bureau of health information

Bureau of Health Information

Technical Supplement

Healthcare in Focus 2015: How does NSW compare?

Annual performance report

Contents

Introduction

This is a supplement to the Bureau of Health Information's sixth annual performance report, *Healthcare in Focus 2015: How does NSW compare?* The supplement describes methods and technical terms used to compute descriptive statistics and performance indicators included in the report. It is technical in nature, and is intended for audiences interested in the creation and analysis of health performance information.

To produce the report, BHI used the following sources of data:

- The Commonwealth Fund International Health Policy Survey 2015
- Commonwealth Fund International Health Policy Survey 2014
- The Organisation for Economic Cooperation and Development (OECD) Health Statistics online database
- NSW Health linked admitted patient, emergency department presentation and fact of death data, accessed via the Centre for Epidemiology and Evidence [5]
- NSW Health admitted patient (2001/02–2013/14), emergency department presentation (2000–2015) and elective surgery waiting list (2014–2015) data collections, accessed via the Health Information Exchange (HIE) and Waiting List Collection Online System (WLCOS)
- Australian Bureau of Statistics (ABS) mortality data for 2014
- Survey results from the ABS Patient Experience Survey 2013–14
- Survey results from BHI's NSW Patient Survey Program 2013–14
- Australian Institute of Health and Welfare (AIHW) expenditure data
- Health and healthcare performance data already published by governments or journal articles. The sources of these data are indicated where appropriate.
- BHI used SAS/STAT™ software for the statistical analysis of data published in the report [1]

Data Sources and Methods

The Commonwealth Fund International Health Policy Survey

Each year, The Commonwealth Fund, a philanthropic organisation in the United States, commissions an international survey to support the creation of public reports that benchmark the performance of comparable healthcare systems.

The survey focuses on different populations, generally following a three-year cycle. In 2013, the sample was drawn from adults aged 18 years and over, while in 2014 it focused on aged 55 years and over. In 2015, the survey was a sample of primary care physicians or general practitioners (GPs).

The Bureau of Health Information, as a partner, invested in an additional sample of The Commonwealth Fund International Health Policy Survey (2015 IHPS) to ensure the number of NSW participants was sufficient to compute robust estimates of performance indicators of the NSW health system, and to make statistically valid comparisons with the countries participating in the survey.

Fieldwork in all countries took place between March and June 2015. The survey assessed confidence in the healthcare system including questions of access, cost and quality. Social Science Research Solutions (SSRS) produced a comprehensive methodological report that details the sample design, data collection, data processing and survey procedures used in conducting the survey.

Final samples were weighted to reflect the distribution of the GP population in each country. The characteristics and populations used to calculate weights for each country are summarised in the SSRS methodology report [2]. Australian data were weighted to represent providers from the national list of physicians provided by the Medical Directory of Australia, of more than 23,000 Australian physicians, where general practitioners were selected.

In Australia, 747 GPs were surveyed, including 401 in NSW. The response rate was 25% for Australia. Response rates for countries sampled for the 2015 IHPS varied from 8% in France to 47% in Sweden (Table 1).

To align GP responses with patient perspectives results from the 2014 Commonwealth Fund International Health Policy Survey of Older Adults were also used. Respondent numbers and response rates for the 2014 survey are provided in (Table 2). For more detailed information on the 2014 survey, see the Technical supplement for Healthcare in Focus 2014.

Statistical analysis

The performance of the NSW healthcare system was reported alongside Australia and 10 other countries. Reported percentages are the weighted estimates that are intended to reflect the views and experiences of the population (whether by NSW, region or country) or primary care practices.

Consistent with published reports on The Commonwealth Fund data [3], non-response categories, such as ‘not sure’, ‘declined to answer’, and ‘not applicable’ were excluded from reporting and statistical analyses. Some physicians responded by mail resulting in a small number of multiple responses for questions where only a single response was requested. These multi-responses were also excluded (<1% and only for a small subset of countries on a small number of questions). More information can be provided upon request.

The NSW estimates are compared with results for the rest of for Australia and the 10 other countries. Note that while results are shown for all of Australia, any differences between Australia and NSW are based on comparisons with the rest of Australia. A main response category was determined for each question, and responses were dichotomised such that the response value of interest (for example ‘always’) is coded as 1, and all other values, excluding non-response categories, are coded as 0. Logistic regression is then used to fit this binary variable on an

explanatory variable for each respondent country, with appropriate adjustment for survey weights using the SAS procedures SURVEYLOGISTIC for the analysis [1]. Any values different from NSW are noted with an asterix (*) or shaded to identify statistically significant differences at a 5% significance level. If no difference is flagged than with the available data, we are unable to detect statistical differences in the performance based on the statistical model.

Organisation for Economic Cooperation and Development

The Organisation for Economic Cooperation and Development (OECD) is a comprehensive and consistent source of comparable international data on various economic and social topics, including health care.

The latest edition of the OECD's biennial report *Health at a Glance* was released in November 2015. The OECD Health Care Quality Indicators included in that report are based on specifications developed by the US Agency for Healthcare Research and Quality () and made available through the OECD website OECD *Health Statistics* (www.oecd-ilibrary.org/social-issues-migration-health/data/oecd-health-statistics_health-data-en)

Statistical analysis

A subset of these healthcare measures have been presented in this report with the NSW results calculated based on specifications from the OECD and the Australian Institute for Health and Welfare [7]. Details relevant to BHI's calculation of these indicators are provided in Table 3.

In some analysis, to provide additional information for variation within NSW, hospital-level results were calculated. In this case, non-overlapping confidence intervals were used to flag hospitals where confidence interval around the expected values for the hospital was not overlapping with that of NSW.

Standardised International comparisons

International data comparisons from both survey and administrative data sources present challenges due to differences in data collection, definition and quality, as well as differences in each country's organisation of healthcare. A synthesis of administrative data measures based on values for international comparators is also provided. NSW results were compared to the range of available country values on a normalised scale.

The scores are calculated for each country using the formula $((x_i-\bar{x})/\sigma_x$ where x_i is the result for the country and $\bar{x}$ and σ_x are, respectively, the mean and standard deviation of the results of all countries. Scores are transformed such that the value greater than zero indicates better than average performance. The interquartile range of these transformed scores is shown in the grey area [13][14].

Australian Bureau of Statistics: Patient Experience Survey and Cause of Death

The Australian Bureau of Statistics (ABS) conducts an annual Patient Experience Survey, a nation-wide population-based survey of patients' experiences using the Australian health system. The ABS provided BHI with a customised report on NSW results for 2014–15. The sample of 27,341 people aged 15+ years was weighted to represent the estimated population aged 15+ years in private dwellings in each state and territory. Further information on survey and analysis methods can be found in the ABS's survey methods documentation [4].

The ABS also provided a customised report on causes of death in NSW for the calendar years 2009–2013. The report included age-standardised rates of mortality and potential years of life lost for selected causes of death, by sex and year of death registration. Further information can be found in the ABS's methodological documentation for its *Causes of Death 2013* report [5].

Australian Institute for Health and Welfare: Healthcare expenditures

The Australian Institute for Health and Welfare (AIHW) provided a customised report of healthcare expenditures stratified by finance, provider and function categories according to the OECD's System of Health Accounts (SHA) definitions. For more information, see the AIHW annual report [6]. Other reports from AIHW on hospital statistics and cancer screening [12] were used throughout the report and referenced in related figures.

Bureau of Health Information: NSW Patient Survey Program

BHI conducts a regular, comprehensive statewide patient experience survey program. The NSW Patient Survey Program collects information from patients across NSW about their experiences with a variety of healthcare services.

For this report, BHI used de-identified unit record data from the survey program. The most recent Adult Admitted Patient Survey includes responses from 27,000 patients who were admitted to a NSW public hospital between January and December 2014 (adjusted response rate 43%). The Emergency Department Patient Survey includes18,301 patients of all ages who visited an emergency department in a NSW public hospital between April 2014 – March 2015 (adjusted response rate 27%).

The SAS procedure SURVEYFREQ was used to compute patient population estimates using sampling and post-stratification weights provided by IPSOS [1, 5]. Where the distribution of results by hospital are provided, statistical differences between a hospital and NSW result are noted if the 95% confidence intervals of the two estimates are not overlapping.

NSW Ministry of Health: Linked admitted patient, emergency department and fact of death data

The Centre for Epidemiology and Evidence (CEE) at the NSW Ministry of Health maintains a data warehouse called Secure Analytics for Population Health Research and Intelligence (SAPHaRI) [5]. SAPHaRI holds records of hospital admissions, emergency department presentations and fact of death, each of which has been assigned a unique person identifier. The person identifier is a statistical linkage key generated by the Centre of Health Record Linkage (CHeReL) using probabilistic record linkage methods. Data linkage allowed the computation of various statistics at a patient level of analysis, such as unplanned readmission rates. The linkage of these data occurs on a six-monthly cycle. Further information can be found at www.cherel.org.au. The linked data at the time of analysis were available for the 2014–15 financial year. For the Admitted Patient Data Collection, the most recent complete year of data including private hospitals, was 2013–14.

