High-cost users of hospital beds in Western Australia: a population-based record linkage study

Janine Calver, Kate J Brameld, David B Preen, Stoney J Alexia, Duncan P Boldy and Kieran A McCaul

ABSTRACT

Objective: To describe how high-cost users of inpatient care in Western Australia differ from other users in age, health problems and resource use.

Design and data sources: Secondary analysis of hospital data and linked mortality data from the WA Data Linkage System for 2002, with cost data from the National Hospital Cost Data Collection (2001–02 financial year).

Outcome measures: Comparison of high-cost users and other users of inpatient care in terms of age, health profile (major diagnostic category) and resource use (annualised costs, separations and bed days).

Results: Older high-cost users (≥ 65 years) were not more expensive to treat than younger high-cost users (at the patient level), but were costlier as a group overall because of their disproportionate representation ($n = 8466$; 55.9%). Chronic stable and unstable conditions were a key feature of high-cost users, and included end stage renal disease, angina, depression and secondary malignant neoplasms. High-cost users accounted for 38% of both inpatient costs and inpatient days, and 26% of inpatient separations.

Conclusion: Ageing of the population is associated with an increase in the proportion of high-cost users of inpatient care. High costs appear to be needs-driven. Constraining high-cost inpatient use requires more focus on preventing the onset and progression of chronic disease, and reducing surgical complications and injuries in vulnerable groups.

MJA 2006; 184: 393–397

In the 2003–04 financial year, it was estimated that Australia spent 9.7% of its gross domestic product (GDP) on health, a total of $78.4 billion or about $3919 per person.[1] Although there has been a shift towards deinstitutionalisation, hospitals remain the largest providers of health services in Australia, having received 34.9% of total recurrent health expenditure in 2002–03.[1] Despite this, little is known about the characteristics of hospital users, particularly those who use a disproportionate share of resources ("high-cost users").

We used data from the Western Australian Data Linkage System (WADLS) to investigate the prevalence of high-cost inpatient use in WA and to describe how high-cost users differ from other hospital users in terms of their age, health problems and resource use. To our knowledge, this is the first Australian study of its kind.

METHODS

Data sources and population selection

Linked anonymised hospital and mortality data were sourced from the WADLS. Ethics approval for the study was granted by Curtin University of Technology.

The study population included separations from a WA public or private hospital in 2002. Only complete episodes of hospitalisation were considered (ie, episodes with both an admission and discharge date in 2002). Although this approach underestimated the number of hospital separations in 2002 (by about 1.4%), it avoided distortions to the length-of-stay distribution as a result of artificially truncating episodes of care that extended into 2003 or began in 2001. Separations due to pregnancy-related conditions, newborns, boarders, and duplicated records were excluded. Linked death records were used to identify people who died within 1 year of their first separation.

Costs were estimated by assuming that hospitalisations had the average costs for patients in the relevant Australian Refined Diagnosis Related Group (AR-DRG), as reported in the National Hospital Cost Data Collection, WA Cost Weights Round 6 (2001–02),[2] and then aggregating all costs related to the same patient. No cost data were available for seven patients, who were therefore removed from the analysis.

Total hospital separations and bed-days accrued in 2002 were aggregated for each person. For length-of-stay calculations, same-day hospital separations were counted as a length-of-stay of 1 day. Using the primary admitting diagnosis, a major diagnostic category was constructed for each person. People with multiple separations were assigned the major diagnostic category associated with the most bed-days, or the diagnostic category associated with the earliest separation when multiple diagnostic groups shared equal numbers of bed-days.[3]

Comorbidities were assigned using the original Charlson Index,[4] which was applied to the first admission in 2002 and all hospitalisations in the previous 12 months. Coexisting diagnoses that belonged to the same ICD-10-AM chapter[5] as the major diagnostic category were excluded from the comorbidity score.

