealand population in 1996.

Figure 1: National Hospital Utilisation Expectancy by Age, by Gender, 1996



As noted above, hospitalisation can be expected to occupy a small portion of future life expectancy at all ages. In 1996 a newborn male could expect to spend a total of 51 days in public hospital during his lifetime. The corresponding figure for a newborn female is 54 days. These numbers represent less than a fifth of one percentage of their respective life expectancy at birth.

From the time of birth, HUE reduces systematically with age, reaching 21 days at age 85 years for both males and females in 1996. However, the reduction in HUEs is not uniformly spread over the age groups. There is a sharp drop in HUE between birth and age five; though not shown in Figure 1, most of the drop occurred in the first year of life. The curve is fairly even at childhood and young adulthood, but starts to decline exponentially after reaching the end of the reproductive ages. The sharpest decline occurs at the oldest ages.

Trends in hospital utilisation expectancies in New Zealand

Trends in HUEs are reported here at two age points: at birth (HUE_0) and at age 65 years (HUE_{65}). The former sums the expected hospital days across all ages and thus provides a complete picture. The latter focuses on the life cycle stages where hospital use tends to be most intense.

Over the period 1980-1998, HUE_0 of New Zealand males decreased by 40% (or 31 days) from 78 days to 47 days, and for females decreased by 44% (or 39 days) from 88 days to 49 days (see Figure 2). The decline in HUE_0, however, did not occur in a linear fashion over the time period. The 1980-84 period was one of minimal change in HUE_0, followed by the 1984-92 period of substantial decrease. The 1992-96 period was characterised by a one-day increase followed by a continuing decline in HUE_0.

Female HUE_0 was consistently above that of males. This is opposite to the pattern in hospital bed day rates where male rates were higher (see Figure 3). It should be noted that hospital bed day rates did not take account of mortality. This highlights the fact that, despite having higher levels of mortality (i.e. being of poor health status) and having higher rates of hospitalisation while living, males can be expected to spend fewer days in hospital because of their shorter life expectancy which allows them less opportunity to be hospitalised.

In 1980, female HUE_0 were 12% higher than those for males. By 1998, female HUE_0 was only 4% higher than that of the male HUE_0 showing that gender disparity in HUE_0 had narrowed substantially.

Figure 2: National Hospital Utilisation Expectancy at Birth and at Age 65 Years, by Gender, 1980-98

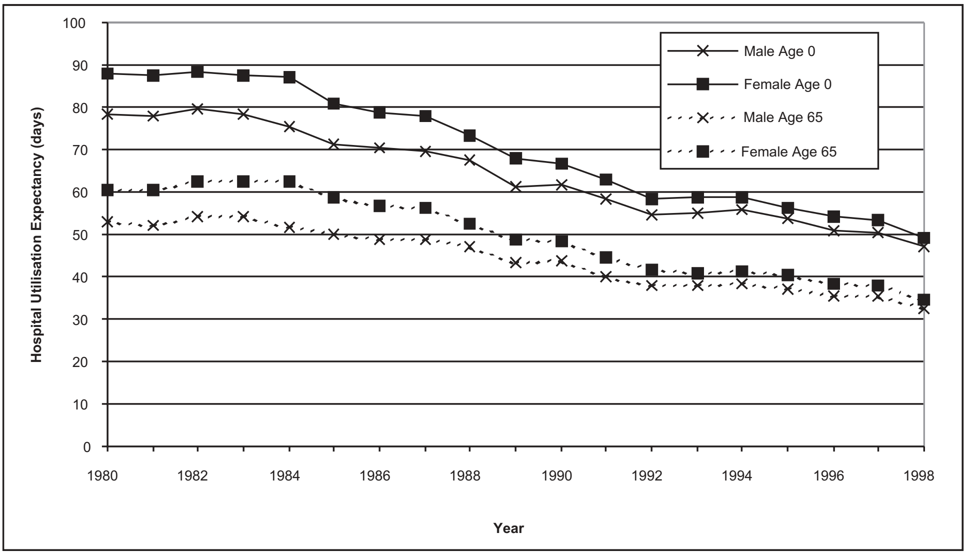


Figure 3: Life Expectancy at Birth and Age-standardised Bed Day Rates, New Zealand 1980-98

