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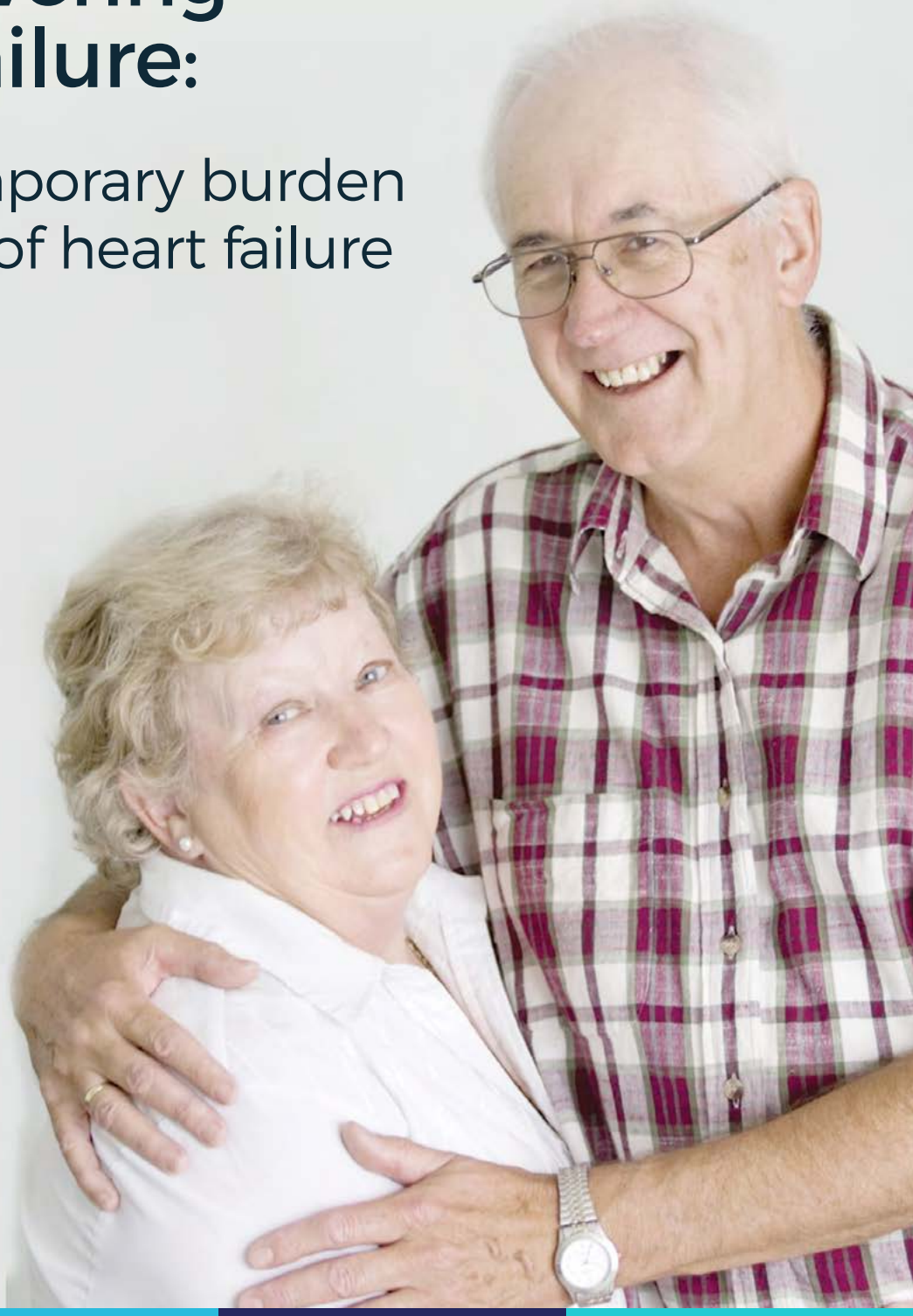
Rediscovering Heart Failure:

The contemporary burden and profile of heart failure in Australia



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HEART & DIABETES INSTITUTE

CRE to Reduce Inequality in Heart Disease
Equal Hearts for All

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Abbreviations and acronyms

ABS	Australian Bureau of Statistics
ACEi	Angiotensin Converting Enzyme Inhibitor
ACT	Australian Capital Territory
AF	Atrial Fibrillation
AIHW	Australian Institute of Health and Welfare
ARB	Angiotensin Receptor Blocker
AUS	Australia
BB	Beta Blocker
CHF	Chronic Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
ESC	European Society of Cardiology
GCCSA	Greater Capital City Statistical Areas
GP	General practitioner
HCN	Health Communication Network
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HMD	Hospital Mortality Database
HT	Hypertension
ICD	International Classification of Diseases
ICH	International Conference for Harmonisation
IDI	International Diabetes Institute
LOS	Length of Stay
LVSD	Left Ventricular Systolic Dysfunction
MI	Myocardial Infarction
NBPSD	National Blood Pressure Screening Day
NHFA	National Heart Foundation of Australia
NHMRC	National Health and Medical Research Council
NHS	National Health Survey
NSW	New South Wales
NT	Northern Territory
NYHA	New York Heart Association
PVD	Peripheral Vascular Disease
QLD	Queensland
RHD	Rheumatic Heart Disease
SA	South Australia
SAHMRI	South Australian Health and Medical Research Institute
TAS	Tasmania
VD	Vascular Disease
VIC	Victoria
WA	Western Australia

Executive summary

We undertook a study of the contemporary burden of heart failure to complement a previous report released more than a decade ago. During that time, a combination of population dynamics (an ageing population), an evolving armoury of therapeutics to treat the traditional drivers of heart failure (coronary artery disease and hypertension) and a changing risk factor profile (with more diabetes and obesity than ever before) had the potential to either reduce or increase the impact and burden of heart failure from a whole society perspective.

At the same time, the definition of heart failure has evolved and this has provided an extra dimension to the burden it imposes; even if the therapeutic options for affected individuals with so-called heart failure with preserved ejection fraction or diastolic heart failure is limited.

We would emphasise that estimating the "theoretical" burden of heart failure based on systematic screening of representative samples from whole populations as an accurate picture of the "actual" clinical burden of heart failure based on real-word clinical practice is fraught with danger and uncertainty. Some of the figures in this report only make sense if you accept that a problem is only as big as you can quantify it. In so-called Rumsfeld speak we quantify both the "known-known" and the "known-unknown" aspects of heart failure from a population to clinical burden perspective.

Noting the above caveats, utilising contemporary Australian data (including the Western Australia Linkage data-set and the landmark Canberra Heart Study), we were able to update our estimates and provide, what we would regard as a valid and relatively accurate picture of the contemporary burden imposed by heart failure in Australia from an individual to whole society perspective. We would emphasise that much of this burden remains hidden. However, this hidden burden can be likened to the submerged iceberg that feeds the incident cases of clinical heart failure in our community.

Key findings

Our key findings were as follows:

1. The latent risk of developing acute and chronic forms of heart disease among middle-aged Australian adults remains at historical highs despite important gains including reduced smoking rates.
2. The number of Australians aged ≥ 45 years developing any form of heart failure with clinically overt signs and symptoms is estimated to be more than 60,000 per annum; comprising a majority of older women in whom heart failure with preserved ejection fractions is more common and thus a definitive diagnosis is less likely to be achieved.
3. Based on conservatively high mortality rates (~50% at 5 years and ~75% at 10 years), these data would suggest a minimum prevalence of 350,000 to 400,000 Australians with clinically overt heart failure.
4. Consistent with the above, within the past decade, the annual prevalence of Australians aged ≥ 45 years with heart failure associated with systolic dysfunction (reduced ejection fraction) is likely to have risen to 315,000 and 161,000 in men and women, respectively. This represents a combined total of just less than half a million adults with this form of heart failure.
5. An additional 164,000 men and 332,000 women are estimated to have heart failure with a preserved ejection fraction.
6. In total, we now estimate that nearly one million Australians are now affected by the syndrome (with a similar proportion of men and women). As such, heart failure represents a still to be recognised, major public health problem.
7. As anticipated, the prevalence of heart failure is elevated within Australia's Indigenous communities where high levels of antecedent risk drive heart failure at a much younger age than the rest of the population.
8. It remains extremely difficult to estimate the burden imposed by heart failure on the primary health care sector without systematic registries to capture such data. At the minimum, we estimate that 669,000 of 8.9 million (7.5%) Australians aged ≥ 45 years are prescribed with the combination of a diuretic and an Angiotensin Converting Enzyme inhibitor/Angiotensin Receptor Blocker (the main stays of hypertension and heart failure treatment).
9. The number of *de novo* hospitalisations for heart failure per annum is estimated to be 27,468 (45%, from 61,444 incident cases) associated with 226,000 days of hospital stay.
10. Readmission and mortality rates remain high in those unfortunate enough to be admitted for the first time with heart failure.
11. Overall, we estimate that each year heart failure is attributable to ~150,000 hospital admissions and in excess of one million days in hospital (one third as a principal diagnosis) of which just over half (51%) involve women with the syndrome.
12. The annual direct cost of managing heart failure in the community is close to $900 million and as part of an acute hospitalisation $1.8 billion (total direct cost = ~$2.7 billion). These figures are likely to rise without the application of evidence-based strategies capable of cost-effectively reducing the costliest component of heart failure management – hospital stay.