Definition of high-cost users

High-cost users were defined as the top 5% of people when all individuals with at least one hospitalisation in 2002 were ranked from highest to lowest total inpatient cost. Defining high users on the basis of cost has been reported elsewhere.[6]

Statistical methods

Age at admission was divided into nine subgroups. For each age group, two prevalence measures were calculated: (1) high-cost hospital users as a proportion of total hospital users in 2002; and (2) total hospital users as a proportion of the WA population.[7] Logistic regression was used to examine the association between age (fitted as a single age-group term) and the prevalence of high-cost users in 2002. Odds ratios were calculated to examine differences in the proportion of high-cost users and other hospital users who died within 1 year of hospitalisation, and who had frequent use (≥ 12 separations) or long stay (> 35 days) hospitalisations in 2002.

Average annualised inpatient costs and bed-days were expressed as both a median and an arithmetic mean. The median provides the "typical" value for individuals, whereas the mean provides a more informative measure of the total financial impact of hospitalisation, and is more useful from a policy perspective.[8]

Independent samples *t* tests were used to compare differences in mean comorbidity score and overall resource use between high-cost users and other hospital users. Linear tests for age trend were performed for annualised resource use (cost, separations, bed-days) by entering age group as a continuous parameter in the model and adjusting for the potential confounding effects of sex, major diagnostic category, comorbidity, and living status 12 months post-hospitalisation. (This last parameter is important to avoid overemphasising the effect of age on hospital costs.)[9]

In large samples, *t* tests and least-squares linear regression are valid for any distribution, even those with very non-normal data, when the purpose of the analysis is to make inferences about the association between variables rather than to predict outcomes for individuals.[10]

Statistical analyses were performed using SPSS (version 12; SPSS Inc, Chicago, Ill, USA).

1 Age distribution of people hospitalised in Western Australia, 2002

Age group (years)	High-cost users		Total users	
	Number	Percent of total users	Number	Percent of population
0–14	397	1.0%	39 791	10.0%
15–24	660	2.4%	27 217	9.8%
25–34	902	2.8%	32 256	11.5%
35–44	1 144	2.9%	39 967	13.4%
45–54	1 562	3.4%	45 526	16.8%
55–64	2 010	4.9%	40 897	22.2%
65–74	2 888	7.9%	36 482	30.7%
75–84	3 513	11.9%	29 644	40.8%
⩾ 85	2 065	18.8%	11 008	45.6%
Total	**15 141**	**5.0%**	**302 788**	**15.9%**

RESULTS

Prevalence and age profile of high-cost users

There were 302 788 people hospitalised (585 815 separations) in WA in 2002, excluding episodes of care that extended from 2001 or into 2003 (n = 3961 and 4276, respectively) and separations related to pregnancy (n = 40 036), newborns (n = 25 983), boarders (n = 18 043), and duplicate records (n = 6938). As three individuals had the same cost at the cut-off point (⩾ $25 051), there were 15 141 high-cost users (154 433 separations), not 15 139 (Box 1).

Older people (⩾ 65 years) accounted for more than half of the high-cost users (55.9%, n = 8466). The prevalence of high-cost users increased with age (odds ratio, 1.43; 95% CI, 1.42–1.44; P < 0.001). As shown in Box 1, this trend existed alongside a higher prevalence of hospital use for older people overall.

Health profile of high-cost users compared with other users

The primary diagnostic category differed between high-cost users and other hospital users (Box 2). Factors influencing health status and contact with health services was the most common reason for high-cost hospital use, of which extracorporeal dialysis and chemotherapy accounted for most separations (93.2%). Angina, heart failure and acute myocardial infarction accounted for 50.9% of separations where diseases of the circulatory system were responsible for high-cost use. Depressive illness and schizophrenia accounted for 43.5% of separations where mental and behavioural disorders were identified as the main reason for high-cost hospital use. Of the top five major diagnostic categories for high-cost users, mental and behavioural disorders was the only one in which people aged 65 years and older were not the majority. A fairly large number of inpatients (n = 361) became high-cost users as a consequence of procedural complications and complications of internal orthopaedic prosthetic devices, implants and grafts. High-cost users also had slightly higher Charlson comorbidity scores (mean difference, 0.88; 95% CI, 0.85–0.91).

In contrast to high-cost users, most other hospital users in each of the top five major diagnostic categories were younger than 65 years (81.8%).

