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Ageing and utilisation of hospital services in Hong Kong: a retrospective cohort study

Key Messages

1. In the 3 years before death, older age-groups do not use inpatient hospital services more than younger age-groups. However, they do use more accident and emergency department services.
2. No compression in morbidity was demonstrated.
3. Data obtained from this retrospective study may be used to project future usage for each type of service as a result of the changing age structure of the population, so as to facilitate health care planning.
4. Health care costs as a result of the changing age structure of populations may also be estimated more accurately, instead of assuming a linear increase in all types of services with age.

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Introduction

Ageing populations result in increasing health care expenditure, as the prevalence of chronic diseases and disability increases with age. However, proximity to death, rather than age, is the main cost driver, whereas improving health as a result of health promotion interventional programmes is also a determining factor. Projection studies using age-specific costs may exaggerate the impact of ageing. Most of these studies examine the use of acute medical services, but the cost of community care (social, nursing services) may follow a different pattern, and should be taken into account in the overall assessment of projected health service needs of ageing populations. Examining the use of services in the final years of life may provide more accurate prediction of future needs. This study tests the following hypotheses: (1) In the 3 years before death, older age-groups do not use hospital services more than younger age-groups; (2) the use of hospital services in the older age-groups in the 3 years before death declined between 1999 and 2005, as a result of compression of morbidity.[1]

Methods

The study was conducted from November 2006 to April 2008. Deaths occurred in all Hospital Authority hospitals from 1 January 1999 to 31 December 2005 were included. The number of admissions and durations of hospital stay during the final 12, 24 and 36 months of life were calculated for each death. For multivariate analyses we used negative binomial regression models with duration of hospital stay of 12, 24, and 36 months before death as the outcome variables, person-years as offset, and age, gender, year of death (period), and birth cohort as predictor variables. In order to test whether usage of hospital services before death was influenced by age at death, we fitted age-period models with duration of hospital stay in the final 12, 24, and 36 months of life as the outcome variables. Age was grouped as 0-4, 5-15, 16-24, 25-44, 45-64, 65-74, 75-84, 85+ years, and period as 1999-2000, 2001-2002, and 2003-2005. The effects of age and period were modelled using indicator variables, with the age-group 65-74 years and the period 1999-2000 as the references.

Results

For the 3 years before death, the longest duration of hospital stay occurred in the age-group of 5-15 years, with the shortest being the age-group of 25-44 years (Fig 1). Duration of hospital stay rose slightly from age 44 years onwards, reaching a plateau in the age-group of 75-84 years. The pattern was the same for 2 years before death. Differences in duration of hospital stay for 1 year before death for different age-groups were less marked. The longest occurred in the age-group of 5-15 years, followed by the age-group of 0-4 years. There was little difference in duration of hospital stay between age-groups from age 45 years upwards. The highest number of admissions for all three periods before death occurred in the age-groups of 5-15 and 85+ years, followed by the age-groups of 45-84 years; the differences became less marked in the 1 year before death (Fig 2). The highest number for all three periods occurred in the age-group of 45-64 years, with a declining frequency with increasing age. There was a clear-cut gradient with age, the number rising with increasing age-groups for all three