Conclusions and recommendations

In parallel to the findings outlined above, we would make the following comments and recommendations:

1. Prevention (as opposed to cure) remains the most effective means of addressing the burden of heart failure in our community, by treating established risk factors (including hypertension, vascular disease, obesity, dyslipidaemia and diabetes).
2. Ongoing efforts to systematically screen at-risk individuals (including those with hypertension, diabetes, chronic kidney disease, coronary artery disease and vascular disease) for heart failure or asymptomatic structural heart disease need to continue in order to initiate evidence-based measures and positively influence its natural history as early as possible. Renewed efforts to prevent progressive cardiac dysfunction should be the focus of research efforts and preventative health care programs.
3. Within an ageing population in whom risk factors and antecedent heart disease remains high, the prevalence of heart failure is likely to climb and our data confirm this trend. While the age and prevalence of associated comorbidities of affected individuals steadily rises, the acuity (and cost) of presentations will continue to rise.
4. Greater effort needs to be applied to quantify (and optimise) the management of heart failure in primary care; particularly as the burden of milder cases of the syndrome continue to rise.
5. The rate and number of incident hospitalisations for heart failure is holding steady, indicating both negative and positive health gains in the Australian population. However, within vulnerable communities (e.g. Indigenous Australians) the data are not so favourable.
6. Residually high morbidity and mortality (including high rehospitalisation rates) reinforce the need for a systematic approach to the proven strategy of nurse-led multidisciplinary management programs – these have been funded intermittently and variably around Australia but have never been made a non-negotiable gold-standard service to all hospitalised Australians.
7. The hospital burden imposed by heart failure remains high and this is where the most gains in terms of ensuring the health care system can cope with a progressively ageing population can be made – both in terms of prevention and replacing prolonged hospital stay with community-based care.
8. Conservatively (based on those hospitalised with the syndrome alone), the estimated direct cost of heart failure has now risen to $2.7 billion per annum - with two thirds ($1.8 billion) attributable to hospital care alone (noting these costs are conservative).
9. A coordinated strategy (from optimal prevention to cost-effective management) is required to reduce this enormous expenditure.
10. Without a dramatic change in the risk profile of the Australian population, more and more, older and sicker Australians will develop this deadly and disabling syndrome – it represents an enormous public health problem now and for the foreseeable future.

Introduction

In 2004 our group published a landmark report in an attempt to highlight the burden and impact of an often hidden and most definitely under-estimated "epidemic" of heart failure within our ageing population. Entitled "Uncovering a hidden epidemic" the introduction to our study contained the following sentence:

> Despite a paucity of specific data, it is highly unlikely that Australia has escaped this epidemic (of heart failure). Indeed, it is likely that heart failure (HF) already imposes a considerable burden on the health care system.

As indicated, there was a paucity of data to describe the burden of heart failure at the time and thus, using the best available public health data, we generated the following overall estimates and conclusions for that time.

Results:

In 2000, we estimate that around 325,000 Australians (58% male) had symptomatic HF associated with both left ventricular systolic dysfunction (LVSD) and diastolic dysfunction and an additional 214,000 with asymptomatic LVSD 140,000 (26%) live in rural and remote regions, distal to specialist health care services. There was an estimated 22,000 incidents of admissions for congestive heart failure and approximately 100,000 admissions associated with this syndrome overall.

Conclusion:

Australia is in the midst of a HF epidemic that continues to grow. Overall, it probably contributes to over 1.4 million days of hospitalisation at a cost of more than $1 billion. A national response to further quantify and address this enormous health problem is required. [1]

Now a decade later, it is worth asking how much progress we have made to either verify these initial estimates or supersede them with much more accurate data taken from whole population studies (as advocated at the time)?

The rather unfortunate answer is that despite some key progress, we remain largely unaware and unappreciative of the latent and already substantive burden of heart failure imposed on the individual to societal level in Australia. Much of our attention is focused on more easily recognised and understood concepts such as "heart attack" (although there is still misconceptions around the difference between sudden and often fatal cardiac events and the broad spectrum of acute coronary syndromes that may or may not contribute to such an event).

A quick visit to the National Heart Foundation of Australia's website (http://www.heartfoundation.org.au) describing the burden of cardiovascular disease is indicative of the problem any individual or organisation faces in trying to neatly describe the burden of cardiovascular disease...

Cardiovascular disease (CVD) is the leading cause of death in Australia, with 43,946 deaths attributed to CVD in Australia in 2012. Cardiovascular disease kills one Australian every 12 minutes. Cardiovascular disease is one of Australia's largest health problems. Despite improvements over the last few decades, it remains one of the biggest burdens on our economy.

Cardiovascular disease

- is heart, stroke and blood vessel diseases
- kills one Australian every 12 minutes
- affects one in six Australians or 3.72 million
- prevents 1.4 million people from living a full life because of disability caused by the disease
- affects two out of three families
- was the main cause for 523,805 hospitalisations in 2011/12 and played a secondary role in a further 800,000
- claimed the lives of 43,946 Australians (30% of all deaths) in 2012 - deaths that are largely preventable
- lower socioeconomic groups, Aboriginal and Torres Strait Islander people and those living in remote areas had the highest rate of hospitalisation and death resulting from CVD in Australia

Coronary heart disease

- affects around 1.4 million Australians
- claimed the lives of 20,046 Australians (13% of all deaths) in 2012
- kills 55 Australians each day, or one Australian every 26 minutes

Heart attack

- it is estimated over 340,000 Australians have had a heart attack at some time in their lives
- each year, around 55,000 Australians suffer a heart attack. This equates to one heart attack every 10 minutes
- heart attack claimed 9,286 lives in 2012, or on average, 26 each day [2]

It is immediately obvious on reading these headline statistics that heart failure is not readily identified or even recognised as a major contributor to the overall burden of cardiovascular disease.

To best understand the disconnect between the perceived and actual profile/burden of heart failure it important to understand what heart failure actually means and, given its nature, how that contributes to a chronic lack of recognition of its presence and overall impact.

What is heart failure?

As defined in a recent Heart Foundation report on the management of those affected (see below), [2] heart failure (referred to as chronic heart failure [CHF] in many reports) is actually a syndrome (a collection of clinical characteristics and typical symptoms) rather than a single clinical entity.

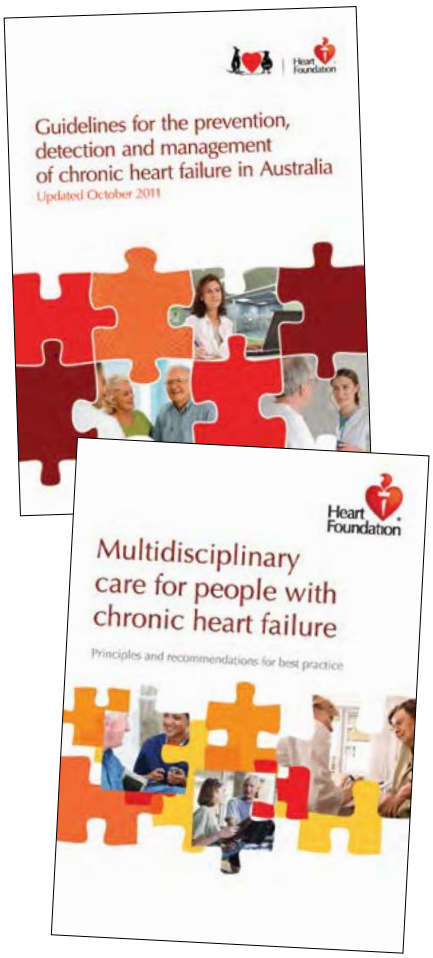
- CHF is a complex clinical syndrome that is frequently, but not exclusively, characterised by objective evidence of an underlying structural abnormality or cardiac dysfunction that impairs the ability of the left ventricle (LV) to fill with or eject blood, particularly during physical activity. Symptoms of CHF (e.g. dyspnoea and fatigue) can occur at rest or during physical activity.
- Systolic heart failure (the most common form of CHF) is characterised by weakened ability of the heart to contract. Heart failure with preserved systolic function (HFpSF), also known as diastolic heart failure, is characterised by impaired relaxation and/or abnormal stiffness of the LV in response to exercise or a volume load, despite normal ventricular contraction.
- Systolic heart failure (or heart failure with a reduced left ventricular ejection fraction (HFrEF) is often associated with left ventricular diastolic dysfunction. The distinction between them is relevant to the therapeutic approach. Please refer to current national CHF management guidelines.