An "episode" is a single record containing information about a patient admitted to a hospital or emergency department; information includes patient demographics, date, conditions and treatment or procedure received and the Australian Refined-Diagnosis related group (ARDRG) code. BHI calculated OECD indicators based on episodes following specifications used by AIHW in calculating the Australia values provided to OECD. This term is used interchangeably with "admission", "separation", "discharge" and "hospitalisation" in other AIHW and OECD reports. A "period of care" is not the same as an episode. Periods of care identify contiguous hospitalisation episodes within the same or different hospitals into one single period of care in order to follow an outcome of interest. Periods of care are used in 30 day mortality and return to acute care measures.

Statistics calculated based on denominators containing only hospitalisations exclude episodes at Albury Base Hospital, since this facility is administered by the Victorian Department of Health. Statistics calculated as a rate per 100 or 100,000 population exclude non-residents of NSW.

Where the distribution of results by hospital are provided, statistical differences between a hospital and NSW result are noted if the 95% confidence intervals of the two estimates are not overlapping. The variance is given by the standard variance for a binomial distribution, with the exception of Average length of stay estimates where non-parametric ranking tests were performed.

NSW Ministry of Health: Hospital activity data (Health Information Exchange and Waiting List Collection Online System)

The NSW Ministry of Health maintains data warehouses containing the most recent accumulation of NSW hospital and health facility activity data available. Inpatient and emergency department presentation data are uploaded weekly and become available for BHI analysis two weeks later. Elective surgery waiting list data are uploaded monthly and available two weeks later.

BHI, in conjunction with the NSW Ministry of Health and other agencies, has developed various measures of NSW public hospital admissions and emergency department and elective surgery activity and performance for hospitals with electronic data available. These measures are published in the BHI report series *Hospital Quarterly* and are available on BHI's online data portal Healthcare Observer. The statistics reported have been calculated for the 2014–15 financial year rather than for quarters. *Hospital Quarterly* activity and performance statistics exclude episodes at Albury Base Hospital, since this facility is administered by the Victorian Department of Health.

Table 1 The Commonwealth Fund International Health Policy Survey of Primary Care Physicians 2015, number of respondents and response rates by country

Country	Method	Number of Respondents	Response Rate
Australia (New South Wales (n=401)	Phone/email/fax recruit to online	747	25.1%
Canada	Postal mail recruit to online/mail	2,284	31.7%
France	Phone (CATI)	502	8.1%
Germany	Postal mail	559	18.7%
Netherlands	Postal mail	618	40.6%
New Zealand	Phone/email/fax recruit to online	503	27.7%
Norway	Postal mail	864	44.4%
Sweden	Postal mail recruit to online/mail	2,905	46.5%
Switzerland	Postal mail recruit to online/phone (CATI)	1,065	39.0%
United Kingdom	Phone recruit to phone (CATI)/online	1,001	39.4%
United States (excluding Alaska and Hawaii)	Postal mail recruit to online/mail	1,001	30.9%

Table 2 The Commonwealth Fund International Health Policy Survey of Older Adults 2014, number of respondents and response rates by country

Country	Number of respondents	Response rate
Australia (including New South Wales)	3,310	31%
Canada	5,269	28%
France	1,500	29%
Germany	928	26%
Netherlands	1,000	25%
New Zealand	750	27%
Norway	1,000	16%
Sweden	7,206	23%
Switzerland	1,812	60%
United Kingdom	1,000	23%
United States (excluding Alaska and Hawaii)	1,755	24%

Indicator specifications by chapter

Table 3 Specifications for indicators calculated by BHI by chapter

Indicator	Cohort description (numerator, denominator)	Further details (inclusions, exclusions, references)	Data source
Accessibility			
Median time from emergency presentation to starting treatment, by urgency category	Cohort: Emergency presentations to NSW public hospital emergency departments Time to treatment is the difference between arrival time and start of treatment time	Excludes: • Non-emergency presentations • Presentations for which their treatment was not started • Presentations that did not have a valid visit type, presentation time, start of treatment time or urgency category For further details, see www.bhi.nsw.gov.au/publications/hospital_quarterly_nsw/technical_supplements_of_hospital_quarterly	NSW public hospital activity data; AIHW hospital statistics
Percentage of emergency department presentations leaving within four hours, by mode of separation	Denominator: All presentations to NSW public hospital emergency departments Numerator: Denominator cases where the time between arrival at and departure from the ED was less than four hours	For further details, see www.bhi.nsw.gov.au/publications/hospital_quarterly_nsw/technical_supplements_of_hospital_quarterly	NSW public hospital activity data; AIHW hospital statistics
Median waiting times for elective surgery	Cohort: Patients removed from the elective surgery waiting list because they received their surgery Waiting time: in days, the difference between patient's listing date on the waiting list and date of their removal from the waiting list	For further details, see www.bhi.nsw.gov.au/publications/hospital_quarterly_nsw/technical_supplements_of_hospital_quarterly	Waiting list online collection system (WLCOS)
Percentage of patients' surgeries completed in recommended time, by selected elective surgery type	Denominator: Count of procedures of a particular type performed Numerator: Cases in the denominator with a waiting time less than recommended for the urgency category	For further details, see www.bhi.nsw.gov.au/publications/hospital_quarterly_nsw/technical_supplements_of_hospital_quarterly	Waiting list online collection system (WLCOS)
Appropriateness			
Percentage of patients receiving hip fracture surgery within two days, for patients aged 65 years and over	Denominator: Episodes selected with principal diagnosis ICD-10-AM codes S72.0, S72.1 or S72.2 with a procedure performed Numerator: Denominator cases where the difference between admission date and procedure date is less than or equal to two days	Excludes: • Patients under 65 years of age	Linked hospital activity data; OECD Health Statistics

Indicator	Cohort description (numerator, denominator)	Further details (inclusions, exclusions, references)	Data source
Percentage of deaths in hospital, Hospital and ED use in the period before death	Denominator: ABS deaths in NSW during 2006 and 2013 Numerators: In hospital deaths, patients with at least one hospitalisation/ emergency presentation near end of life (within 30, 180 and 365 days of death), during 2006 and 2013 patients with at least one hospitalisation for Palliative care	Excludes: • Patients with hospitalisations/ emergency presentations more than three days after date of death • Non-emergency presentations	ABS deaths, Linked NSW Admitted Patient and the NSW Emergency Department Data Collections, and the NSW Register of Births, Deaths and Marriages
Effectiveness			
Directly age-sex standardised hospitalisation rates for hospitalisations for chronic disease related conditions (COPD, Diabetes complications, Asthma, Heart failure)	Denominator: NSW estimated resident population aged 15 years and over at 30 June 2011 Numerator: Acute episodes of care with principal diagnosis ICD-10-AM codes for each condition as follows: • Asthma: J45, J46 COPD: J40*, J41, J42, J43, J44, J47 *J40 only qualifies if accompanied by J41, J43, J44 or J47 • Congested Heart Failure: I11.0, I13.0, I13.2, I50.0, I50.1, I50.9 • Diabetes : E10, E11,E13, E14 • Diabetic amputation procedure: 44361-00, 44361-01, 44367-02, 44367-00, 44367-01, 44370-00, 44373-00	Standard population is the 2005 OECD resident population, as specified in Table 6 Excludes: • Non NSW residents • Transfers from another institution • Pregnancy/childbirth and puerperium episodes • Same-day discharge • Patients with cystic fibrosis or respiratory system anomalies (asthma only) • Patients with trauma (S78.0, S78.1, S78.9, S88.0, S88.1, S88..9, S98.0, S98.1, S98.2, S98.3, S98.4, T05.3, T05.4, T05.5, T13.6) or tumour related (C40.2, C40.3) (diabetic amputation only)	Linked admitted patient, emergency department presentation and fact of death data
Directly age-sex standardised mortality rate following hospitalisation for stroke, per 100 patients hospitalised	Denominator: Patients aged 45 years and over with principal diagnosis ICD-10-AM codes for each condition as follows: • Ischaemic stroke: I63, I64 Numerator: Cases in denominator that died in or out of hospital within 30 days of admission	Standard population is the 2010 OECD hospitalised population, as specified in Table 5 Results are included in the synthesis only. Excludes: • Non NSW residents	Linked hospital activity data; OECD Health Statistics
Unadjusted hospitalisation rate, per 100,000 episodes, for foreign body left during procedure	Denominator: hospital episodes for patients aged 15 years and over Numerator: Cases in denominator with secondary diagnosis ICD-10-AM codes T81.5, T81.6, Y61.0, Y61.1, Y61.2, Y61.3, Y61.4, Y61.5, Y61.6, Y61.7, Y61.8, Y61.9	Excludes: • Episodes with principal diagnosis of foreign body left during procedure • Same day discharge	Linked hospital activity data; OECD Health Statistics