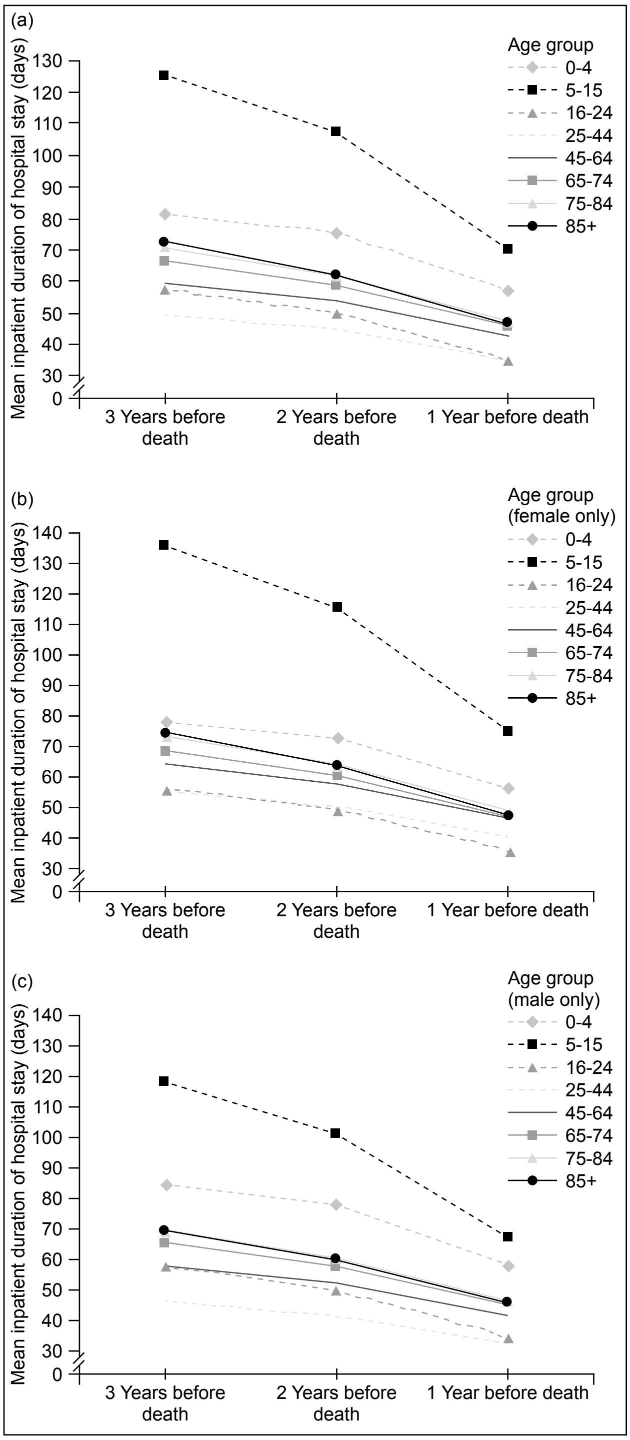

Fig 1. Mean inpatient duration of hospital stay: (a) by age-group, (b) by age-group (female only), and (c) by age-group (male only)

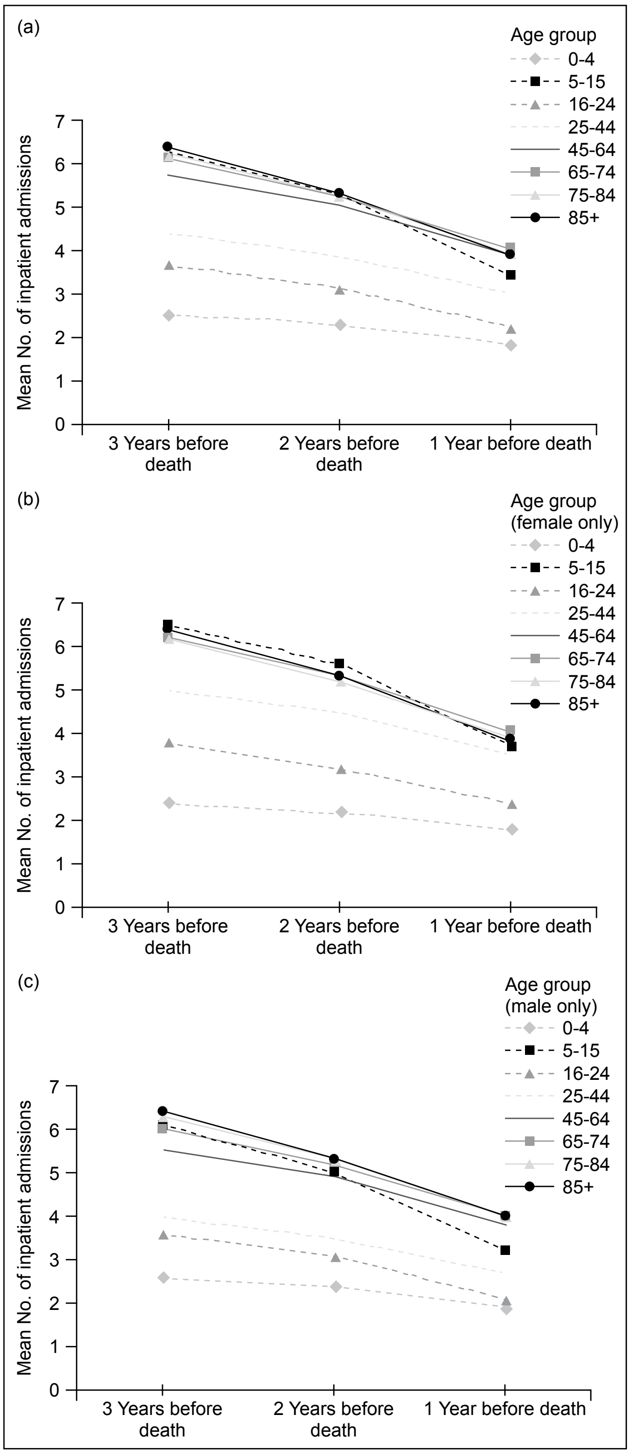

Fig 2 Mean number of inpatient admissions: (a) by age-group, (b) by age-group (female only), and (c) by age-group (male only)

periods. Moreover, as for the other indicators of service utilisation, the differences between age-groups narrowed with increasing proximity to death.