Compared with other hospital users, high-cost users were 9.4 (95% CI, 9.0–9.8) times more likely to die in the year following their first hospitalisation, which reduced to 4.6 (95% CI, 4.4–4.8) times after adjustment for age. High-cost users who died were also 1.6 (95% CI, 1.4–1.7) times more likely to die in hospital. Most high-cost users who died were aged 65 years and older (74.3%; n = 2411). Most older high-cost users who died had been high-cost users because of neoplasms (24.6%; n = 593), factors influencing health status and contact with health services, such as haemodialysis and chemotherapy (21.8%; n = 526), and diseases of the circulatory system (15.9%; n = 384). Similarly, people aged 65 years and older comprised the majority of other hospital users who died (79.4%; n = 6452). Neoplasms (22.6%; n = 1460), diseases of the circulatory system (20.6%; n = 1329), and diseases of the respiratory system (14.6%; n = 940) were the main reason these older people had been hospitalised in 2002.

Use of inpatient services

High-cost users accounted for 38.4% of both inpatient costs and inpatient days, and 26.4% of inpatient separations. They had higher annualised costs (by definition) and bed-days, which resulted in mean differences of $44 400 (95% CI, $44 274–$44 525) and 42.6 days (95% CI, 42.4–42.8 days) compared with other hospital users. The distributions for annualised costs and bed-days were positively skewed for both high-cost users and other hospital users (range of skewness coefficient, 1.8–8.4) (Box 3). High-cost users were 40 times more likely than other hospital users to be frequently hospitalised (⩾ 12 separations in 2002) (95% CI, 38.5–43.5) or have a long stay hospitalisation (> 35 days) (95% CI, 37.0–41.7).

For high-cost users, costs generally decreased as age increased (mean change per age group, –$1726; 95% CI, –$1492 to –$1961; P < 0.001 for linear trend test), after adjustment for potential confounders (Box 4). This effect was most noticeable from the age of 45 years. Conversely, a significant upward trend in annualised costs was detected across age groups for other hospital users (adjusted mean change per age group, $283; 95% CI, $276–$290, P < 0.001 for linear trend test), again with the effect most noticeable from the age of 45 years. For high-cost users, the mean annualised cost for patients aged 85 years and older was $9576 (95% CI, $7687–$11 466) lower than for patients aged 45–54 years. For other hospital users, the mean annualised costs for patients aged 85 years and older was $2253 higher than for patients aged 45–54 years, after adjustment for potential confounders.