Indicator	Cohort description (numerator, denominator)	Further details (inclusions, exclusions, references)	Data source
Unadjusted hospitalisation rate, per 100,000 surgical episodes, for post-operative pulmonary embolism or deep vein thrombosis	Denominator: Surgical episodes for patients aged 15 years and over Numerator: Cases in denominator with secondary diagnosis ICD-10-AM codes I26.0, I26.9, I80.1, I80.2, I80.3, I80.8, I80.9, I82.8 or I82.9 More information on hip and knee procedure codes available upon request.	Excludes: • Episodes with principal diagnosis of pulmonary embolism or deep vein thrombosis • Episodes with procedure code 'interruption of vena cava' (ACHI procedure code 34800-00) • Pregnancy/childbirth and puerperium episodes • Episodes with length of stay less than 2 days	Linked hospital activity data; OECD Health Statistics
Unadjusted hospitalisation rate, per 100,000 surgical episodes, for post-operative sepsis	Denominator: Abdominal surgical **episodes** for patients aged 15 years and over Numerator: Cases in denominator with secondary diagnosis ICD-10-AM codes A40.0, A40.1, A40.2, A40.3, A40.8, A40.9, A41.0, A41.1, A41.2, A41.3, A41.4, A41.5, A41.8, A41.9, R57.2, R57.8, R65.0, R65.1 or T81.1 More information on abdominal procedure codes available upon request.	Excludes: • **Episodes** with principal diagnosis of sepsis or infection • Immunocompromised patients • Cancer patients • Pregnancy/childbirth and puerperium episodes • Episodes with length of stay less than 3 days Additional diagnosis codes for recording wound infection sepsis are available in the Australia modification of the ICD-10 (T81.42). For comparative purposes, this was excluded for international comparison. The post-operative sepsis cases excluded had minimal impact on the rate published.	Linked hospital activity data; OECD Health Statistics
Unadjusted rates of hospitalisation for obstetric trauma, per 100 vaginal deliveries, with and without instrument	Denominator: Vaginal deliveries for females aged 15 years and over ICD-10-AM diagnosis codes: O80, O81, O83, O84, O84.0, O84.1, O84.8, O84.81, O84.82, O84.9 Numerator: Cases in denominator with ICD-10-AM diagnosis codes O70.2 or O70.3 or ACHI procedure code 16573-00	Method based on OECD definition ACHI procedure codes for instrument-assisted delivery: 90468-00, 90468-01, 90468-02, 90468-03, 90468-04, 90468-05, 90469-00, 90469-01, 90470-01, 90470-02, 90470-04, 90474-00, 90475-00	Linked hospital activity data; OECD Health Statistics
Readmission: AMI CHF and COPD	See Spotlight on measurement Return to acute care following hospitalisation, Insights into readmissions http://www.bhi.nsw.gov.au/publications/spotlight_series for AMI and CHF See appendix B for COPD		Linked admitted patient and fact of death data

Indicator	Cohort description (numerator, denominator)	Further details (inclusions, exclusions, references)	Data source
Mortality: AMI, CHF, and COPD	**See Spotlight on measurement** *Measuring 30-day mortality following hospitalisation, Considering approaches for ongoing reporting in NSW* http://www.bhi.nsw.gov.au/publications/spotlight_series for AMI See appendix C for CHF and COPD		Linked admitted patient and fact of death data
Efficiency			
Average length of stay (ALOS) for vaginal delivery and caesarean delivery	Maternal and child health register data was linked to admission records and the length of stay is calculated by subtracting the baby born date to the mother discharge date	Excludes: • Length of stay greater than 120 days	Linked hospital activity data and maternal and child health register data
The number of knee arthroscopy procedures	Denominator: Knee arthroscopy procedures on patients aged 50 years and over Numerator: hospitalisation with ACHI procedure codes: 49557-00, 49503-00, 49560-03, 49562-01, 49561-01, 49557-02, 49558-00, 49558-01 Costs was estimated by multiplying the total length of stay of knee arthroscopy episodes with the average cost of knee arthroscopy per day, which derived from 2012-13 costing report round 17—public hospital cost estimated for ARDRG code Arthroscopy (I24Z)	Excludes: • patients under 50 years of age	Linked admitted patient data
Equity			
Hospitalisation rates for removal or restoration of teeth	Denominator: children aged 1 to 4 years old. Numerator: hospitalisations with ACHI procedure codes: 97411 - 97679 with K02 (Dental caries) in diagnosis code 1 (restoration of teeth) or 97311 - 97327 with K02 (Dental caries) in diagnosis code 1 (removal of teeth)	Excludes: • Non NSW residents	Linked admitted patient data
Frequent user of emergency departments	Count of emergency ED presentations recorded between 1 July 2014 and 30 June 2015 for each patient were categorised into 1, 2 and 3 or more presentations	Excludes: • Non NSW residents	Linked emergency department presentation
Frequent user of overnight hospitalisations	Count of overnight hospitalisations recorded between 1 July 2013 and 30 June 2014 for each patient were categorised into 1, 2 and 3 or	Excludes: • Non NSW residents • Baby born in hospital (ICD codes:	Linked admitted patient data

Indicator	Cohort description (numerator, denominator)	Further details (inclusions, exclusions, references)	Data source
	more presentations	'Z38.0','Z38.3','Z38.6')	
Calculations by socio-economic status.	In this report, the NSW population was divided into five groups based on the Index of **Relative Socio-Economic Disadvantage** (IRSD) scores of their postal area of residence. This means that postal areas were sorted by IRSD score and assigned to population-weighted quintiles, each containing close to one-fifth of the total population of NSW. The denominator in each quintile was derived from ABS 2011 data of which each quintile contains roughly one-fifth of the total NSW population.	Excludes: • postal area is missing • postal area of the patient is not in NSW *Note: While the index of disadvantage is not a measure of socio-economic advantage, the language of high SES to represent the least disadvantaged quintile, and low SES to reflect the most disadvantaged quintile was used for ease of communication.*	

Table 4 Definitions and derived data items

Data item	Description
NSW resident	NSW residents are identified in administrative data collections using the data field STATE OF RESIDENCE in SAPHaRI datasets. The data recorded in this field is taken directly from the relevant table in the Health Information Exchange data warehouse. Surveys use sampling methods that ensure persons surveyed are usual residents of NSW.
Transfers into a health facility	Episodes of care that begin with a transfer in from a previous hospital are identified using BHI's method of collapsing contiguous episodes of care linked by a unique patient identifier into a period of care. As such, transfers can be identified by the absence of a subsequent episode that meets the criteria.
Same day discharge/day only admission	A same day discharge is identified by equal episode start and end dates.
Length of stay	An episode's length of stay is calculated as the difference between the episode end date and the episode start date minus total episode leave days. This definition is specified in the AIHW Health Minimum dataset. The quantity is derived in SAPHaRI datasets.
Chronic condition	The chronic condition cohort includes patients with the following conditions: hypertension or high blood pressure, heart disease (including heart attack), diabetes, asthma or chronic lung disease (such as chronic bronchitis, emphysema or COPD), depression, anxiety or other mental health problems, cancer, joint pain or arthritis.
Area of usual residence	Area of usual residence is used to attach an index of socio-economic status and remoteness category to where a patient lives.
Hospital in the Home (HITH)	In NSW, Hospital in the Home (HITH) is defined as the range of service delivery models providing acute and post-acute care that is delivered in home (including Residential Aged Care Facilities), clinic or other settings as a substitution or avoidance of hospital [NSW Health, *NSW Hospital in the Home (HITH) Guideline*].