In recent years there has been increasing focus on better defining heart failure. For the purpose of this report the following key points are worth considering:

- Heart failure is caused by myocardial damage from another cardiovascular condition (from a heart attack or long-standing high blood pressure [hypertension]).
- It can be asymptomatic (latent heart failure) or associated with typical symptoms of breathlessness and fatigue (note that chest pain is not typical of the syndrome).
- Actual cases of heart failure are usually identified when there is underlying heart damage and dysfunction plus typical symptoms (including increasing breathlessness with activity) that respond to treatment.
- Heart failure is usually a chronic condition (hence the term chronic heart failure - CHF).
- However, a major component of the heart failure burden is acute events of extreme breathlessness – either occurring as the first event of heart failure or as an "exacerbation" due to underlying clinical problems (for example atrial fibrillation or myocardial ischaemia).
- Heart failure is largely categorised according to two main types:
    - **Heart failure with reduced ejection fraction** (HFrEF - typically associated with those men and women who have coronary artery disease and have experienced some form of heart attack) with an impaired ability to pump blood from the heart – otherwise known as left ventricular systolic dysfunction.
    - **Heart failure with preserved ejection fraction** (HFpEF - typically associated with older individuals who have had hypertension for a long time) with a typically "stiff" heart that is unable to relax properly – otherwise known as diastolic dysfunction.
- Some affected individuals may move between the two predominant forms (HFpEF and HFrEF) of heart failure and the only way to truly understand what is happening is to image the heart when it is actively pumping and relaxing blood flow (via an echocardiograph)
- For a number of reasons, it could be argued that the most accurate (and perhaps conservative) way to quantify the number of heart failure cases is to focus on those with HFrEF/LVSD. This is the strategy we have adopted in this report. Nonetheless, we will also provide some estimates of the potential burden imposed by HFpEF.
- Heart failure affects the whole body – including the kidneys, brain and peripheral muscles.

Heart failure treatment and management

In response to an increasing burden of heart failure in Australia, the National Heart Foundation and Cardiac Society of Australia and New Zealand, led particularly by Professor Henry Krum (Monash University) have produced a series of reports and updates outlining the gold-standard treatment and management of the syndrome. It is not the purpose of this report to reproduce these or comment on them, other than to provide a reliable and valid rationale for State and Federal governments to prioritise treatments and programs (e.g. nurse-led heart failure management) to cost-effectively improve health outcomes in those affected.



Key references/reports

Krum H, Jelinek M, Stewart S, Sindone A, Atherton J, Hawkes A on behalf of the National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand Chronic Heart Failure Clinical Practice Guidelines Expert Writing Panel. **Guidelines for the Prevention, Detection and Management of People with Chronic Heart Failure in Australia 2006.**

Davidson P, Driscoll A, Huang N, Aho Z, Atherton J, Krum H, Sindone A, Stewart S. National Heart foundation of Australia. **Best-practice multidisciplinary care for people with chronic heart failure.** Melbourne; National Heart Foundation of Australia 2010.

Krum H, Jelinek M, Stewart S, Sindone A, Hawkes A on behalf of the National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand Chronic Heart Failure Clinical Practice Guidelines Expert Writing Panel. **2011 Update for the Guidelines for the Prevention, Detection and Management of People with Chronic Heart Failure in Australia.**

Page K, Marwick TH, Lee R, Grenfell R, Abhayaratna W, Aggarwal A, Briffa T, Cameron J, Davidson PM, Driscoll A, Garton-Smith J, Gascard D, Greenland R, Hickey A, Korczyk D, Mitchell JA, Sanders R, Spicer D, Stewart S, Wade V. **A systematic approach to chronic heart failure care: a consensus statement.** Med J Australia. 2014; 201(3):146-50.

It is important to note that many clinical trials of drug therapies and devices targeting heart failure have demonstrated clinical improvements (with reduced hospitalisation and prolonged survival) in those with clearly defined HFrEF. Alternatively, management programs that are independent of treatment and more reliant on providing flexible health care services tailored to the individual have improved outcomes in all forms of heart failure.

Aim & Objectives

We aim to provide the public, clinicians and health administrators alike with the most comprehensive and contemporary report on the likely burden of heart failure in Australia. Our specific objectives were as follows:

Primary objective

To quantify the heart failure burden in Australia from a number of perspectives including: epidemiological profile, health services burden, health expenditure and future burden.

Secondary objectives

To raise public awareness on the negative impact of a largely hidden and underestimated heart failure burden in Australia. In the process, highlight critical public health issues that need to be addressed by health authorities in respect to prevention and treatment.

Methods

Commentary on previous heart failure burden estimates

We would emphasise there are no 'gold-standard' methods or even quantifiable data readily available in Australia to describe the complete scope and burden of heart failure. Much of the speculation around heart failure contained within an Australian Institute of Health and Welfare (AIHW) report in 2003 remains the same. [3] For 2011, the AIHW provides the following estimate of the overall prevalence of heart failure (noting the total of 277,800 cases compared to our previous estimates of around 325,000 cases in 2004). [4]

> In 2007–08, it is estimated from the NHS that 1.3% of Australians had heart failure or oedema, equating to approximately 277,800 people. More females (177,200) had heart failure or oedema than males (100,500). The prevalence of Australians with heart failure or oedema increased with age, with over a third with the condition aged 75 years or over. It was more prevalent among females than males in every age group, except the very youngest, and especially so among females aged 85 years and over. [4]

Unfortunately, as also noted early in the AIHW report, these data are unreliable and potentially very misleading. They are based on self-report and it is incontrovertible that these data are largely derived from a combination of "false positives" (potentially when they are combined with a question relating to oedema and people confuse this question with a heart attack) and "false negatives" (i.e. the large proportion of people who have been diagnosed with the syndrome but are specifically unaware of what that means).

The lack of systematic attention to accurately describing the burden and profile of heart failure from the individual to population perspective is of concern and hopefully addressed in a decades time – negating the need for a third heart failure burden report!

Fortunately, there are some notable studies that provide us with a much more complete and accurate picture of heart failure in Australia and we would regard these data as more valid and likely more accurate than our previous burden study published in 2004. Nevertheless, we applied the same principle methods as reported in our original paper published in the *Medical Journal of Australia*. [5]

Investigational strategy

In order to derive robust and accurate estimates and projections of the contemporary burden of heart failure, we applied a combination of population statistics with validated epidemiological and clinical data-sets. Based on previously published/highly cited reports from our group (see text box below), this represents a validated and highly cited method for estimating the burden of heart failure in Australia and beyond.

> Stewart S, MacIntyre K, Capewell S, McMurray JJ. **Heart failure and the aging population: an increasing burden in the 21st century?** Heart. 2003; 89(1):49-53.
>
> *Scotland, like many industrialised countries, has an ageing though numerically stable population (5.1 million). Current estimates of prevalence, general practice (GP) consultation rates, and hospital admission rates related to heart failure were applied to the whole Scottish population. These estimates were then projected over the period 2000 to 2020, on an age and sex specific basis, using expected changes in the age structure of the Scottish population.* [6]
>
> Clark RA, McLennan S, Dawson A, Wilkinson D, Stewart S. **Uncovering a hidden epidemic: a study of the current burden of heart failure in Australia**. Heart Lung Circ. 2004; 13(3):266-273.
>
> *Australian Bureau of Statistics (ABS) data for the year 2000 were used in combination with contemporary, well-validated population-based epidemiologic data to estimate the number of individuals with symptomatic and asymptomatic HF related to both preserved (diastolic dysfunction) and impaired LVSD and rates of HF-related hospitalisation.* [7]

Data sources (heart failure data)

Consistent with our previous projections of the heart failure burden in the United Kingdom and Australia the following criteria were applied to selecting data (with key input from experts in the field of heart failure research both during the compilation of the report and in commenting on the report in its draft form).

1. Where original Australian data were available these were utilised in preference to overseas data - these were identified via a systematic review of the literature and in consultation with an Australian panel of heart failure research experts.

   Where there were multiple Australian sources, preference was given to the largest most comprehensive (and contemporary) data-sets or according to the purpose it was best suited (e.g. use of WA data to generate data on *de novo* heart failure admissions as opposed to broader NSW data describing all primary and secondary admissions for heart failure per annum).

2. Where there are no contemporary Australian data, the most relevant international data (with preference given to that derived from New Zealand) were identified and utilised.