For high-cost users, annualised hospital separations decreased as age increased

2 Top five diagnostic categories responsible for the most hospital days per year, Western Australia, 2002

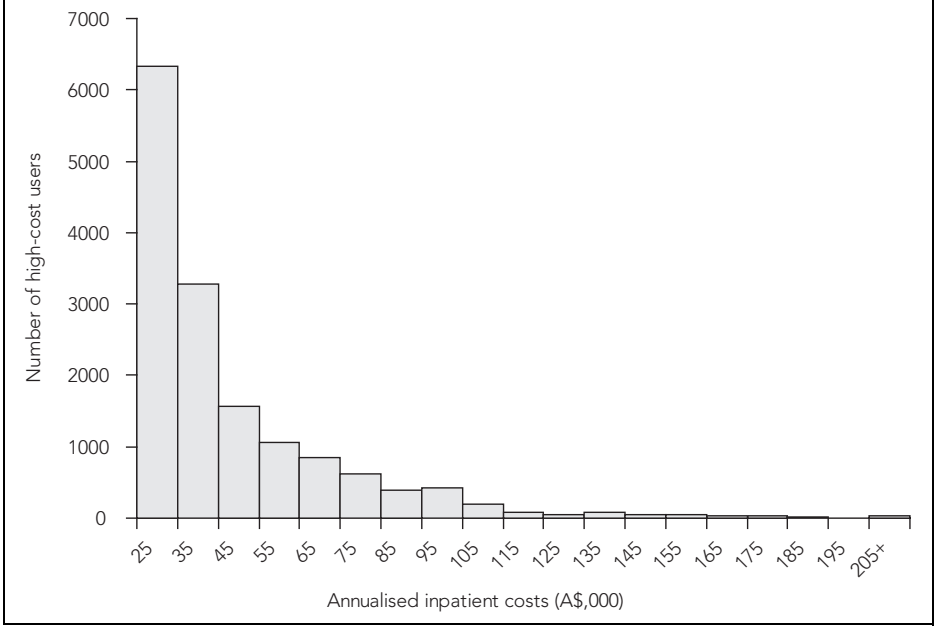
Primary diagnostic category (ICD-10 chapter in parentheses)	Number of users (%)	Number of separations	Most frequent ICD-10 subcategory	Number of users	Separations (% ICD-10 chapter)
High-cost users (n = 15 141)					
Factors influencing health status and contact with health services (21)	3414 (22.5%)	84 189	Extracorporeal dialysis (Z49.1)	616	69 619 (82.7%)
			Chemotherapy for neoplasm (Z51.1)	429	8823 (10.5%)
Diseases of the circulatory system (9)	2382 (15.7%)	5687	Angina (I20)	851	1540 (27.1%)
			Heart failure (I50)	344	676 (11.9%)
			Acute myocardial infarction (I21)	457	678 (11.9%)
Mental and behavioural disorders (5)	2134 (14.1%)	8292	Depressive episode or recurrent depressive disorder (F32, F33)	446	2239 (27.0%)
			Schizophrenia (F20)	733	1367 (16.5%)
Neoplasms (2)	2091 (13.8%)	7592	Secondary malignant neoplasm of other sites (C79)	274	647 (8.5%)
			Secondary malignant neoplasm of respiratory and digestive organs (C78)	254	644 (8.5%)
			Malignant neoplasm of bronchus and lung (C34)	204	573 (7.5%)
Injury, poisoning and certain other consequences of external causes (19)	1217 (8.0%)	2378	Fracture of femur (S72)	298	377 (15.9%)
			Complications of procedures not elsewhere classifiable (T81)	165	366 (15.4%)
			Complications of internal orthopaedic prosthetic devices, implants and grafts (T84)	196	330 (13.9%)
Other users (n = 287 647)					
Diseases of the digestive system (11)	53 896 (18.7%)	60 487	Embedded and impacted teeth (K01)	7961	7968 (13.2%)
			Gastro-oesophageal disease (K21)	5097	5253 (8.7%)
			Cholelithiasis (K80)	3549	4233 (7.0%)
Diseases of the musculoskeletal system and connective tissue (13)	29 285 (10.2%)	34 747	Internal derangement of knee (M23)	5227	5423 (15.6%)
			Dorsalgia (M54)	3215	4300 (12.4%)
			Gonarthrosis (M17)	3517	3652 (10.5%)
Injury, poisoning and certain other consequences of external causes (19)	25 538 (8.9%)	29 193	Fracture of forearm (S52)	2316	2569 (8.8%)
			Fracture of lower leg, including ankle (S82)	1568	1753 (6.0%)
			Fracture of skull and facial bones (S02)	1162	1339 (4.6%)
Diseases of the genitourinary system (14)	24 355 (8.5%)	28 831	Other diseases of the urinary system (N39)	2603	2812 (9.8%)
			Excessive, frequent and regular menstruation (N92)	2410	2558 (8.9%)
			Female infertility (N97)	1154	2039 (7.1%)
Diseases of the respiratory system (10)	21 791 (7.6%)	25 643	Pneumonia, organism unspecified (J18)	3332	3593 (14.0%)
			Chronic diseases of tonsils and adenoids (J35)	3537	3565 (13.9%)
			Asthma (J45)	2800	3294 (12.8%)

(adjusted mean change per age group –2.02; 95% CI, –2.21 to –1.84; $P < 0.001$ for linear trend test). However, the mean number of bed-days did not vary consistently with age (adjusted mean change per age group, 0.02; $P = 0.880$ for linear trend test). Conversely, for other hospital users, the mean number of separations increased slightly with age (adjusted mean change per age group, 0.03; 95% CI, 0.03–0.03; $P < 0.001$ for linear trend test), as did the mean number of bed-days (adjusted mean change per age group, 0.56; 95% CI, 0.54–0.57; $P < 0.001$ for linear trend test).