Table 5 OECD standard hospitalised population 2010 [6]

Age group	Male	Female	Total
45–49	74,148	20,572	94,720
50–54	108,762	29,478	138,240
55–59	127,052	38,458	165,511
60–64	136,650	51,020	187,670
65–69	125,408	58,289	183,697
70–74	124,159	71,511	195,670
75–79	113,769	85,892	199,661
80–84	95,557	95,372	190,929
85+	83,829	132,234	216,063
Total	989,333	582,826	1,572,160

Table 6 OECD standard resident population, 2005, by age group and sex [6]

Age group	Male	Female	Total
15–19	40,625,795	38,773,417	79,399,212
20–24	41,743,145	40,258,194	82,001,339
25–29	41,941,848	40,948,668	82,890,516
30–34	43,389,484	42,704,755	86,094,239
35–39	43,371,817	42,895,601	86,267,418
40–44	43,161,119	43,109,483	86,270,602
45–49	40,248,518	40,649,038	80,897,556
50–54	36,427,644	37,364,408	73,792,052
55–59	33,380,411	34,689,310	68,069,721
60–64	26,289,839	28,254,493	54,544,332
65–69	22,346,079	25,279,333	47,625,412
70–74	18,074,327	22,236,819	40,311,146
75–79	13,607,727	19,097,765	32,705,492
80–84	8,425,270	14,684,935	23,110,205
85+	5,282,533	12,504,426	17,786,959
Total	458,315,556	483,450,645	941,766,201

Appendix A:
OECD country comparison data tables

The analysis of *Healthcare in Focus* places NSW in an international context focusing on Australia and 10 other countries: Canada, France, Germany, the Netherlands, New Zealand, Norway, Sweden, Switzerland, the United States and the United Kingdom. In addition, data for the remaining 23 of the 34 OECD countries (Austria, Belgium, Chile, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Poland, Portugal, the Slovak Republic, Slovenia, Spain and Turkey) was obtained for a broader perspective of performance across a range of measures.

A summary of values used in the report summary figures is provided in **Table A.1** and **A.2**. Country data is available at (http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT) including detail on years and methods.

Table A.1 Indicator values for NSW and available country comparators, 2013 or nearest (Part 1 of 2)

	Cataract extraction median wait (days)	Hip replacement surgery median wait(days)	Knee replacement surgery median wait (days)	(%) Influenza shot (% of aged 65+)	Vaccination in children (%)	Hip fracture surgery within two days (% of aged 65+)	Caesarean section (% of births)	Congestive heart failure hospitalisation rate per 100,000 population	Asthma hospitalisation rate per 100,000 population	Diabetes amputation rate per 100,000 population	COPD hospitalisations rate per 100,000 population
NSW	222	207	291	71	91.4	70	31.5	220	58.3	4.13	311
Australia	79	106	194	74.6	91		32.1	240	64.7	4.48	324
Canada	48	87	98	64.1	96	92	26.3	179	14.9	7.43	243
France				51.9	99		20.8	238	30.3	7.46	120
Germany				58.6	96	87.6	30.9	382	22.6	9.15	245
Netherlands				68.8	97	95.2	15.6	199	31.2	4.71	164
New Zealand	74	87	95	69	92	82.3	25.8	228	72.2	5.93	325
Norway	100	135	164	20.8	94	89.3	16.5	175	25.6	5.67	222
Sweden				45.8	98	93	16.4	300	22.8	4.07	192
Switzerland				46	96	85.9	32.5	174	12.7	3.1	101
United Kingdom	61	75	79	75.5	96	87.6	23	99.4	60.5	3.11	213
United States				66.5	94		32.5	367	103		216
Austria				36.1	83	84.4	28.8	283	43.6		305
Belgium				58	99	84.3	20.2	183	34.2	4.81	211
Chile	154	232	154	76.5	91		44.7	119	20.6		118
Czech Rep.				22.1	99	85.4	26.1	415	37		159
Denmark	61	41	48	45.6	94	95.8	22.2	154	45.9	8.52	288
Estonia	83	145	229	1.1	94	80.9	20.1		36.9		307
Finland	87	103	123	41	98	85.8	15.8	278	60.8		132
Hungary	39	75	114	36.7	99	88.3	35.3	441	73.3		354
Iceland					91	95.8	15.2	197	20.8	3.5	206
Ireland				59.2	96	82.3	28.5	175	41.3	3.24	395
Israel	58	56	82	61.2	94	84.8	15.4	234	54.1	15.9	207
Italy				54.2	97	44.8	36.1	268	9.76	2.71	69.8
Japan				50	98			137	34.7		23.5
Korea				77.4	99		36	102	98.5	2.43	212
Latvia					95	49.9			95.2		162
Luxembourg				43.3	99		26.8		25.2	3.47	166
Mexico				78.5	83		45.2	74	12.8		106
Poland	371	221	328	12.1	99		34.6	548	80.3		181
Portugal	66.7	82.4	182	49.9	98	45	35	195	16.9	11.9	72
Slovak Rep.				15.6	98		30.7	437	109		170
Slovenia				13	95	61.9	19.5	306	42.6	15.3	108
Spain	97	130	162	56.4	96	43.3	25.2	206	42	6.7	194

Notes: Hospitalisation rates are age-sex standardised rates for the population aged 15 years and over. COPD: Chronic Obstructive Pulmonary Disease. Most data is for 2011, 2012 and 2013 in a few cases values are for 2008 and 2009.

Table A.2 Indicator values for NSW and available country comparators, 2013 or nearest (Part 2 of 2)

	Diabetes complications rate per 100,000 population	PE/DVT hospitalisations following hip/knee rate per 100,000 surgical procedures	Sepsis (abdominal) rate per 100,000 surgical procedures	Obstetric trauma (with instrument) rate per 100 births	Obstetric trauma (without instrument) rate per 100 births	AMI in and out of hospital mortality within 30 days) per 100 patients	Ischemic stroke in and out of hospital mortality within 3 days) per 100 patients	Cervical cancer five-year relative survival (%)	Breast cancer five- year relative survival (%)	Colorectal cancer five-year relative survival (%)	Average length of stay (days)
NSW	122	2,471	2,167	6.4	2.2	7.6	13.3	65.4	87.6	67.5	5.8
Australia	141	1,716	2,272	7.3	2.4			66.2	88	68.7	5.6
Canada	95			17.1	3.1	7.1	9.9	66	87.7	63.5	7.6
France	181	2,064		2.6	0.6						10.1
Germany	216			8.1	2.1			64.8	85.8	64.1	9.1
Netherlands	68.3			3.7	2.5	7.6	9.6	64.6	85.3	63.9	6.4
New Zealand	187			8.4	2.6	8.2	11	64.9	86	63.2	7.9
Norway	76.4			4.8	1.4	7.6	8.4	81.2	88.9	63.5	6.1
Sweden	111			13.2	2.8	8.3	9.6	67.2	89.4	65.4	5.8
Switzerland	44	548	1,104	7.2	2.6	8.9	8.2				8.7
United Kingdom	64.3	535	1,723	7.2	2.8	9.1	10.6	59.5	81.1	56.1	7.1
United States	198	594	1,941	10.3	1.5			61.8	88.9	64.2	6.1
Austria	296							64.4	83.1	64.4	8.1
Belgium	171	465	2,176	2.9	0.6			64.6	86	66.9	7.9
Chile	231							45.3	79.6		5.7
Czech Rep.	192					10.5	13	65	80.8	53.9	9.4
Denmark	125			13.4	2.6	8.3	10.2	69.4	86.2	60.9	4.3
Estonia						13.1	13.2	67.4	74.2	52.5	7.5
Finland	126			4.2	0.9	8.5	6.8	68.6	88.8	64.4	10.8
Hungary	110										9.5
Iceland	55.1							67.8	86.7		5.9
Ireland	139	577	2,960	4.8	1.9			62.3	81.5	60.3	6
Israel	87.6			1.9	0.5	8.8	8.1	66.8	87.8	70.3	6.5
Italy	43.5			1.4	0.5	7.5	9	70.6	85.8	63.7	7.9
Japan	162							68.0			17.2
Korea	311					10.3	4.8	77.8	85.9	70.9	16.5
Latvia	131					19.1	27	58.5	84.2	58.3	
Luxembourg	168					10.5	11.1				8.9
Mexico	338										4
Poland	231					8.2		54.5	74.8	50.2	7
Portugal	85.7			2.3	0.5	10.4	10.8	64.5	87.9	61.6	8.9
Slovak Rep.	225										7.5
Slovenia	112	939	2,010	0.8	0.3	9	14.9	56.5	83.6	61.3	6.5
Spain	52.3			3.2	0.8	8.2	9.9				7.6

Notes: AMI=Acute Myocardial Infarction. Hospitalisation rates are age-sex standardised rates for the population aged 15 years and over. Mortality measures are based on the population aged 45 years and over, and standardised to the population in Table 5. For adverse event related measures, post-surgery or obstetric, Poland was removed as there were notes suggesting there were underestimation and comparability issues. Survival estimates are based on a mix of cohort and period analysis with differing methods, as noted on the full tables available on the OECD website.

Appendix B:
Risk standardised 30-day return to acute care following hospitalisation for chronic obstructive pulmonary disease

The condition

Chronic obstructive pulmonary disease (COPD) is a long-term lung disease, associated with prolonged exposure to tobacco smoke. While no existing treatment can cure COPD, it can be effectively managed outside the hospital setting with appropriate and timely care.

Between July 2009 and June 2012, 44,363 COPD index hospitalisations were included in the analyses. Of these, 9,404 (22%) were followed by an unplanned readmission within 30 days of discharge.