Table 1 Data references

Author	Data source
Australian Bureau of Statistics [8]	ABS. Australian Demographics Statistics 2014, available from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3101.0Mar%202014?OpenDocument
Antecedents [9-19]	1980, 1983, 1985 data: NHFA Risk Factor Prevalence Survey (capital city participants) 1995 data: ABS National Nutrition Survey (includes urban participants) ABS. Health risk factors. Australian Health Survey: Updated Results 2011-2012. Retrieved October 2014, available from http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4364.0.55.003Chapter4002011-2012 AIHW. National Drugs Strategy Household Surveys key findings - Tobacco smoking. Retrieved October 2014, available from http://www.aihw.gov.au/alcohol-and-other-drugs/ndshs/2013/tobacco/ Barr E, *et al*. Tracking the Accelerating Epidemic: Its causes and outcomes The Australian Diabetes, Obesity and Lifestyle Study. 2006. International Diabetes Institute, Melbourne Dunstan D, *et al*. Diabesity and Associated Disorders in Australian 2000 The Australian Diabetes, Obesity and Lifestyle Study. 2001. International Diabetes Institute, Melbourne Carrington M, Jennings G, Stewart S. Pattern of blood pressure in Australian adults: results from a national blood pressure screening day of 13,825 adults. International journal of cardiology. 2010; 145(3):461-467 Folsom AR, *et al* Absolute and attributable risks of heart failure incidence in relation to optimal risk factors. Circulation: Heart Failure. 2009; 2(1):11-17 Weston R, Qu L, Soriano G, The changing shape of Australia's population, in Australian Family Briefing. 2001, Australian Institute of Family Studies ABS. Australian Health Survey: Health Service Usage and Health Related Actions. October 2014; available from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/322DB1B539ACCC6CCA257B39000F316C?opendocument Carrington M, Stewart S. Australia's cholesterol crossroads: An analysis of 199,331 GP patient records. 2011. Baker IDI Heart and Diabetes Institute. Melbourne Hung J, *et al*. Trends From 1996 to 2007 in Incidence and Mortality Outcomes of Heart Failure After Acute Myocardial Infarction: A Population Based Study of 20,812 Patients With First Acute Myocardial Infarction in Western Australia. Journal of the American Heart Association. 2013; 2(5):e000172
Population incidence of heart failure data [20, 21]	Cowie M, Wood D, Coats A, Thompson S, Poole-Wilson P, Suresh V, Sutton G. Incidence and aetiology of heart failure; a population-based study. European heart journal. 1999; 20(6):421-428 Bleumink GS, Knetsch AM, Sturkenboom MC, Straus SM, Hofman A, Deckers JW, Stricker BHC. Quantifying the heart failure epidemic: prevalence, incidence rate, lifetime risk and prognosis of heart failure: The Rotterdam Study. European heart journal. 2004; 25(18):1614-1619

Population prevalence of heart failure data [21-25]	Senni M, Tribouilloy CM, Rodeheffer RJ, Jacobsen SJ, Evans JM, Bailey KR, Redfield MM. Congestive heart failure in the community a study of all incident cases in Olmsted County, Minnesota in 1991. Circulation. 1998; 98(21):2282-2289 Abhayaratna WP, Smith WT, Becker NG, Marwick TH, Jeffery IM, McGill DA. Prevalence of heart failure and systolic ventricular dysfunction in older Australians: the Canberra Heart Study. Medical Journal of Australia. 2006;184(4):151-154 Bleumink GS, Knetsch AM, Sturkenboom MC, Straus SM, Hofman A, Deckers JW, Stricker BHC. Quantifying the heart failure epidemic: prevalence, incidence rate, lifetime risk and prognosis of heart failure: The Rotterdam Study. European heart journal. 2004; 25(18):1614-1619 McGrady M, *et al*. Heart failure, ventricular dysfunction and risk factor prevalence in Australian Aboriginal peoples: the Heart of the Heart Study. Heart. 2012; 98(21):1562-1567 Brown A, *et al*. Cardio-metabolic risk and disease in Indigenous Australians: The heart of the heart study. International Journal of Cardiology. 2014; 171(3):377-383
Primary care burden of heart failure [26]	Carrington MJ, Jennings GL, Stewart S. Pressure points in primary care: blood pressure and management of hypertension in 532,050 patients from 2005 to 2010. Journal of Hypertension. 2013; 31(6):1265-1271
Hospital burden of heart failure [27]	Teng TH, Finn J, Hobbs M, Hung J. Heart Failure Incidence, Case Fatality, and Hospitalization Rates in Western Australia Between 1990 and 2005. Circulation: Heart Failure. 2010; 3(2):236-243 The NSW Heart Failure Snapshot investigators and research team, 2014. Un-published data.
Financial burden of heart failure [28]	Stewart S, Carrington MJ, Marwick TH, Davidson PM, Macdonald P, Horowitz JD, Chan YK, Scuffham P. Impact of Home Versus Clinic-Based Management of Chronic Heart Failure The WHICH? (Which Heart Failure Intervention Is Most Cost-Effective & Consumer Friendly in Reducing Hospital Care) Multicenter, Randomized Trial. Journal of the American College of Cardiology. 2012; 60(14):1239-1248
Australian Bureau of Statistics projection data [29]	ABS. (2013) Population Projections, Australia, 2012 (base) to 2101, available from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3222.02012%20(base)%20to%202101?OpenDocument

Definition of heart failure inferred from each source

Population incidence of heart failure

Cowie *et al.* 1999	This research paper adopted the criteria recommended by the working group on Heart Failure of the European Society of Cardiology (ESC). To be diagnosed with heart failure, patients must have the appropriate symptoms as well as presence of an underlying abnormality in the cardiac structure and function. All data was presented to a panel of cardiologists who determined whether this definition had been met or not. A patient's hospital history and general practitioner notes were checked to ensure those without history of heart failure were included. [20]
Bleumink *et al.* 2004	To ascertain presence of heart failure, a two-step approach was used. Firstly, the presence of dyspnoea during rest or exertion (not resultant from pre-existing COPD), ankle oedema and pulmonary crepitation were assessed. If two of these three symptoms or signs were present in conjunction with evidence of angina pectoris, MI, coronary artery bypass surgery, percutaneous transluminal angioplasty, AF or electrocardiographic left ventricular hypertrophy, then heart failure was determined as present. Secondly, the examining physician utilised standard questions to validate the indication of medication with the participant. Participants were classified as 'possible heart failure' if using diuretics, glycosides or ACEi and only participants with a definite indication for heart failure in whom objective evidence of cardiac disease was found were included. [21]

Population prevalence of heart failure

Abhayaratna *et al.* 2006	To determine heart failure in this Australian Study, participants were asked if they had any of the following symptoms: dyspnoea, orthopnoea, paroxysmal nocturnal dyspnoea or dependant oedema. They were examined for the existence of elevated heart rate, raised jugular venous pressure, displaced apex heartbeat, additional heart sounds, cardiac murmurs, lung crepitation and peripheral oedema. Heart failure status was determined according to the Framingham Criteria for clinical diagnosis of heart failure and participants with LVSD but not past history or clinical evidence were considered to be in preclinical phase of heart failure. [22]
Bleumink *et al.* 2004	To ascertain presence of heart failure, a two-step approach was used. Firstly, the presence of dyspnoea during rest or exertion (not resultant from pre-existing COPD), ankle oedema and pulmonary crepitation were assessed. If two of these three symptoms or signs were present in conjunction with evidence of angina pectoris, MI, coronary artery bypass surgery, percutaneous transluminal angioplasty, AF or electrocardiographic left ventricular hypertrophy, then heart failure was determined as present. Secondly, the examining physician utilised standard questions to validate the indication of medication with the participant. Participants were classified as 'possible heart failure' if using diuretics, glycosides or ACEi and only participants with a definite indication for heart failure in whom objective evidence of cardiac disease was found were included. [21]
Senni *et al.* 1998	Each participant underwent a physical examination and their medical records and history were reviewed by a trained nurse whom employed established criteria for hypertension or acute myocardial infarction (AMI) to determine if a diagnosis of heart failure was present. If so, every medical encounter of the participants was reviewed to determine if the clinical information satisfied the Framingham Criteria. If there was no definitive heart failure diagnosis but either diastolic or systolic dysfunction determined by echocardiography, the participant was considered to be with 'preclinical dysfunction'. [23]

Hospital burden of heart failure

Teng *et al.* 2010	The definition of heart failure from this reference is based upon the International Classification of Diseases, ninth revision (ICD9) and tenth revision (ICD10) diagnostic codes. For the first-listed principal diagnosis of HF, ICD9 codes included 428x, 402.01, 402.11, 402.91, 404.1, 404.3, 425x, 518.4, 514, 391.8, and 398.91, and ICD10 codes included I50x, I11.0, I13.0, I13.2, I42x, J81, I01.8, I020. A broader definition of de novo or index hospitalisation including HF as a secondary diagnosis with a principal diagnosis of a cardiovascular condition (excluding AMI) was also used. Primarily, each of the secondary heart failure cases had a principal diagnosis of ischemic heart disease or atrial fibrillation. To determine co-morbidities, a weighted Charlson Co-morbidity Index was calculated for each individual based on the ICD codes recorded on the Hospital Morbidity Database (HMD) records. THE HMD records principal and secondary discharge diagnoses for all patients discharged from all 129 public and private hospitals in WA. Patients were identified utilising this database. Patients were identified to have a de novo or index admission if there was no prior hospital admission for HF within a 10-year look-back and patients were followed until 2006 or death. Individuals hospitalised for HF in WA from 1990 to 2005 were included in this research paper. The largest non-European ancestral groups were Aboriginal and Torres Strait Islander comprising 3% of the population and Chinese, 3% also. The majority of the population resided within Perth, the capital of WA and 70% of the hospital beds in WA were within public hospitals. The analyses were restricted to WA residents who were aged 20 years to decrease loss to follow up. [27]
McGrady *et al.* 2012 & Brown *et al.* 2014	Heart failure diagnosis (in the Indigenous cohort) was adjudicated by two doctors according to the ESC guidelines (Dickstein *et al.* 2008). [24,25]

Financial burden imposed by heart failure

Stewart *et al.* 2012	Heart failure was determined by underlying cardiac dysfunction (either associated with impaired or preserved systolic function) and identification of typical symptoms of exercise intolerance (Krum *et al.* 2011). ESC guidelines were employed to govern normal or near normal left ventricular ejection fraction, normal or near normal LV volume, and evidence of diastolic dysfunction (Dickstein *et al.* 2008). [28]