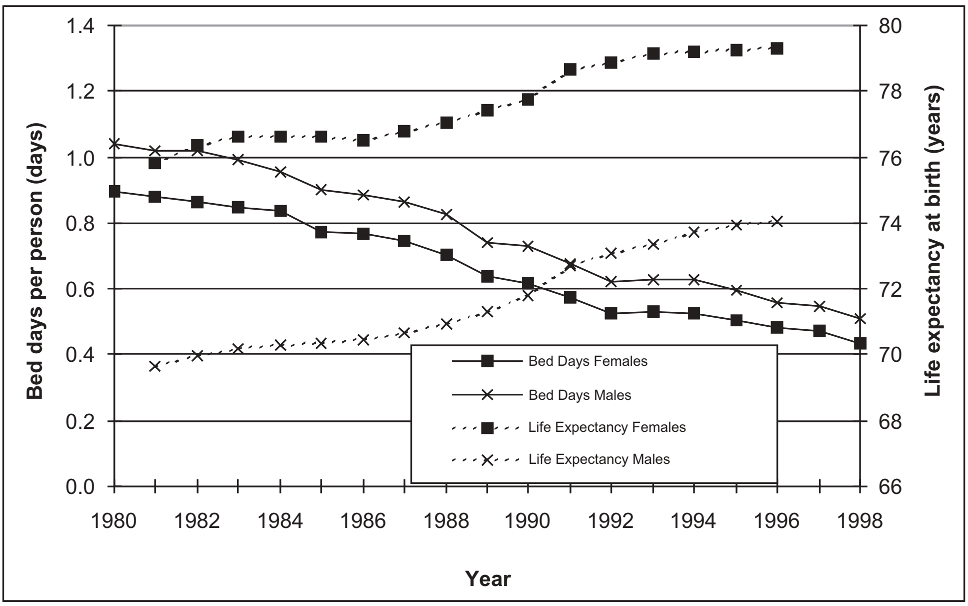


Figure 3 juxtaposes changes in the bed day rates (age-standardised to the 1991 New Zealand population) and life expectancy at birth over the time with changes in HUE_0 so that the influence of these factors on HUE_0 can be traced. The decrease in HUE_0 roughly followed the pattern of decrease in population-based hospital day rates although moderated by life expectancy changes over time.

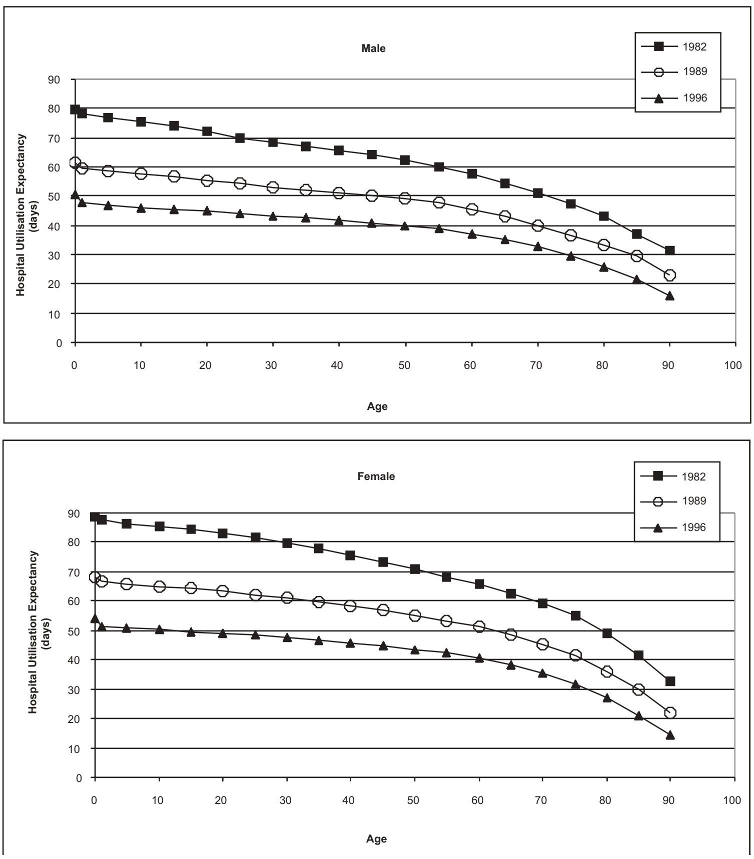
Turning specifically to older ages, the HUE_{65} of New Zealanders decreased by 38% (or 20 days) for males and 43% (or 26 days) for females over the period 1980-1998 (see Figure 2). The percentage decrease in HUE_{65} was slightly lower than that for HUE_0, suggesting that greater decreases occurred among younger people. Female HUE_{65} was consistently above that of males, though the disparity had reduced substantially. In 1980, female HUE_{65} was 14% higher than those for males. By 1998, female HUE_{65} (35 days) was only 6% higher than that for males (33 days).