The indicator

The risk standardised readmission ratio (RSRR) provides a fair comparison of a particular hospital's results in returns to acute care given its case mix with an average NSW hospital with the same case mix.

Data sources

Data are drawn from the NSW Ministry of Health's Health Information Exchange (HIE) and NSW Registry of Births, Deaths and Marriages, and probabilistically linked by the Centre for Health Record Linkage (CheReL). Data are accessed via SAPHaRI, Centre for Epidemiology and Evidence, NSW Ministry of Health.

Calculation

The ratio of the observed number of emergency returns to acute care (numerator) to the expected number of emergency returns to acute care (denominator) within 30 days following discharge from COPD index admissions at a given hospital.

Cohort index admissions

An index admission is the hospitalisation included in calculating RSRRs for the condition of interest. The index admissions form the 'cohort' for assessing returns to acute care (Figure 3).

Inclusions

- Principal diagnosis of COPD: J20*, J40*, J41, J42, J43, J44, J47 (*only if accompanied by secondary diagnosis of J41-J44, J47)
- Aged 45 years or over
- Admissions to acute care
- Discharged between 1 July 2009 and 30 June 2012.

Exclusions

- Index admissions with mode of separation 'Discharged at own risk', as the hospital would not be able to complete treatment or discharge planning
- Index admissions within 30 days of a prior index admission (any admission within 30 days following discharge from an index admission is considered a readmission)
- Discharges from NSW hospitals administered by agencies external to NSW
- Index admissions with mode of separation 'Transferred to palliative care'

- Index admissions ending with an in-hospital death
- Discharges from a private hospital.

Periods of care and transfers

Multiple acute, contiguous hospitalisations are considered as a single, acute period of care. Acute admissions on the same day of separation from another acute hospitalisation are included in the same acute period of care, regardless of the mode of separation at the previous hospitalisation. If an acute admission is coded as ending in a transfer, and there is another acute admission within one day of that transfer, the second admission is concatenated into the same period of care.

Numerator

Observed number of hospital-level returns to acute care, where an emergency return to acute care meets the following criteria:

- All-cause hospitalisations within 30 days following discharge from a COPD index admission
- Acute and emergency hospitalisations
- Admitted to any NSW hospital (public or private).

In cases where more than one emergency return to acute care occurs within 30 days of an index admission, only the first readmission is counted.

Denominator

Expected number of emergency returns to acute care at a given hospital, on the basis of an average NSW hospital's performance with the same case mix, calculated as the sum of the estimated probabilities of emergency returns to acute care using a NSW-level prediction model.

Attributions of index admissions and emergency returns to acute care

In case of patient transfers, index admissions and emergency returns to acute care are attributed to the last hospital that discharged the patient to a non-acute care setting.

When there is a non-emergency overnight acute rehospitalisation in the 30 days following discharge from the index admission, and preceding the first emergency return to acute care, no return is assigned to that index admission.

Transfers to non-acute care

Periods of care include acute hospitalisations only. A transfer from acute to non-acute care, within the same or to a different hospital, is considered to be a discharge. Should the patient then be transferred from non-acute care as an acute, emergency return to acute care within 30 days of discharge, it will be considered as a return to acute care. The return to acute care is attributed to the hospital which discharged the patient from acute to non-acute care.

Development and validation of the prediction model

The NSW-level prediction model is developed using Fine & Gray competing risks regression models adjusting for patient-level risk factors, and taking into account the competing risk of death. The standard errors are adjusted for within hospital correlations.

A backward modelling approach is used to build the multivariable regression models. Variables significant at 20 percent level in the univariate analysis are considered for inclusion in multivariable models. Only variables with a 2-sided p-value of less than 0.05 in the multivariable models are retained in the final model.

Risk adjustment variables

The following variables are included in the development of the prediction models:

- Age at index admission
- Sex
- Elixhauser comorbidities, dementia and history of COPD with a one year look back period

The final prediction model is shown in Table 1. The prediction ability of the model is assessed using c-statistics in data from previous financial years (Figure 1). The stability of the coefficients in previous financial years is also tested (Figure 2). The clinical relevance of the variables in the final model and their direction of association with the outcome are reviewed by clinicians. The model's C-statistic was 0.65, and its performance was relatively stable over different financial years.

Table 1: Prediction model, return to acute care within 30 days of discharge using Fine and Gray competing risks regression models, July 2009-June 2012

Risk factors	Subhazard ratio	p-value	95% Conf.	Interval
Age	1.01	0.000	1.00	1.01
Female versus male	0.87	0.000	0.83	0.91
History of COPD	1.84	0.000	1.76	1.91
Congestive heart failure	1.25	0.000	1.19	1.32
Cardiac arrhythmia	1.07	0.012	1.02	1.14
Pulmonary circulation disorders	1.09	0.039	1.00	1.19
Hypertension	1.12	0.000	1.06	1.19
Renal failure	1.15	0.002	1.05	1.26
Liver disease	1.28	0.001	1.10	1.48
Solid tumour*(without metastasis)	1.31	0.000	1.19	1.45
Weight loss	1.20	0.000	1.12	1.29
Fluid and electrolyte disorders	1.17	0.000	1.11	1.23
Blood loss anaemia	1.28	0.046	1.00	1.64
Alcohol abuse	1.16	0.009	1.04	1.30
Drug abuse	1.48	0.000	1.25	1.74
Psychoses	1.30	0.009	1.07	1.58
Depression	1.18	0.000	1.08	1.29

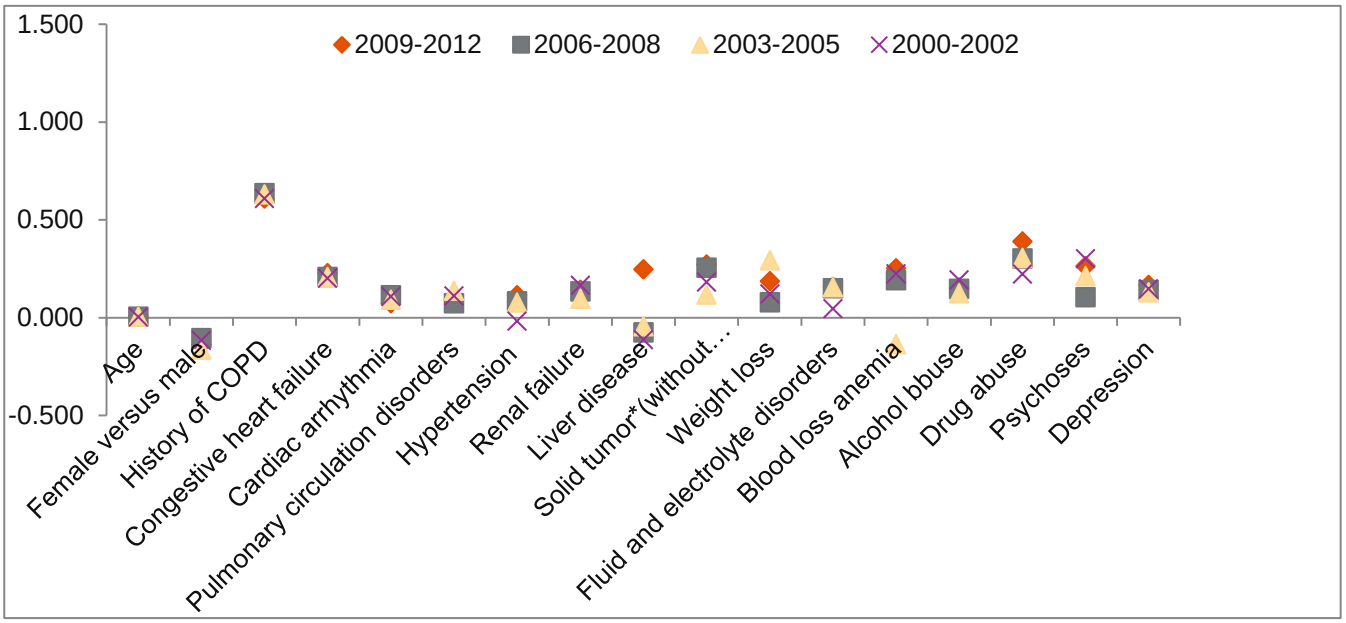
Figure 1: Model performance (C-statistics) over different time periods

Reference period	c-statistics	
July 2009-June 2012	0.65	
Validation period	Method 1	Method 2
July 2006-June 2009	0.64	0.64
July 2003-June 2006	0.64	0.64
July 2000-June 2003	0.63	0.63