Key statistics used to estimate the following:

Table 2 Population incidence of heart failure data source (cases per 1000 person-years)

Cowie *et al.* 1999	Men	Women
45 - 54 years	0.3	0.1

Bleumink *et al.* 2004	Men and Women
55 - 59 years	1.4
60 - 64 years	3.1
65 - 69 years	5.4
70 - 74 years	11.7
75 - 79 years	17.0
80 - 84 years	30.1
≥ 85 years	41.9

Table 3 Population prevalence of heart failure data source

Senni *et al.* 1998	Men	Women
45 - 54 years	5.10%	1.00%
55 - 64 years	7.40%	2.20%

Abhayaratna *et al.* 2006	Men	Women
60 - 64 years	3.60%	2.60%
65 - 69 years	7.30%	2.00%
70 - 74 years	5.20%	4.80%
75 - 79 years	17.80%	7.80%
80 - 84 years	15.70%	10.40%
Bleumink *et al.* 2004	**Men**	**Women**
≥ 85 years	5.90%	14.00%

Table 4 Hospital burden of heart failure data source

Teng *et al.* 2010 (Primary diagnosis)	*De novo* HF		All HF (non-elective)	
	Men	Women	Men	Women
45 - 49 years	0.03%	0.01%	0.06%	0.04%
50 - 54 years	0.03%	0.03%	0.06%	0.04%
55 - 59 years	0.07%	0.03%	0.06%	0.04%
60 - 64 years	0.11%	0.06%	0.06%	0.04%
65 - 69 years	0.18%	0.11%	0.76%	0.49%
70 - 74 years	0.28%	0.17%	0.76%	0.49%
75 - 79 years	0.41%	0.31%	2.41%	1.97%
80 - 84 years	0.89%	0.62%	2.41%	1.97%
≥ 85 years	1.21%	1.23%	2.41%	1.97%

(Secondary diagnosis)	*De novo* HF		All HF
	Men	Women	Men and Women
45 - 49 years	0.001%	0.012%	1.16%
50 - 54 years	0.03%	0.02%	1.19%
55 - 59 years	0.08%	0.02%	1.14%
60 - 64 years	0.14%	0.04%	1.19%
65 - 69 years	0.19%	0.08%	1.15%
70 - 74 years	0.24%	0.13%	1.16%
75 - 79 years	0.37%	0.27%	1.12%
80 - 84 years	0.49%	0.37%	1.18%
≥ 85 years	0.68%	0.56%	1.00%

Table 5 Financial burden of heart failure data source

Stewart *et al.* 2012	Description/cost	Source
Total in-patient costs		
Fixed	Heart failure and shock without catastrophic complication and/or co-morbidity (F62A): $564 per admission Heart failure and shock with catastrophic complication and/or co-morbidity (F62B): $1,530 per admission	Australian Refined Diagnosis Related Groups (AR-DRG) Version 5.2, Round 13 (2008-09)
Variable (per diem)	General Unit: $722 per day (Ave. Z60A, Z60B, Z63A, Z63B) Intensive care unit/coronary care unit: $3,356 per day (A06Z)	
Community-based costs		
Community management	General practitioner consultation: $33.55 per visit	National Hospital Cost Data Collection (NHCDC) cost report, Round 12 (2008-09) Table 122: Ave. cost per occasion of service for Tier 2 non-admitted clinic
Pharmaceuticals	Cardiovascular disease: median PBS drug cost $2,050 per annum	J of Med Econ, 14(6): 698-704, 2011

Primary care burden of heart failure

To derive the indicative primary care burden of heart failure via the prescription of those agents typically used to treat (but not exclusively) the syndrome, data were used from the database created to complete the 'Pressure points in primary care: blood pressure and management of hypertension in 532,050 patients from 2005 to 2010' report. [26]

Data source

De-identified data (removal of patient's name, address, telephone number, medicare number or any other information that could 'reasonably' identify the person) for this report were supplied by the Health Communication Network© (HCN). HCN are the providers of Medical Director, the leading clinical software product in the Australian health market that is used by more than 17,000 clinicians and 85% of computerised GPs (refer www.hcn.com.au/Products/Medical+Director). The data from a representative sample of GP clinics using Medical Director are stored in a longitudinal patient-based database; currently, this dataset stores more than 32 million patient encounters, over 30 million scripts for approximately 3 million unique patients from 1,100 GPs.

The 'pressure points' database contains information from 733 GPs from 286 clinics. Blood pressure measurements from 532,050 patients aged over 18 years who went to their GP in the time between 2005 and 2010.

Australian population data

In order to build a comprehensive picture of the burden of heart failure in Australia, we evaluated contemporary data from the ABS to describe the demographic and geographic distribution of the Australian population (Figure 1) noting these figures are being continuously updated and a new set of data have already superseded the figures used in this report.

> The 2011 Census of Population and Housing: was conducted on 9th August 2011. Updated estimates for the year 2012 arising from these data were used in our estimates.

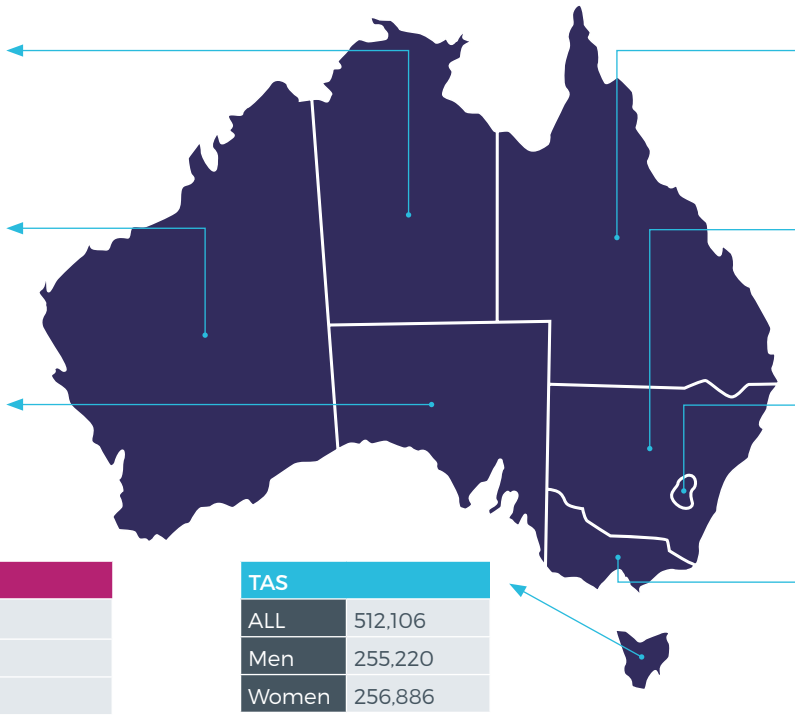
At the broadest level, all key parameters to outline the burden of heart failure are presented on an age and sex-specific basis for the total population with consideration of key populations (including a separate report on heart failure among Indigenous Australians in the near future).

Outputs from the 2011 Census/Population estimates are organised into the following regions:

- Statistical Areas Level 2 (SA2s) - are medium-sized general purpose areas which aim to represent communities that interact together socially and economically. SA2s are based on officially gazetted suburbs and localities. In urban areas SA2s largely conform to one or more whole suburbs, while in rural areas they generally define the functional zone of a regional centre.
- Statistical Areas Level 3 (SA3s) - are aggregations of whole SA2s and reflect a combination of widely recognised informal regions as well as administrative regions such as state government regions in rural areas and local government areas in urban areas.
- Statistical Areas Level 4 (SA4s) - are made up of whole SA3s and are designed to reflect labour markets. In rural areas, SA4s generally represent aggregations of small labour markets with socioeconomic connections or similar industry characteristics. Large regional city labour markets are generally defined by a single SA4. Within major metropolitan labour markets SA4s represent sub-labour markets.
- Greater Capital City Statistical Areas (GCCSAs) - are built from whole SA4s and represent a broad socioeconomic definition of each of the eight State and Territory capital cities. They contain not only the urban area of the city, but also the surrounding and non-urban areas where much of the population has strong links to the capital city, through for example, commuting to work. [29-30]

For the purpose of this report we applied a combination of these areas on a State-by-State basis (minimal level GCCSA) to describe the geographical distribution of heart failure on an age and sex-specific basis; noting the potential to break-down these figures further into major cities versus regional populations (as per our 2004 report).

Population profile of Australia



NT	
ALL	135,881
Men	124,014
Women	111,867

QLD	
ALL	4,568,205
Men	2,278,777
Women	2,289,428

WA	
ALL	2,437,994
Men	1,231,693
Women	1,206,301

NSW	
ALL	7,307,185
Men	3,627,571
Women	3,679,612

SA	
ALL	1,656,035
Men	820,328
Women	835,707

ACT	
ALL	375,183
Men	186,616
Women	188,567

	Population
ALL	22,728,254
Men	11,312,823
Women	11,415,431

TAS	
ALL	512,106
Men	255,220
Women	256,886

VIC	
ALL	5,632,521
Men	2,786,545
Women	2,845,976

Figure 1 Estimated population of Australia on 30th June 2012

Table 6 Estimated population of Australia according to age on 30th June 2012

Age group (years)	Australian Population
< 45	13,863,726
45 - 49	1,532,695
50 - 54	1,523,710
55 - 59	1,366,102
60 - 64	1,224,010
65 - 69	1,023,622
70 - 74	755,425
75 - 79	572,906
80 - 84	445,791
≥ 85	420,267

Data management & analyses

All study data were managed by the Data Management Group at Baker IDI using its standard operating procedures. All analyses were supervised by the Principal Investigator Professor Simon Stewart.