DISCUSSION

About 15% of the WA population was hospitalised in 2002 (not counting pregnancy-related events and neonates), which translated into more than half a million separations, 1.8 million hospital days, and costs of $1.9 billion. Most importantly, resource use was disproportionately concentrated in a small group of high-cost users, who comprised 5% of WA's inpatient population, but accounted for 38% of inpatient costs and 26% of hospital days. Of obvious interest to health policy makers in search of solutions to Australia's health care problems[11] is

3 Annualised inpatient costs for high-cost users, Western Australia, 2002 ($n = 15\,141$)



whether this high-cost use occurs randomly and the extent to which it can be curbed.

Although older high-cost users (≥ 65 years) were not more expensive to treat than younger high-cost users (at the patient level), they accounted for more than half of the high-cost users, which made them a costlier group overall. Our finding that older high-cost users were more likely than younger ones to die in the year after hospitalisation suggests they were sicker than other high-cost users.

Chronic stable and unstable conditions were a key feature of high-cost users. They also had slightly higher comorbidity scores and were nine times more likely to die in the year following their first hospitalisation (4.6 times more likely after adjustment for age). These results demonstrate vertical equity within WA's hospital system, where people with the greatest disease burden receive the most care. This finding is consistent with Canadian research.[6]

Our finding that many high-cost users were hospitalised for chronic conditions (such as end-stage renal disease, angina, congestive heart failure and cancer) that have identifiable and modifiable risk factors highlights the potential preventability of some hospital use. Key risk factors for chronic renal failure, the most common cancers, and circulatory disease overlap considerably, and include type 2 diabetes, obesity, hypertension, tobacco use, alcohol consumption, dyslipidaemia, sedentary lifestyle, and poor diet.[12-14] Effective strategies for addressing these risk factors have been reported, highlighting the considerable opportunity for reducing medical costs and human suffering through prevention strategies that focus on lifestyle modification and pharmacological management.[14-17] However, widespread behaviour change must be facilitated by intervention at multiple levels, requiring regulatory and environmental change.

In other areas, evidence supporting the effectiveness of preventive strategies is lacking or mixed. For example, there have been many falls prevention initiatives to reduce fractured femurs in older people (eg, home hazards modifications, exercise programs), but limited evidence of their effectiveness.[18,19]

People with mental and behavioural disorders comprised 14.1% of high-cost users. Furthermore, of the top five primary conditions of high-cost users, this was the only one not dominated by older people. Worldwide, policies have supported the development of community care initiatives intended to avoid hospitalisation of people with severe mental disorders. Cochrane reviews of the effectiveness of these interventions in reducing hospital use and health care costs are abundant, and with few exceptions, the results are far from promising,[20-23] if not

4 Annualised inpatient expenditure (A$) by age, Western Australia, 2002

	High-cost users ($n = 15\,141$)		All other users ($n = 287\,647$)	
Age (years)	Mean expenditure (95% CI)	Median expenditure (interquartile range)	Mean expenditure (95% CI)	Median expenditure (interquartile range)
0–14	51 784 (47 821–55 747)	39 097 (25 108–398 854)	3048 (3021–3074)	2218 (432 – 25 022)
15–24	52 822 (49 652–56 081)	38 923 (25 266–814 588)	3050 (3013–3087)	1986 (405 – 25 022)
25–34	51 110 (49 222–52 999)	38 836 (25 070–207 157)	3202 (3164–3240)	2023 (316 – 25 023)
35–44	51 090 (49 051–53 129)	37 274 (25 059–557 597)	3326 (3290–3363)	2023 (316 – 25 023)
45–54	50 723 (49 210–52 237)	38 612 (25 081–300 678)	3544 (3506–3581)	2078 (405 – 25 028)
55–64	48 889 (47 674–50 104)	38 100 (25 051–349 358)	4048 (4003–4094)	2232 (405 – 25 040)
65–74	48 140 (47 146–49 134)	37 982 (25 052–324 135)	4922 (4866–4978)	2824 (405 – 25 049)
75–84	46 783 (45 920–47 646)	38 190 (25 051–458 070)	5978 (5909–6047)	3394 (405 – 25 047)
≥ 85	44 026 (43 164–44 888)	37 793 (25 065–182 072)	7267 (7142–7393)	5076 (405 – 25 048)
< 65	50 557 (49 779–51 335)	38 361 (25 051–814 588)	3397 (3381–3412)	2034 (316 – 25 040)
≥ 65	46 573 (46 036–47 110)	38 100 (25 051–458 070)	5629 (5587–5671)	3334 (405 – 25 049)
Total	**48 329 (47 873–48 786)**	**38 165 (25 051–814 588)**	**3930 (3914–3945)**	**2226 (316 – 25 049)**