Method 1: using July 2009-June 2012 coefficients

Method 2: using recalibrated coefficients

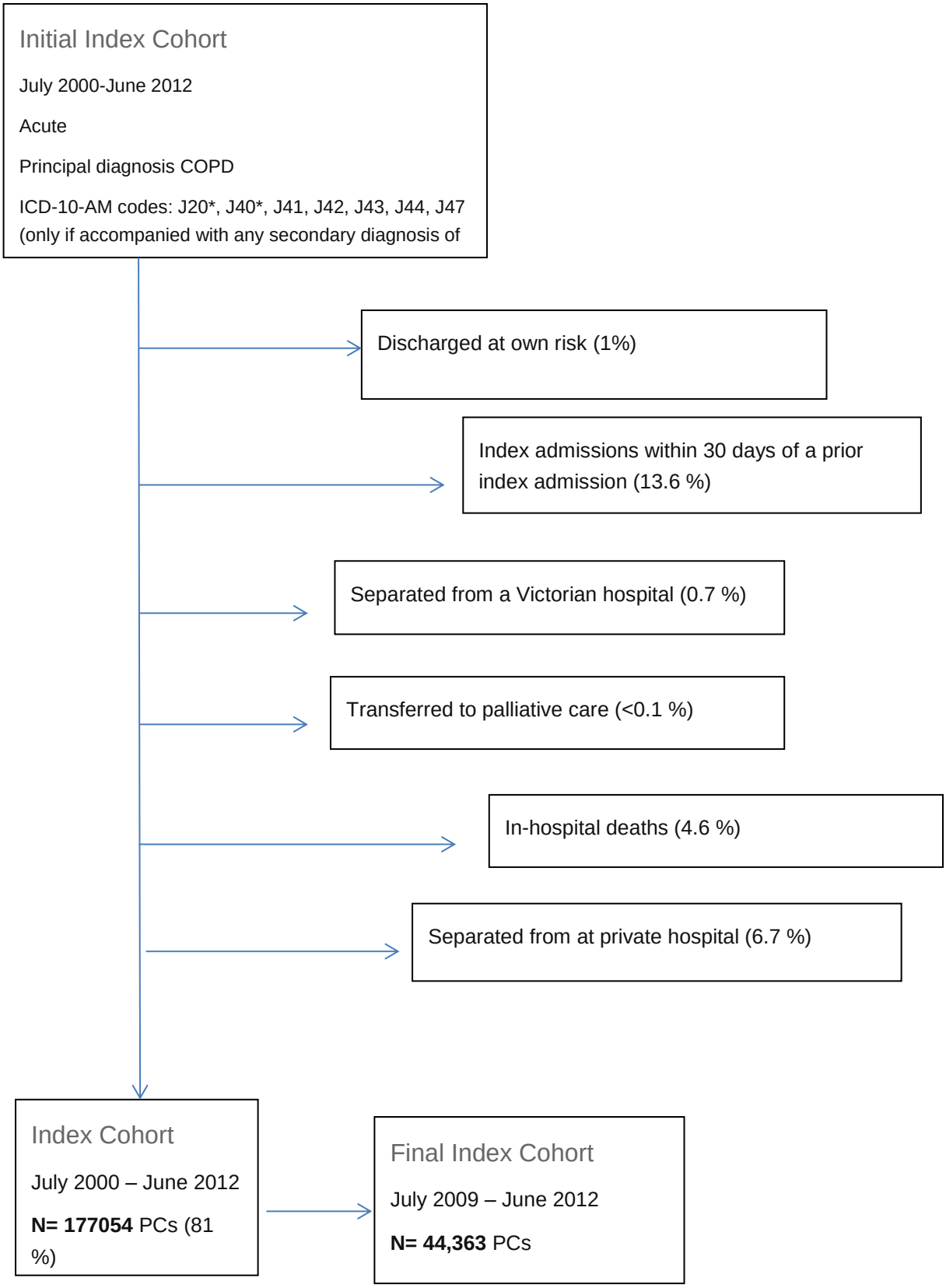
Figure 2: Stability of the prediction model coefficients



Index admissions with less than 30 days of follow-up information

Calculation of unadjusted rates of return to acute care and hospital RSRRs excludes index cases that occurred less than 30 days from the end of the study period (30 Jun 2012) to avoid introducing bias with a truncated follow-up period. However, as competing risk regression models take into account different follow up periods, index admissions without a full 30 days of follow-up information are included to build the NSW prediction models.

Figure 3 Cohort construction and exclusions



Appendix C:
Risk standardised 30-day mortality (all cause) following hospitalisation for chronic obstructive pulmonary disease, and congestive heart failure

The conditions

Chronic obstructive pulmonary disease (COPD) is a long-term lung disease, associated with prolonged exposure to tobacco smoke. In 2013, COPD accounted for 1,907 deaths in NSW (4% of deaths).

Congestive heart failure (CHF) occurs when the heart is unable to keep up with the demands of, or provide adequate blood flow to, other organs. It often develops as a result of hypertension, diabetes or other coronary heart diseases. In 2013, CHF accounted for 1,104 deaths in NSW (2% of deaths).

The indicator – risk standardised mortality ratios

Risk-standardised mortality ratios (RSMRs) can provide important information about healthcare system performance. Hospital variation in mortality, after adjusting for patient case mix, points to differences in processes or delivery of care. The indicator is based on statewide mortality data and uses a statistical model to identify patient level characteristics associated with 30-day mortality, and to quantify the effect of those characteristics on the likelihood of death within 30 days of hospitalisation. This information is then applied to each hospital's patient population, adjusting for the presence of the characteristics shown to affect the likelihood of death. This results in an 'expected' number of deaths for each hospital which is then compared to the 'observed' number of deaths that actually occurred (O/E). Ratios greater than 1.0 indicate higher than expected mortality and ratios less than 1.0 indicate lower than expected mortality. Ratios close to 1.0 are not generally considered to be meaningful and funnel plots are used to interpret the results.

Cohorts

The cohort for the indicators consists of patients aged 45 years or over who were discharged between 1 July 2009 and 30 June 2012 with an acute, emergency admission for a principal diagnosis of the condition of interest (Figures 1 and 2).

- For COPD, ICD-10 codes: J20*, J40*, J41, J42, J43, J44, J47
- For CHF, ICD-10 codes: I11.0, I13.0, I13.2, I50.0, I50.1, I50.9

*only if accompanied by secondary diagnosis of J41-J44, J47

For each condition, a patient is counted once only. This is possible through the use of linked data based on a probabilistically assigned unique patient identifier, which is generated by statistical linkage with a false positive rate of 3 in 1,000 records (0.3%).

In the period July 2009 to June 2012, there were 28,700 patients hospitalised for COPD, and 25,437 patients hospitalised for CHF one or more times.

Of these, 3,029 (11%) died within 30 days of their last hospitalisation for COPD, and 3,770 (15%) died within 30 days of their last hospitalisation for CHF.

Data sources

Data were drawn from the NSW Ministry of Health's Health Information Exchange (HIE) and NSW Registry of Births, Deaths and Marriages, and probabilistically linked by the Centre for Health Record Linkage (CheReL). Data were accessed via SAPHaRI, Centre for Epidemiology and Evidence, NSW Ministry of Health.

Attribution

Multiple acute, contiguous hospitalisations are considered as a single, acute period of care. Regardless of subsequent transfers to other facilities, patients and their outcomes are attributed to the hospital to which patients were initially admitted for an acute period of care, for the condition of interest. This admission is the starting point for the 30-day follow-up interval. If patients had more than one period of care for a condition during the specified financial years, their last period of care for that condition was selected.

Risk adjustment

For each (de-identified) patient, demographic information and recorded Elixhauser comorbidities were obtained from the Admitted Patients Data Collection extending 12 months prior to, and including, the hospitalisation under consideration (index admission). A random intercept logistic regression approach was used to develop a prediction model. The model adjusts for patient level risk factors, and also accounts for within hospital correlations. Only those variables that were shown to have a significant impact on mortality ($P<0.05$) were retained in the final model. The clinical relevance of the variables in the final model and their direction of association with the outcome were reviewed by clinicians.

The model calculates the expected mortality for each hospital. The final condition-specific prediction models are shown in Tables 1 and 2. Our approach to risk adjustment is consistent with that deemed appropriate for a publicly reported outcome measure in the research literature.