With respect to the number of attendance at specialist outpatient departments, the highest average for all three periods occurred in the age-group of 45-64 years, with a declining frequency with increasing age thereafter. In contrast, the number of attendances at accident and emergency departments (AED) rose with age for all three periods; the highest occurred in the age-group of 85+ years, but the differences between age-groups narrowed with increasing proximity to death. There was no gender difference in the pattern of utilisation for any of the above services.

Adding terms representing cohort effects into the age-only model did improve the fit of the model, in all instances, however, the age-period models fitted better than the age-cohort models. Also adding terms representing cohort effects to the age-period models did not significantly improve the model fit, indicating that there was a lack of evidence for an additional cohort effect once the period was controlled for (Table 1). These findings suggest that while the use of hospital services within 3 years before death showed a slight decline, the explanation is likely to be due to causes other than compression of morbidity.

In terms of period effects in the 1 year before death models, there was evidence of a slight increase in admission rates in 2001-2002 (relative to the reference period 1999-2000) for both genders followed by a return to reference period levels in 2003-2005 for males and a drop to a rate very slightly lower than the reference period rate for females (Table 2). The period pattern for the 2-year models was similar to that for the 1-year models, except that in 2003-2005 the rate for males was slightly higher than the reference period, while the rate for females in 2003-2005 was no longer significantly lower than for the reference period.

Discussion

Age effect

Age has differing impacts on the use of different hospital services in the final 3 years before death. With respect to inpatient duration of hospital stay, the highest was in the age-group of 5-15 years, followed by the age-group of 0-4 years and 65 years and older. There was little difference between the age-groups of 65-74, 75-84, and 85+ years. Furthermore, the gap between different age-groups narrowed with increasing proximity to death. This observation confirms previous findings in other countries that proximity to death, rather than old age, is the main cost driver of the use of inpatient services.[2,3] The implication for Hong Kong is that the increasing numbers of elderly people occupying hospital beds is a result of proximity to death rather than age per se. The number of admissions also followed the same pattern as duration of hospital stay.

A gender difference was noted, in that women aged >45 years had longer duration of hospital stay, and women aged 25-64 years were admitted more frequently than men. Possible explanations include obstetric and gynaecological causes, and greater frailty in older women than men.

The pattern for attendance at specialist outpatient department differed, in that persons in the middle age-groups were the highest users, followed by the age-group of 65-74 years. In contrast the age-group of 85+ years were the second lowest users (after the age-group of 0-4 years). This could reflect a survivor effect, or that they were followed

Table 1. Negative binomial age-period-cohort regression model (age, period) for duration of hospital stay 3 years prior to death

Age-group (years)	Male				Female			
	No.	Rate ratio	95% CI for rate ratio	P value	No.	Rate ratio	95% CI for rate ratio	P value
60-62	4348	0.85	0.812-0.881	<0.001	1648	0.85	0.798-0.900	<0.001
63-65	5882	0.91	0.874-0.941	<0.001	2430	0.86	0.821-0.909	<0.001
66-68	7590	0.90	0.867-0.928	<0.001	3690	0.84	0.801-0.874	<0.001
69-71	9813	0.92	0.888-0.946	<0.001	4878	0.88	0.842-0.912	<0.001
72-74	11 318	0.96	0.930-0.989	0.007	6475	0.91	0.876-0.942	<0.001
75-77	11 814	0.97	0.937-0.995	0.022	7586	0.92	0.893-0.957	<0.001
78-80	11 645	0.99	0.965-1.025	0.717	8987	0.96	0.925-0.989	0.009
81-83	10 429	1.00	-	-	9720	0.96	0.931-0.994	0.022
84-86	8249	1.00	0.965-1.031	0.860	9547	1.00	0.966-1.032	0.929
87-89	6068	1.00	0.964-1.037	0.978	8737	1.00	-	-
90-92	3552	1.02	0.978-1.068	0.326	6806	0.94	0.909-0.977	0.001
93-95	1626	0.97	0.912-1.028	0.289	4343	0.93	0.894-0.972	0.001
Year of death								
2000-2002	43 838	1.12	1.098-1.132	<0.001	35 351	1.17	1.147-1.185	<0.001
2003-2005	48 496	1.00	-	-	39 496	1.00	-	-
		Estimate	95% CI			Estimate	95% CI	
Intercept		4.20	-			4.27	-	
Dispersion		1.30	1.292-1.314			1.29	1.273-1.297	

Table 2. Negative binomial age-period-cohort regression model (age, period) for number of inpatient admissions 1 year prior to death