The early 1980s period was characterised by a small increase in HUE_{65}. This was due to relatively stable hospital bed day rates at older ages in conjunction with an increase in life expectancy at these ages. From 1985, HUE_{65} decreased more or less continuously until the end of the time period, with the possible exception between 1992-94. The 5-year period from 1987 to 1992 was a period of substantial decrease, accounting for over 50% of the total decrease in HUE_{65} over the 18-year period.

Changes in hospital utilisation expectancies, by age

The secular downward trend in HUEs as identified above was established for all age groups included in our study. Figure 4 illustrates the changes in HUEs by age for 1982, 1989 and 1996.

Figure 4: Hospital Utilisation Expectancy by Age: New Zealand 1982, 1989 and 1996



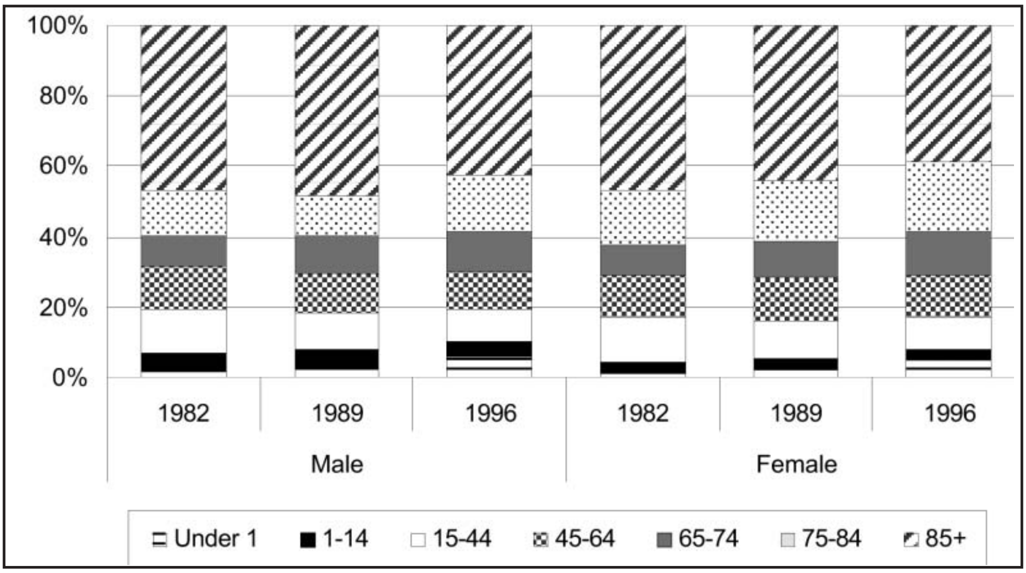
While there was a substantial drop in HUEs at all ages over the time period as discussed above, the shape of the age trajectory flattens considerably. That is, the expected number of hospital days over the entire lifetime has been increasingly reduced into a smaller interval. At the same time the shortened hospital days have shifted up the age spectrum and been compressed into a narrower age range. These findings provide empirical support to the theoretical argument of the compression of morbidity (see Cheung 1999). It can be reasonably concluded that improved survivorship at older ages in recent decades was not realised at the expense of prolonged hospital stay, and therefore a compromised quality of life of the older population.

Changes in age distribution of hospital utilisation expectancy at birth

This part of the analysis looks at how the total of expected hospital bed days over the lifetime, as summed at birth, is distributed across different age groups; that is, how the number of hospital days as measured by HUE_0 is being lived out at different ages. Figure 5 shows the percentage contribution of different age groups to HUE_0 for 1982, 1989 and 1996.

The percentage contribution of the 65 and over age groups to HUE_0 was fairly consistent, with that for males being 67-70% and for females being 69-73% over the time period. That is, hospital bed days at ages 65 and above represent more than two-thirds of all days spent in hospital over the course of the lifetime. Looking at finer age groups, the percentage contribution to HUE_0 increased for the 65-74 year, 75-84 year and under-1 year age groups. In contrast, the remaining age groups saw reduction in their percentage contribution to HUE_0, with ages 15-44 and especially 85 years and over having the greatest reduction in percentage contribution.