Figure 1 Cohort, chronic obstructive pulmonary disease (COPD)

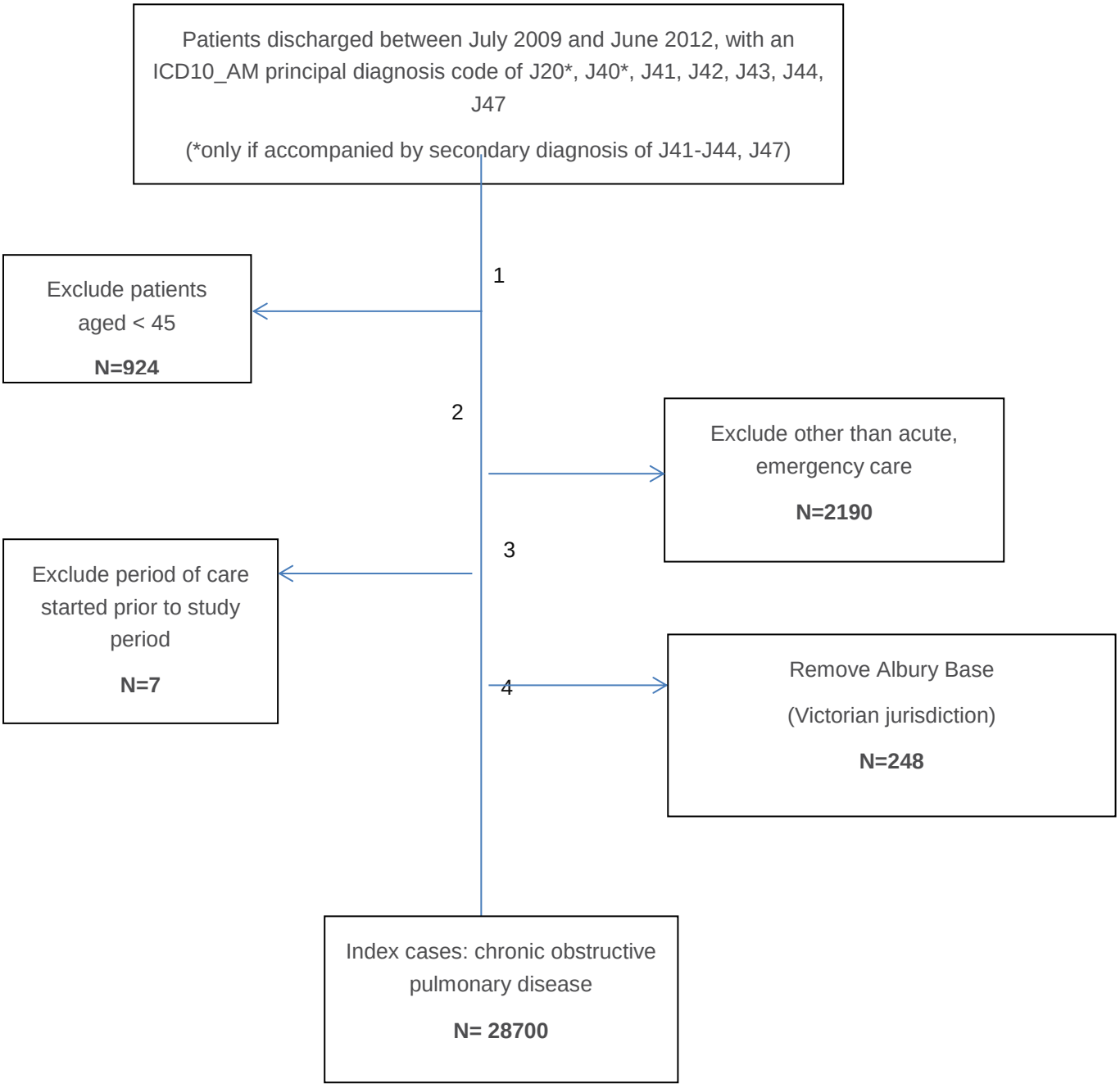


Figure 2 Cohort, congestive heart failure (CHF)

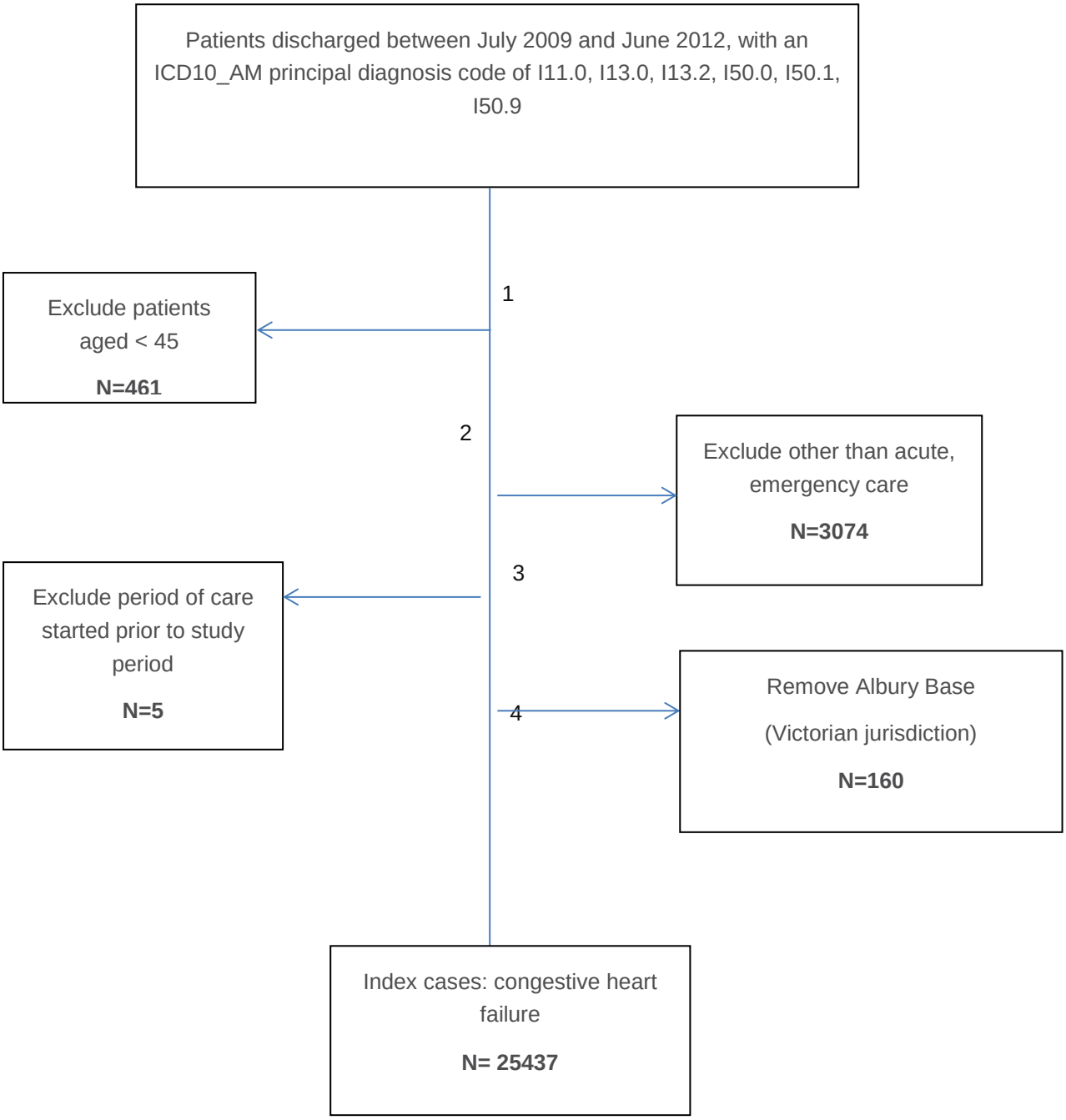


Table 1: Chronic obstructive pulmonary disease: predictors of mortality within 30 days of admission using random intercept logistic regression model, July 2009 – June 2012

Risk factors	Odds Ratio	P>z	[95% Conf.	Interval]
Number of previous acute hospitalisations for COPD*				
One versus zero	1.66	<0.001	(1.50	1.83)
Two versus Zero	2.02	<0.001	(1.76	2.31)
Three or more versus zero	2.89	<0.001	(2.56	3.27)
Female versus male	0.82	<0.001	(0.76	0.89)
Age (per year increase)**	1.03	<0.001	(1.03	1.04)
Age squared	1.00	0.038	(1.00	1.00)
Congestive heart failure	1.43	<0.001	(1.30	1.57)
Cardiac arrhythmia	1.11	0.034	(1.01	1.21)
Pulmonary circulation disorders	1.63	<0.001	(1.43	1.85)
Other neurological disorders	1.44	0.001	(1.16	1.79)
Diabetes, complicated	0.87	0.033	(0.76	0.99)
Liver disease	1.97	<0.001	(1.49	2.59)
Lymphoma	1.60	0.047	(1.01	2.54)
Metastatic cancer	3.17	<0.001	(2.46	4.10)
Solid tumour without metastasis	1.43	<0.001	(1.18	1.74)
Weight loss	1.76	<0.001	(1.57	1.97)
Fluid and electrolyte disorders	1.74	<0.001	(1.59	1.90)
Psychoses	2.14	<0.001	(1.50	3.05)

*contiguous hospitalisation episodes for COPD are counted once, acute episodes with a principal diagnosis of COPD are considered

**age is centred around the mean

Table 2: Congestive heart failure: predictors of mortality within 30 days of admission using random intercept logistic regression model, July 2009 – June 2012