Excel spreadsheets were generated from all ABS population data on an age and sex-specific basis and according to geographic location.

Absolute and proportion rates for each specific parameter of interest were applied to the population data on an age and sex-specific basis to derive the key parameters outlined above.

This study was performed according to the ICH Harmonized Tripartite Guidelines for Good Clinical Practice, with applicable local regulations and with the ethical principles laid down in the Declaration of Helsinki. All data sources have obtained appropriate approval from a Human Research Ethics Committee that complies with the National Health and Medical Research Council (NHMRC) National Statement on Ethical Conduct in Human Research.

Study limitations

The most recent Australian census data was collected on 9th August 2011 and Australia's population was 21,507,717. Updated estimates for the year 2012 arising from these data were used in our estimates (22,728,254 people). As of 31st December 2013, Australia's population was estimated at 23,518,684. Due the increasing difference in the population from 2011 to 2013 (2,101,967 people), it is important to note our estimates are becoming increasingly more conservative over time.

As noted, significant caution should be applied when making extrapolations. There are limited Australian heart failure data published in peer reviewed journals and when Australian data could not be found, international data from countries with the most equivalent population profiled were employed.

Reporting structure

The results section of this report has six main parts to reflect different aspects of the estimated burden of heart failure in Australia:

1. Common antecedents of cardiovascular disease and heart failure: rising or falling?
    - Advancing age
    - Common risk factors for cardiovascular disease (including high blood pressure, dyslipidaemia, smoking, obesity and diabetes)
    - Heart failure following a heart attack/MI
    - The contribution of atrial fibrillation (AF) to the burden of heart failure
2. Population burden of heart failure as reflected by estimated:
    - Incident cases (new/*de novo* cases per annum)
    - Prevalence (total number of new and existing cases)
    - Commentary on heart failure in the Australian Indigenous community
3. Primary care burden of heart failure as reflected by estimated:
    - Proportion of men and women aged ≥ 45 years being treated with pharmacological agents commonly used to treat heart failure
4. Hospital burden of heart failure as reflected by estimated:
    - Incident admissions (new/*de novo* admissions per annum) associated with a primary or secondary diagnosis of heart failure with associated data on:
        - Type of incident admission
        - Length of hospital stay and in-patient case-fatality
        - Discharge destination
        - Ischaemic versus non-ischaemic forms of heart failure
        - Common comorbidities
        - Readmissions within 12 months
        - Mortality within 30-day, 1-year and 5-year
    - All (non-elective) hospitalisations (*de novo* or recurrent event) associated with a primary or secondary diagnosis of heart failure:
        - Pattern of hospitalisation
        - Total number of admissions (and length of stay, LOS) associated with heart failure
        - Acute versus chronic manifestations of heart failure
5. Financial burden imposed by heart failure as reflected in those seeking hospital treatment for the syndrome
6. Future burden imposed by heart failure as reflected in the status quo in respect to event-rates but with an increasingly ageing Australian population

Results

1. Common antecedents of cardiovascular disease and heart failure: rising or falling?

The most pervasive and over-looked risk factor for cardiovascular disease and, more specifically heart failure in high income countries in whom age-adjusted event rates of acute coronary events are in decline overall is old age! This is the paradox of more successful navigation of middle-age into older age. Data below demonstrates the dynamic changes in Australia's demographic profile over the past century.

Australia's advancing age

It is an incontrovertible fact that Australia's population is growing and ageing as greater immigration influx and the Post-War Baby Boomer generation becomes progressively older. Instead of a traditional population pyramid, Australia's demographic profile has, and will evolve as follows:

Figure 2 Age and sex structure of Australia's population, observed (1911, 1961 and 2000) and projected (2051)

These data (Figure 2) show that both the proportion and magnitude of older men and women at-risk of developing cardiovascular disease and specific conditions most likely to occur in old age (heart failure and atrial fibrillation) is increasing over time. [16]

From a preventable risk perspective, there is no escaping the four (and now perhaps five, given the rise and importance of obesity [15]) key risk factors routinely linked to the development of heart failure:

- Hypertension
- Dyslipidaemia
- Smoking
- Diabetes

It is well worth pointing-out that the pathways to heart failure (as reflected in both the similarities and differences between HFrEF and HFpEF) are both common and diverse depending on the age and sex of the affected individual. It also depends on their primary pathway - via coronary artery disease (the predominant cause of heart failure historically and traditionally in men) and hypertension (the predominant cause of heart failure in women and older individuals with or without coronary artery disease).

Note: In reviewing the data trends below, it is extremely important to note the lack of "apples versus apples" data. No survey has been standardised in how data were collected and interpreted and all studies have important limitations.

Elevated blood pressure levels (hypertension)

As shown below (Figure 3), high blood pressure continued to be a regular feature within Australia's adult population in the years prior to these heart failure estimates; with markedly higher prevalence and increasing age (although this in part reflects a "healthy" upward trend with advancing years). In the latest national survey, hypertension was reported to be just over 31% (as with other data, this figure needs to be interpreted with caution). [14]

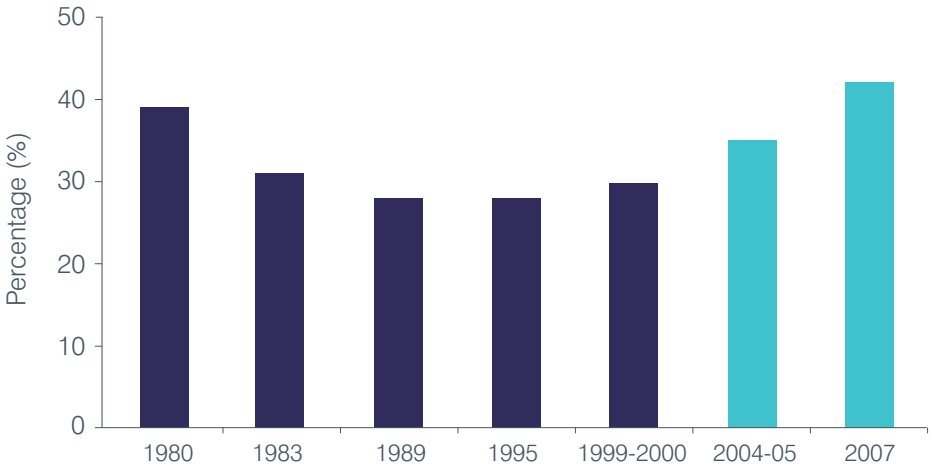


Figure 3 Reported prevalence of hypertension in a series of national studies between 1980 and 2007

Dyslipidaemia

Self-reported dyslipidaemia in the Australian population is very low. Alternatively, national surveys consistently suggest that between 40-50% of adults are at high-risk of atherosclerosis due to elevated lipid levels. As shown by data derived from Australia's largest ever study of lipid levels in primary care undertaken by our group (Figure 4), middle-aged men and women continue to display high total cholesterol levels. [18]

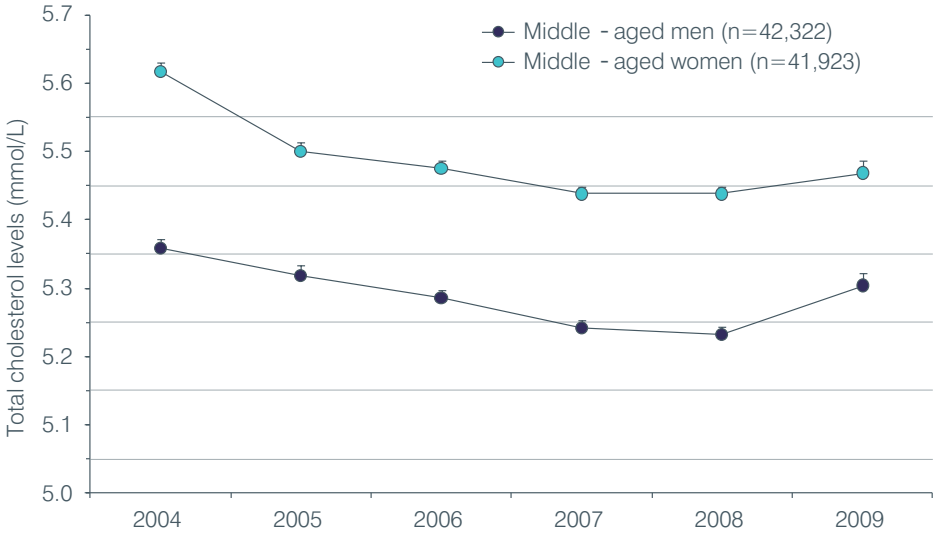


Figure 4 Total cholesterol levels in middle-aged men and women being managed by a GP in Australia