Age group (years)	Male (n=134 099)				Female (n=105 231)			
	No.	Rate ratio	95% CI for rate ratio	P value	No.	Rate ratio	95% CI for rate ratio	P value
0-4	717	0.47	0.44-0.51	<0.001	586	0.46	0.42-0.49	<0.001
5-15	375	0.79	0.72-0.86	<0.001	268	0.92	0.83-1.02	0.110
16-24	1011	0.53	0.50-0.57	<0.001	523	0.60	0.56-0.65	<0.001
25-44	7185	0.68	0.66-0.69	<0.001	4293	0.87	0.84-0.89	<0.001
45-64	26 955	0.96	0.95-0.97	<0.001	11 930	1.02	1.00-1.04	0.037
65-74	36 170	1.00	-	-	18 924	1.00	-	-
75-84	42 281	0.99	0.98-1.01	0.380	34 334	0.97	0.95-0.98	<0.001
85+	19 405	0.99	0.97-1.00	0.134	34 373	0.96	0.95-0.98	<0.001
Year of death								
1999-2000	36 418	1.00	-	-	28 451	1.00	-	-
2001-2002	37 182	1.05	1.03-1.06	<0.001	28 498	1.05	1.04-1.07	<0.001
2003-2005	60 499	1.00	0.99-1.01	0.927	48 282	0.99	0.98-1.00	0.038
		Estimate	95% CI			Estimate	95% CI	
Intercept		1.37	-			1.38	-	
Dispersion		0.48	0.47-0.48			0.42	0.42-0.43	

up in outpatient or family medicine clinics. Attendance at these clinics was not examined. Another possibility is that those who need medical care may have been very frail and residing in care homes for the elderly, which are supported by visiting medical officers or community geriatric outreach teams.

With regard to use of the AED, there was a clear age gradient; the age-group of 85+ years was the highest user. Although this pattern of usage generally followed that for the number of admissions, the extent of AED usage by the age-group of 85+ years far exceeded that for the lower age-groups; the difference was greater than that for the number of admissions where usage plateaued from age 45 years upwards. This suggests that AED may be used as a primary care service by the very old, being easily accessible and available 24 hours. Affordability was not considered a barrier even though attendance fees were introduced during this period, as fees were waived for those not able to pay and in receipt of a comprehensive social security allowance. The findings suggest that a more responsive and affordable primary care system, particularly for the old-old age-group, could reduce inappropriate use of AED services.

Age-period effect and age-period cohort effect

This survey shows a trend towards reduction in duration of stay in hospital. In general one would expect that changes in the duration of hospital stay due to administrative changes would manifest as a period effect in regression models, as they affect all age-groups about equally at the time of the change. In contrast compression of morbidity due to successive generations being healthier at a given age and thus using less medical services at that age should manifest itself mostly as a cohort effect in these models. The sorts of changes that result in healthier populations include better nutrition in childhood and adulthood, healthier lifestyles, better sanitation, and less physically stressful occupations. These would tend to affect persons in corresponding cohorts throughout their lifetime. We found that the data were more consistent with a period effect than with a cohort effect. During this period the number of beds increased as did various community service provision indicators. There were new initiatives in terms of community services to cater for medical and social needs, which may have resulted in shorter duration of hospital stay. At the same time the increasing number of places in long-term residential care may also have contributed to this period effect. Finally, there was a constant pressure on each service unit to reduce duration of hospital stay in order to cope with increasing numbers of people waiting for admission (both for treatment and for investigation by specialties eg to have cardiac procedures, endoscopies, sleep studies etc). Thus, duration of hospital stay formed one of the performance measures for clinical units. There was a constant review process to provide services in a more efficient way, with re-organisation and development of new models of care that may also have contributed to the trend towards reduced duration of hospital stay. Compression of morbidity was not a likely factor contributing to this trend, since no cohort effect was demonstrated.

Contrary to the trend in decreasing duration of hospital stay, the trend for the number of admissions increased. It is possible that the reduction in duration of hospital stay was at the expense of more frequent admissions, reflecting a revolving door phenomenon.[4]

Limitations

We were unable to capture all the mortality data, since a small proportion of subjects used the private sector, in which the pattern might be different. Nevertheless, the ratio of hospital discharges from public and private hospitals remained fairly constant during this period, according to the Hospital Authority Annual Statistical Reports, so that the period effect for duration of hospital stay was unlikely to be due to increasing usage of the private sector. Attendance at general outpatient clinics was not examined, as during this period, the administration of general outpatient clinics was transferred from the Department of Health to the Hospital Authority, and computerisation was only implemented at a later stage. We did not address the use of long-term residential care as one of the indicators of health service usage, although long-term care would be a significant health care cost component. The number of years for which data were available for analysis of any cohort effect may have been too short for any significant effect to be detected. Studies in which compression of morbidity were demonstrated included cohorts that covered 10 or more years difference.[1,5]

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