Risk factors	Odds Ratio	P>z	[95% Conf.	Interval]
Number of previous acute hospitalisations for CHF*				
One versus zero	1.37	<0.001	(1.25	1.51)
Two versus Zero	1.63	<0.001	(1.41	1.89)
Three or more versus zero	2.39	<0.001	(2.03	2.81)
Female versus male	0.90	0.009	(0.84	0.98)
Age (per year increase)**	1.05	<0.001	(1.05	1.06)
Age squared	1.00	0.001	(1.00	1.00)
Valvular Disease	1.13	0.012	(1.03	1.25)
Pulmonary circulation disorders	1.19	0.002	(1.07	1.32)
Peripheral vascular disorder	1.20	0.008	(1.05	1.38)
Hypertension	0.83	<0.001	(0.77	0.90)
Paralysis	1.71	<0.001	(1.39	2.11)
Other neurological disorders	1.65	<0.001	(1.39	1.97)
Chronic pulmonary disease	1.25	<0.001	(1.15	1.37)
Diabetes, complicated	1.14	0.009	(1.03	1.25)
Renal failure	1.84	<0.001	(1.69	2.00)
Liver disease	2.74	<0.001	(2.25	3.33)
Lymphoma	2.17	<0.001	(1.51	3.09)
Metastatic cancer	3.16	<0.001	(2.50	3.98)
Coagulopathy	1.27	<0.001	(1.12	1.43)
Weight loss	1.56	<0.001	(1.38	1.76)
Fluid and electrolyte disorders	1.53	<0.001	(1.41	1.66)
Deficiency anaemia	0.77	<0.001	(0.67	0.88)

*contiguous hospitalisation episodes for CHF are counted once, acute episodes with a principal diagnosis of CHF are considered

**age is centred around the mean

Validity analyses

The model's performance was assessed in terms of discriminant ability using the area under the receiver operating characteristic (ROC) curve (C-statistic) - a summary statistic for assessing model performance. The C-statistic is an indicator of the model's discriminant ability, that is, its ability to correctly classify those who have and have not died within 30 days of hospitalisation.

The model's C-statistic was 0.74 for COPD, and 0.72 for CHF (Figures 3 and 4).

The reported C-statistics by the Yale group in US was 0.72 for COPD, and 0.68 for CHF mortality.

The models were validated by calculating C-statistics for data from previous financial years (2003-2005 and 2006-2008), and assessing the change to the estimated parameters (Figures3-6). The models' performance was stable over three discrete sets of three financial year periods.

Figure 3 COPD model performance (C-statistics) over different time periods

Reference period		
July 2009-June 2012	0.74	
Validation period	Method 1	Method 2
July 2006-June 2009	0.73	0.73
July 2003-June 2006	0.73	0.73

Figure 4 CHF model performance (C-statistics) over different time periods

Reference period		
July 2009-June 2012	0.72	
Validation period	Method 1	Method 2
July 2006-June 2009	0.70	0.70
July 2003-June 2006	0.69	0.70

Method 1: using July 2009-June 2012 coefficients

Method 2: using recalibrated coefficients

Figure 5 COPD: stability of the prediction model coefficients

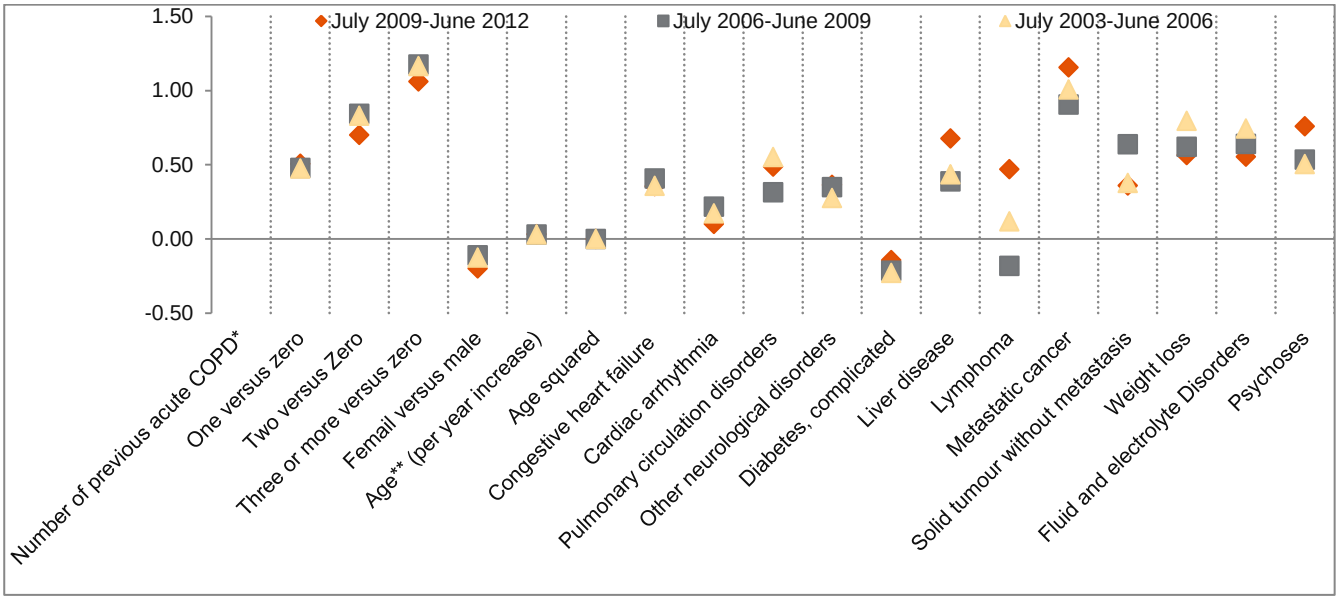
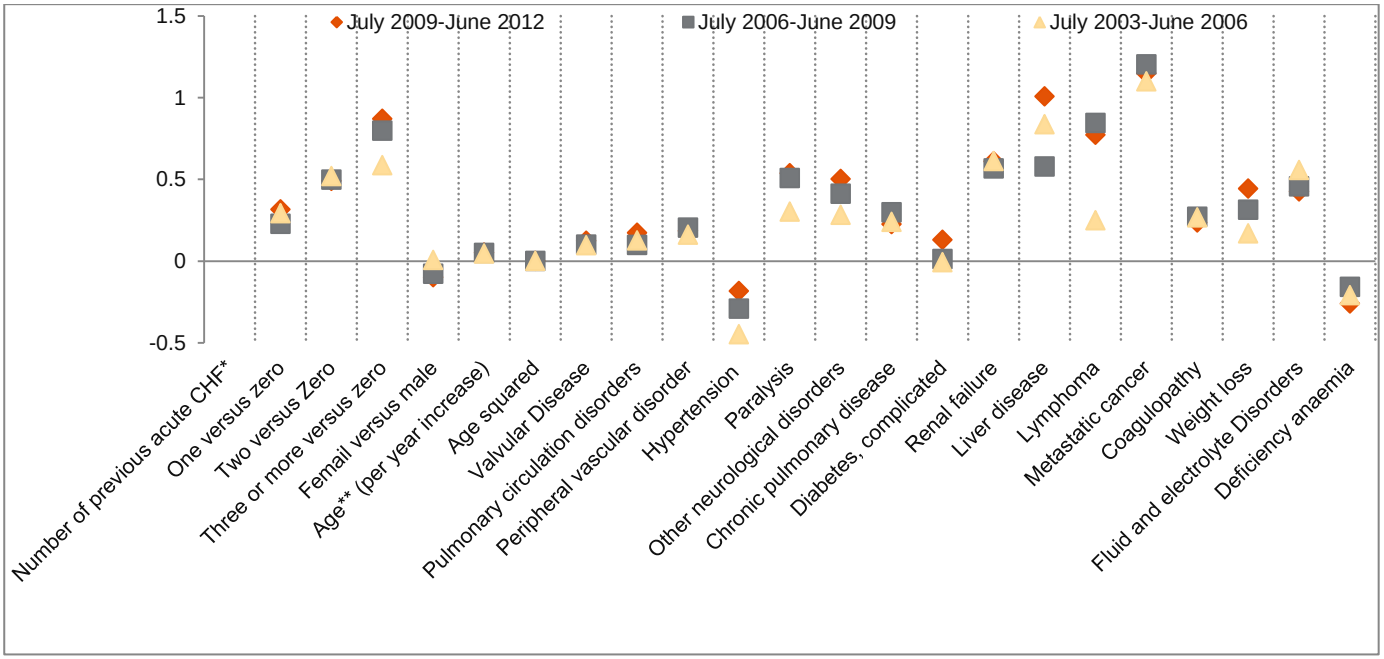


Figure 6 CHF: stability of the prediction model coefficients



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