Figure 5: Percentage Contribution of Age Groups to Hospital Utilisation Expectancy at Birth: New Zealand 1982, 1989 and 1996



In absolute terms, the most substantial reduction in expected hospital days occurred in the 85 year and over group, while the contribution of the 65-74 year age group decreased slightly over the time period. The contribution of infants to HUE_0 was the only one to increase in absolute terms.

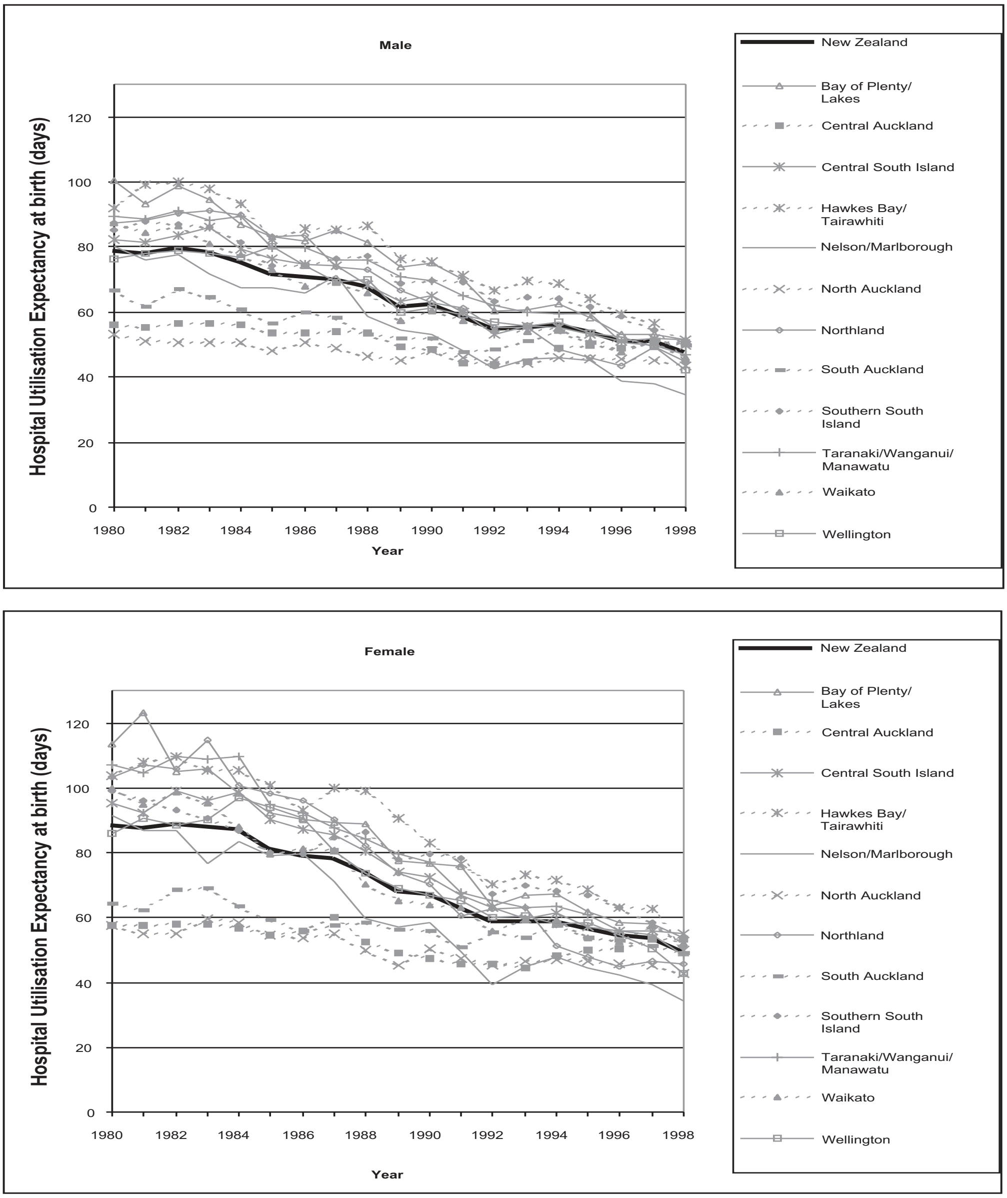
Patterns of hospital utilisation expectancies in 12 New Zealand regions

For the spatial analysis of HUE, we divided New Zealand into 12 regions. The composition of these regions was based on geographically contiguous local authorities, with some community of interest (Katzenellenbogen et al 2001). Our focus here is the general regional trends rather than the details of each region, with the underlying objective of exploring the applicability of the HUE methodology at sub-national levels.