altogether lacking.[24] In a more recent WA study, Preston and colleagues concluded that compulsory community-based psychiatric treatment does not reduce the use of health services.[25] The reality is that, for some people with severe mental disorders, hospital may provide the most appropriate treatment available and efforts to curb use may prove both futile and counterproductive to achieving good health outcomes (eg, treatment compliance, suicide reduction, reduced caregiver burden).

We found that 361 patients were classified as high-cost users because of complications of internal orthopaedic prosthetic devices, implants and grafts, or complications not elsewhere classifiable. Perhaps high-cost users had underlying risk factors that predisposed them to complications, for example, older age, severity of illness or the complexity of care required.[26] Apart from patient factors, there is also a need to assess how many of these complications resulted from medical errors, as a result of substandard performance, products, procedures or organisational systems.[27] Developing confidential, objective, complete and non-punitive reporting systems and review processes is essential if we are to identify preventable complications, remedy their root causes, and reduce medical costs.[28]

This study was limited in several aspects. First, we excluded people with hospital stays exceeding 1 year. Second, there may be residual confounding by comorbidity, because the Charlson Index was not designed for a paediatric population. Lastly, the use of administrative records may have underestimated the burden of disease.[29]

This work represents the first Australian, population-based attempt to understand high-cost use of inpatient services at the patient level. Currently, there is insufficient scientific evidence to develop policies for reducing high-cost hospital use. An integrated package of preventive health strategies appears to offer the most hope for curbing high hospital costs.

ACKNOWLEDGEMENTS

This project was made possible by the technical expertise of the Western Australian Data Linkage Unit in the WA Department of Health. We thank the WA Department of Health for funding this study.

COMPETING INTERESTS

None identified.

AUTHOR DETAILS

Janine Calver, PhD, Research Fellow[1,2]
Kate J Brameld, PhD, Research Fellow[3]
David B Preen, PhD, Research Fellow[3]
Stoney J Alexia, BA(Hons), Senior Linkage Officer[3]
Duncan P Boldy, MSc, PhD, Professor[1]
Kieran A McCaul, MPH, Senior Lecturer[4]

1 Centre for Research into Aged Care Services, Curtin University of Technology, Perth, WA.
2 Information Collection and Management, WA Department of Health, Perth, WA.
3 School of Population Health, University of Western Australia, Perth, WA.
4 School of Public Health, Curtin University of Technology, Perth, WA.