Smoking

One of the most important public health advances has been a steady decline in smoking levels. Figure 5 shows smoking levels preceding the estimates of heart failure in this report. Recent figures are even more encouraging. It is now estimated that 12.8% of Australians are current smokers, with fewer first-time smokers and high mortality rates in smokers. [10,11]

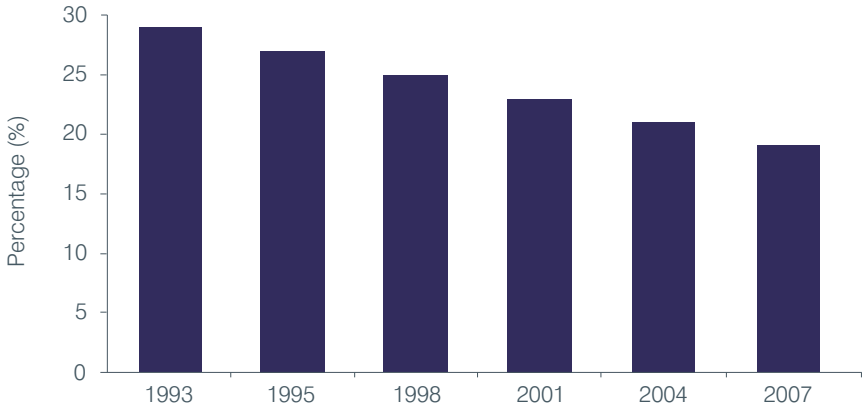


Figure 5 Reported prevalence of smokers from successive household surveys

Diabetes

While smoking rates have declined, unhealthy changes in diet and exercise have contributed to increasing levels of diabetes (as documented by the AusDiab Study). [13] As shown by Australia's largest ever study of diabetes management in primary care (based on 50,721 annual glycated haemoglobin A1c [HbA1c] measurements) average HbA1c levels reflecting blood sugar levels remain high and relatively unchanged at around 7.0% between 2005 and 2013 (Figure 6). This places the affected individuals at very high-risk of developing all forms of cardiovascular disease including heart failure. [31]

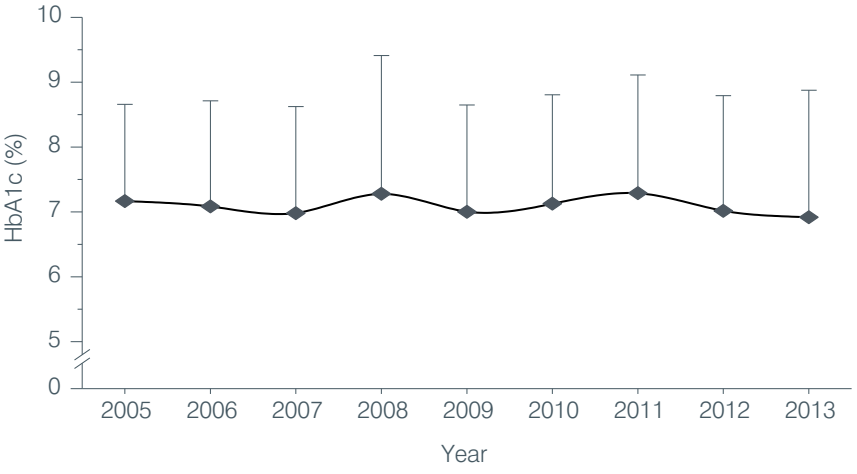


Figure 6 Average annual HbA1c levels between 2005 and 2013

The obesity crisis

A major component of the future risk of Australia's population is its increasingly obese profile - although this trend has inevitably plateaued with around one in four adults obese and around two-thirds overweight (Figure 7). [9,10,12,13]

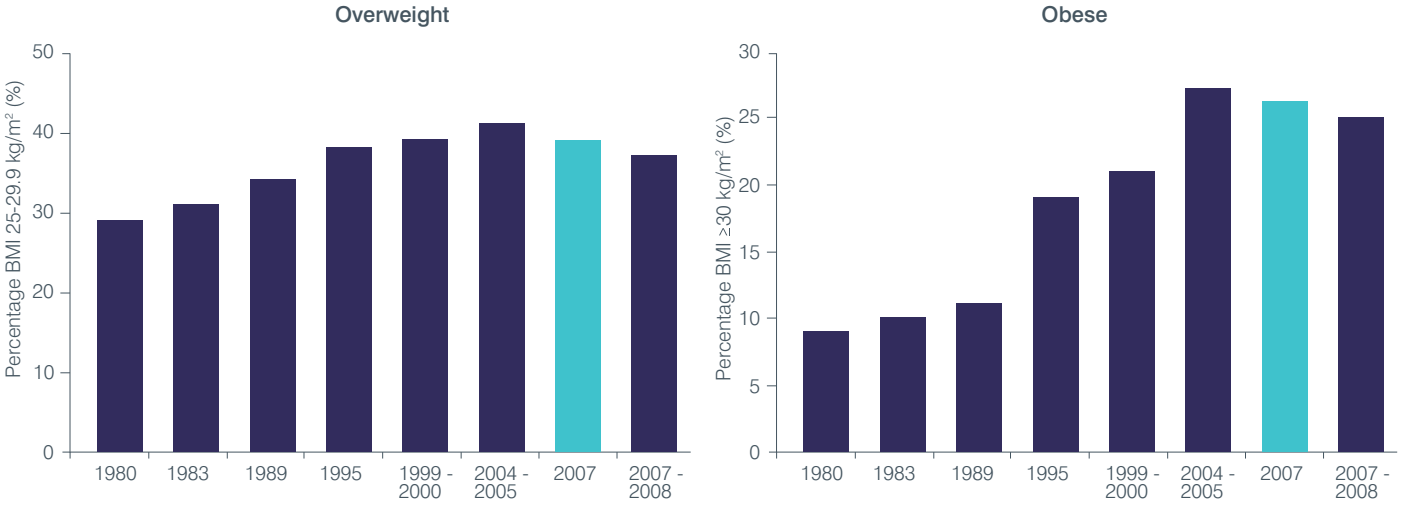


Figure 7 The increasing rate of obesity in Australia

Heart failure following a heart attack

As reported by Hung and colleagues, using data from the WA data-linkage resource, the contribution of heart attacks/AMI to heart failure is declining. [19]

Trends From 1996 to 2007 in Incidence and Mortality Outcomes of Heart Failure After Acute Myocardial Infarction: A Population Based Study of 20 812 Patients With First Acute Myocardial Infarction in Western Australia

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Thomas Briffa, BPhysEd, PhD; Simon Stewart, BA, B.Nursing, PhD;
Frank M. Sanfilippo, BSc, BPharm, PhD; Steven Ridout, BSc (Hons);
Michael Hobbs, MBBS, DPhil (Oxon), FRACP, FAFPHM

Background

Advances in treatment for acute myocardial infarction (AMI) are likely to have had a beneficial impact on the incidence of and deaths attributable to heart failure (HF) complicating AMI, although limited data are available to support this contention.

Methods and Results

Western Australian linked administrative health data were used to identify 20,812 consecutive patients, aged 40 to 84 years, without prior HF hospitalised with an index (first) AMI between 1996 and 2007. We assessed the temporal incidence of and adjusted odds ratio/hazard ratio for death associated with HF concurrent with AMI admission and within 1 year after discharge. Concurrent HF comprised 75% of incident HF cases. Between the periods 1996–1998 and 2005–2007, the prevalence of HF after AMI declined from 28.1% to 16.5%, with an adjusted odds ratio of 0.50 (95% CI, 0.44 to 0.55). The crude 28-day case fatality rate for patients with concurrent HF declined marginally from 20.5% to 15.9% ($P<0.05$) compared with those without concurrent HF, in whom the case fatality rate declined from 11.0% to 4.8% ($P<0.001$). Concurrent HF was associated with a multivariate adjusted odds ratio of 2.2 for 28-day mortality and a hazard ratio of 2.2 for 1-year mortality in 28-day survivors. Occurrence of HF within 90 days of the index AMI was associated with an adjusted hazard ratio of 2.7 for 1-year mortality in 90-day survivors.

Conclusions

Despite encouraging declines in the incidence of HF complicating AMI, it remains a common problem with high mortality. Increased attention to these high-risk patients is needed given the lack of improvement in their long-term prognosis.

However, as more people survive their first heart attack or a lesser form of acute coronary syndrome, there is an increasing pool of individuals likely to develop the syndrome of heart failure. This is reflected in an increasingly older and more complex group of affected individuals.