Over the 1980-98 period, all regions experienced substantial decreases in hospital bed day rates and increases in life expectancy at birth (Katzenellenbogen et al 2001). This resulted in HUE_0 decreasing for all regions, although the extent of decrease varied from region to region (see Figure 6).

The widespread decrease was reflected in the substantial decrease in national HUE_0 for both males and females. Furthermore, regional HUE_0 converged to the national figure, with the main convergence occurring between 1985 and 1993. Regional variation from the national HUE_0 was less for males than females, so that the convergence is more marked in the female figures.

Figure 6: Regional Hospital Utilisation Expectancy at Birth for New Zealand Regions, 1980-98



The 12 regions can roughly be divided into three groups, according to their HUE_0 level relative to New Zealand in the early 1980s: those that were considerably above the national level, those that were at about the national level and those that were well below the national level. Group 1 comprises Bay of Plenty/Lakes, Hawkes Bay/Tairawhiti, Northland, and Taranaki/Wanganui/Manawatu. Group 2 comprises Central South Island, Nelson/Marlborough, Southern South Island, Waikato, and Wellington. Group 3 comprises Central Auckland, North Auckland, and South Auckland.

The first group tended to remain above the New Zealand level for the duration of the period except for Northland, which reduced substantially to below the national level in the early 1990s. Convergence of the remaining regions was very marked.

The second group maintained the middle ground except for Nelson/Marlborough, which started just above the national level and from 1988 reduced steeply to the lowest position relative to other regions. By 1998, the Nelson/Marlborough HUE_0 were 27% and 30% lower than the national levels for males and females respectively. Wellington showed evidence of a drop relative to New Zealand in the late 1990s.

The third group, comprising the three regions around the metropolitan Auckland, is characterised by extremely low HUE_0 levels relative to New Zealand in the early to mid-1980s. Unlike the other regions, the absolute levels changed little over the period, although from 1992 the South Auckland HUE_0 increased somewhat to reach the level of the intermediate group. From 1995, Central Auckland levels increased in absolute and relative terms to end at a level above New Zealand. North Auckland remained below the national level but by a much lower margin. When considering these three regions as one metropolitan Auckland area (containing a third of the New Zealand population), it appears as if all regions outside of metropolitan Auckland converged to the relatively low metropolitan Auckland levels.

Discussion of results

The chief findings of the study are that New Zealand HUEs, gender discrepancies in HUE, and regional variation in HUEs have all decreased over the last 18 years. These results were driven by the increase in life expectancy coupled with the decreasing hospital bed day rates, which were countrywide. The increased use of day procedures from the late 1980s had a major impact on hospital bed day rates. The strong convergence of regional HUE_0 to the national also partly reflects more uniformity in hospital admission policies brought about by health system changes from the late 1980s.

The relatively stable HUE_0 in the early 1980s reflects the declining mortality rates at most ages in conjunction with the slight drop in bed day rates at the time. The corresponding HUE_{65}, which increased slightly from 1982-83, reflect the relatively stable bed day rates in the older age groups, in association with an increasing life expectancy at age 65 years.

A combination of rapid decreases in the age-standardised hospital bed day rates and constant decreases in mortality (corresponding to a substantial increase in life expectancy at birth especially from 1986-91) account for the significant drop in HUE_0 in the 1984-92 period. The slightly less dramatic decrease in HUE_{65} during this period is due to the larger survivorship gains made in the age groups over 65 years.

The marginal increase in HUE_0 between 1992-94 is the result of a temporary and small reversal in the declining trend in bed day rates. This coincides with major health sector changes in which funder/provider split was first introduced. The resumption of gradual decrease in HUE_0 and HUE_{65} from 1994-98 reflects the gradual and continuing changes in mortality and bed day rates during that time.

The convergence of HUEs for males and females can be explained partly by the narrowing of the survivorship gap between them. Male and female hospital bed day rates also converged, probably reflecting supply side factors such as more uniform and stringent admission criteria and increased community support. There is insufficient evidence using our method that there was a decreased need for hospital admission among males.

Thus the substantial reduction in HUEs over the 18 years can be explained both by changes in health status as reflected by mortality patterns and by hospital utilisation. The latter was also influenced in turn by significant changes in clinical and hospital management due to political, economic and technological transformations. In general, the percentage reduction in HUE was greater for younger than older people, largely due to the increased survival (which raises HUE) at older ages. However, HUEs for people 85 years and older dropped as a percentage of the total HUE, possibly reflecting supply side effort to reduce hospitalisation in this high utilisation group through increased community support.