Correspondence:
janine.calver@health.wa.gov.au

REFERENCES

1 Australian Institute of Health and Welfare. Health expenditure Australia 2003–04. Health Expenditure Series No. 25. Canberra: AIHW, 2005. (AIHW Catalogue No. HWE 32.) Available at: http://www.aihw.gov.au/publications/index.cfm/title/10204 (accessed Mar 2006).
2 Australian Government Department of Health and Ageing. National hospital cost data collection. WA cost weights round 6 (2001–02). Available at: http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-casemix-costing-fc_r6.htm (accessed Apr 2005).
3 Roos N, Burchill C, Carriere K. Who are the high hospital users? A Canadian case study. *J Health Serv Res Policy* 2003; 8: 5-10.
4 Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chron Dis* 1987; 40: 373-383.
5 National Centre for Classification in Health. The international statistical classification of diseases and related health problems, 10th revision, Australian modification (ICD-10-AM). Sydney: National Centre for Classification in Health, 1998.
6 Reid R, Evans R, Barer M, et al. Conspicuous consumption: characterizing high users of physician services in one Canadian province. *J Health Serv Res Policy* 2003; 8: 215-224.
7 Australian Bureau of Statistics. Population estimates by age and sex, Western Australia, 2002. Canberra: ABS, 2002. (ABS Catalogue No. 3235.0.55.001.)
8 Thompson SG, Barber JA. How should cost data in pragmatic randomised trials be analysed? *BMJ* 2000; 320: 1197-1200.
9 Gray A. Population ageing and health care expenditure. *Ageing Horizons* 2005; (2): 15-20.
10 Lumley T, Diehr P, Emerson S, Chen L. The importance of the normality assumption in large public health data sets. *Annu Rev Public Health* 2002; 23: 151-169.
11 Van Der Weyden MB. Australian healthcare: purposeful reform or three more years of political rhetoric? [editorial] *Med J Aust* 2004; 181: 593-594.
12 Yusuf S, Reddy S, Ounpuu S, et al. Global burden of cardiovascular diseases. Part I: general considerations, the epidemiologic transition, risk factors and the impact of urbanization. *Circulation* 2001; 104: 2746-2753.
13 Stein C, Colditz G. Modifiable risk factors for cancer. *Br J Cancer* 2004; 90: 299-303.
14 Nahus A, Bello A. Chronic kidney disease: the global challenge. *Lancet* 2005; 365: 331-340.
15 UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998; 352: 837-853. Correction in *Lancet* 1999; 354: 602.
16 Gluckman T, Baranowski B, Ashen M, et al. A practical and evidence-based approach to cardiovascular disease risk reduction. *Arch Intern Med* 2004; 164: 1490-1500.
17 Goldstein MG, Whitlock EP, DePue J, et al. Multiple behavioural risk factor interventions in primary care: summary of research evidence. *Am J Prev Med* 2004; 27(2S): 61-79.
18 Gillespie LD, Gillespie WJ, Roberston MC, et al. Interventions for preventing falls in elderly people. *Cochrane Database Syst Rev* 2003; (4): CD000340.
19 Lyons RA, Sander LV, Weightman AL, et al. Modification of the home environment for the reduction of injuries. *Cochrane Database Syst Rev* 2003; (4): CD003600.
20 Marshall M, Gray A, Lockwood A, et al. Case management for people with severe mental disorders. *Cochrane Database Syst Rev* 2000; (2): CD000050.
21 Tyrer P, Coid J, Simmonds S, et al. Community mental health teams (CMHTs) for people with severe mental illness and disordered personality. *Cochrane Database Syst Rev* 2000; (4): CD000270.
22 Joy CB, Adams CE, Rice K. Crisis intervention for people with severe mental illnesses. *Cochrane Database Syst Rev* 2004; (4): CD001087.
23 Marshall M, Crowther R, Almaraz-Serrano A, et al. Day hospital versus admission for acute psychiatric disorders. *Cochrane Database Syst Rev* 2003; (1): CD004026.
24 Catty J, Burns T, Comas A. Day centres for severe mental illness. *Cochrane Database Syst Rev* 2001; (2): CD001710.
25 Preston NJ, Kisely S, Xiao J. Assessing the outcome of compulsory psychiatric treatment in the community: epidemiological study in Western Australia. *BMJ* 2002; 324: 1244.
26 Thomas EJ, Brennan TA. Incidence and types of preventable adverse events in elderly patients: population based review of medical records. *BMJ* 2000; 320: 741-744.
27 Edmonds M. Adverse events, iatrogenic injury and error in medicine. Adelaide: University of Adelaide, 2005. Available at: http://www.informatics.adelaide.edu.au/topics/Safety/ME-AdverseEvents.html (accessed Apr 2005).
28 Barach P, Small S. Reporting and preventing medical mishaps: lessons from non-medical near miss reporting systems. *BMJ* 2000; 320: 759-763.
29 Preen DB, Holman CDJ, Lawrence DM, et al. Hospital chart review provided more accurate comorbidity information than data from a general practitioner survey or an administrative database. *J Clin Epidemiol* 2004; 57: 1295-1304.

(Received 26 Oct 2005, accepted 14 Feb 2006) ❑