Methodological discussion

Useful properties of HUE

Like their parent Health Expectancy methodology, HUEs are empirically grounded and therefore not heavily dependent on assumptions, and this distinguishes them from other commonly used measures synthesising mortality and morbidity, such as QALYs. Unlike Health Expectancies, however, HUEs use existing population-based discharge data as against data requiring specially designed sample surveys.

This is a property that has major advantages. Above all, their use of readily accessible data that involve large numbers going back decades makes time series comparisons possible. For geographical analyses, this property is very valuable, as there are sufficient numbers in cells to allow regional analyses.

Ethnicity analyses should also be enhanced although in New Zealand ethnic counts are not strictly comparable over time due to changes in how ethnicity has been recorded since 1980 (Katzenellenbogen et al, 2001). In contrast, since numbers are typically small in sample surveys, health expectancies can only be satisfactorily computed for New Zealand as a whole for one point in time (1996/7) (Tobias and Cheung 1999).

Few countries have sufficient data to calculate health expectancies over a period of time at the regional level (Gutierrez-Fisac et al 2000, van Oyen et al 1996, Bone et al 1995). In New Zealand, HUEs have been taken back at a national level as far as 1951 (Pool and Cheung 1999). Because of a lack of geo-coded data prior to 1978, HUEs cannot be done at a regional level before that time.

Another useful property of HUEs is that the measure combines both duration and prevalence, so the results are not affected by problems of multiple admission (Cheung 1999). This unique feature enhances the analytical power of HUEs and their utility for health services management.

The methodology can be extended to other types of services and interventions. HUEs can (and should) be calculated for mental health, maternity and long-term hospital services to complete the picture of all-type hospital use. In addition, the same methodology can be extended to other population health variables – for example, time in a disabled state or on a benefit or receiving community support services.

HUEs can also be calculated for different aggregations or clusters of discharges, thereby further extending the utility of the measure. Discharges can be grouped by almost any characteristic including diagnosis (specific disease or disease chapter), type of discharge, or level of preventability (Katzenellenbogen et al 2001).

In summary, the strengths of HUE are in its ability to be applied at different levels, geographically, by causes groups and longitudinally. Furthermore, in all levels of application the HUE methodology will retain its distinctive advantage with significantly larger cell sizes compared to its potential competitors.

Limitations of the HUE methodology

As alluded to earlier, the HUE methodology is not geared to address causal relationships between the supply and availability of health services and level of utilisation. The level of hospital use represents a complex interaction of a range of factors, among which the health status of the population and therefore its level of need for hospital services is merely one integral component of the formula.

Supply-side factors include the available of services, relative access to the services by the population, and administrative practices which can vary considerably between hospitals. In addition, the availability of services in a private setting (ie, those funded privately that may or may not be performed in public hospitals) also has an effect on the level of public hospital use.

Like many other tools in studying population health, HUE is not entirely free from potential pitfalls. In this case, trends may reflect underlying changes in the composition of the population. Populations studied using HUE essentially represent the average of demographically different sub-population groups. For example, distinctive patterns of risk exposure and service use by different major ethnic groups and / or birth cohorts would be distorted in an "averaged" synthetic measure. Ethnicity-specific analysis and the analysis by selected birth cohorts, although information is somewhat limited, can help to demonstrate this point.

Other limitations not specific to HUE analysis are errors in both population data and hospital data. Numerator errors in hospital data, particularly variations between hospitals, may impose some limitations on regional analysis of HUE.

Conclusion

HUEs reflect not only health status (demand factors) but also health system (supply) factors. Through this property, HUE provides a more comprehensive picture and thereby offers applications for health systems research. At the same time, the methodology presents a challenge to unravel health status and health system factors from one another.

HUEs can be used to predict where the burden of resource use will be in terms of hospital utilisation, taking into account bed day rates and survival. Its usefulness as a tool for health services planning and management is thus in its analytical ability in planning for the volumes of services required in the future. Indeed, to date, HUEs have been reported in population health needs assessment reviews in two health districts in New Zealand (Portal Consulting 1999a-d, Jackson et al 2001).

In countries where national population-based health statistics and survey-based estimates of health and disability status are rare or limited to certain districts/cities, HUE offers also the potential for a reliable health indicator (Pool et al 2000).

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