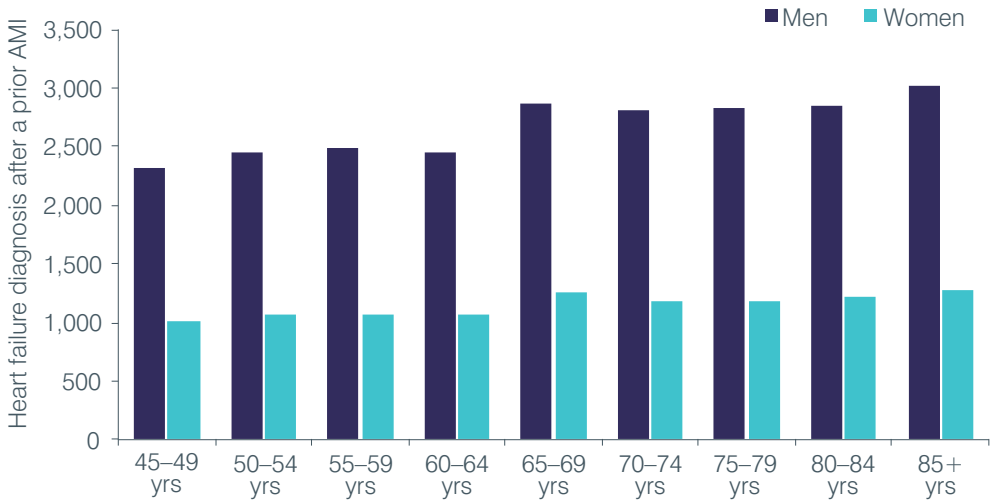


Figure 8 Number of men and women aged ≥ 45 years developing heart failure following an acute myocardial infarction (AMI) per annum

As shown in Figure 8 above, the number of individuals across each age group ≥ 45 years (estimated total of 34,415) developing heart failure following an acute myocardial infarction is not insubstantial.

The contribution of atrial fibrillation (AF) to the burden of heart failure

AF and heart failure share common risk factors (e.g. hypertension, diabetes, cardiac remodelling) and frequently coexist. The presence of either one of these conditions increases the risk of developing the other. Therefore, a patient with AF in the context of heart failure requires more intensive health care and surveillance and imposes perhaps a more substantial burden than either condition experienced in isolation.

AF is the most common arrhythmia seen in clinical practice and is responsible for substantial morbidity and an independent risk of mortality. Further, AF is an independent risk factor for heart failure. A common cause of heart failure resulting from AF is tachycardia-induced cardiomyopathy which impairs haemodynamic function and increases myocardial oxygen demand, thereby reducing cardiac output in as little as 24 hours. Resolution of tachycardia by rate or rhythm control results in improvement in ejection fraction and other signs of heart failure but any recurrence results in an abrupt decline in left ventricular ejection fraction. Conversely, heart failure can lead to AF due to progressive cardiac dysfunction and associated pathological changes (including fibrosis). It has been found that AF increases the risk of heart failure by approximately 3-fold, and 42% of AF patients have heart failure at some point during their lifetime (Figure 9).

In Australia, current AF prevalence in adults > 55 years is estimated to be 5.4% and is ageing, changing patterns of cardiac risk factors and improved survival rates in other forms of CVD.

Due to the strong association between AF and heart failure, it can be assumed that this concomitant state will equally increase in prevalence. The prevalence of AF in patients with heart failure ranges between 6% in asymptomatic patients or those with minimal symptoms to 15%-35% for patients with New York Heart Association (NYHA) class II-IV symptoms. Furthermore, AF has been found to be more common in patients with HFpEF than in those with HFrEF.

As substantial morbidity and mortality is attributable to each of these individual conditions, the concomitant presence of AF and heart failure identifies individuals at even higher risk of illness and death and, therefore, with a greater attributable personal, social and economic burden.

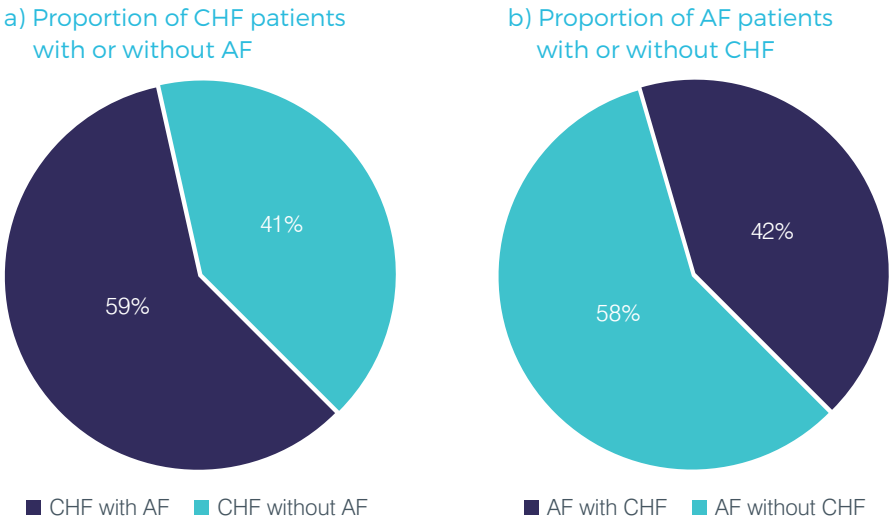
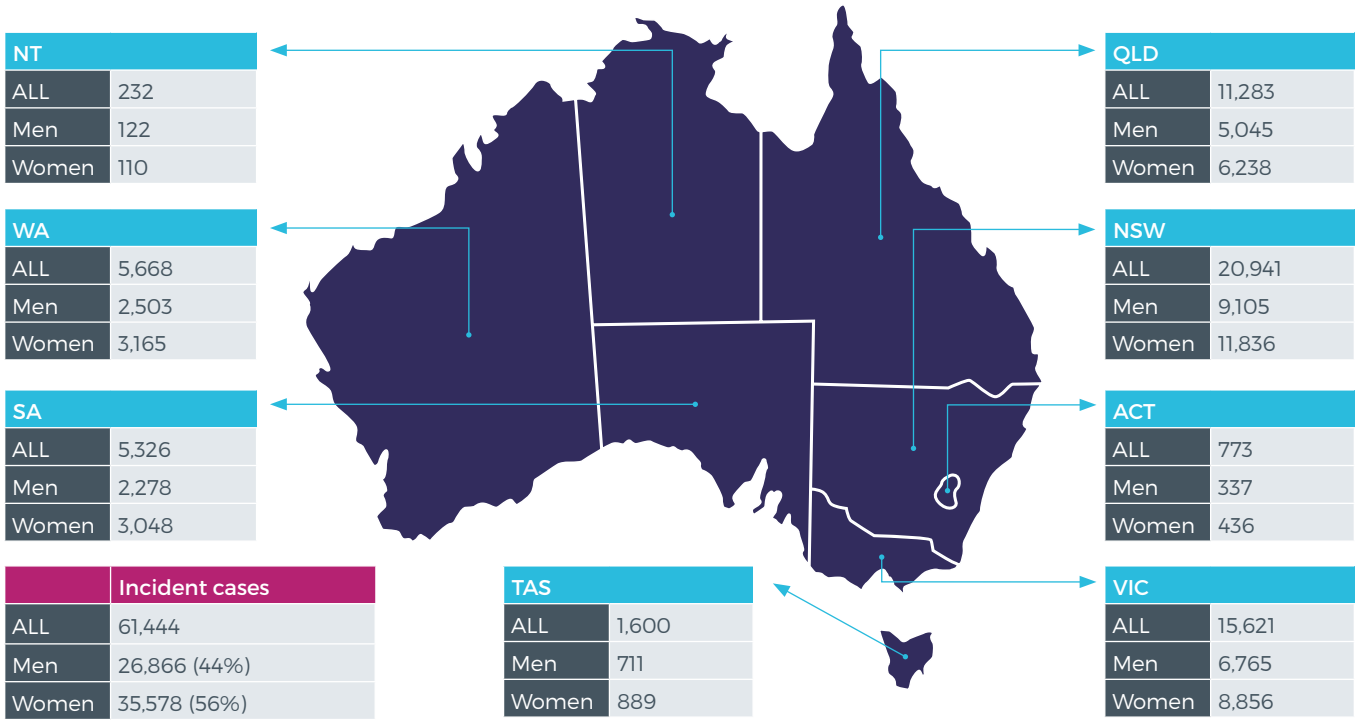


Figure 9 Burden of a) AF in heart failure patients and b) heart failure in AF patients

2. Population burden of heart failure Incident cases (new/*de novo* cases per annum)



NT	
ALL	232
Men	122
Women	110

WA	
ALL	5,668
Men	2,503
Women	3,165

SA	
ALL	5,326
Men	2,278
Women	3,048

	Incident cases
ALL	61,444
Men	26,866 (44%)
Women	35,578 (56%)

TAS	
ALL	1,600
Men	711
Women	889

QLD	
ALL	11,283
Men	5,045
Women	6,238

NSW	
ALL	20,941
Men	9,105
Women	11,836

ACT	
ALL	773
Men	337
Women	436

VIC	
ALL	15,621
Men	6,765
Women	8,856

Figure 10 *De novo* cases of heart failure in Australia (among those aged ≥ 45 years)

We estimate each year over 61,000 adult Australians develop heart failure predominantly associated with LVSD. Based on conservatively high mortality rates (meaning less surviving cases at the start of each year), over a 10-year period, this figure would generate a minimum prevalent population of around 350,000 to 400,000 cases with this type of heart failure.

Incident cases

Figure 11 Incident cases of *de novo* heart failure in Australians aged ≥ 45 years according to State & Territory

As expected, Figure 11 shows that the greatest burden of incident cases of heart failure occurs in the most populous States on the Eastern seaboard of Australia.

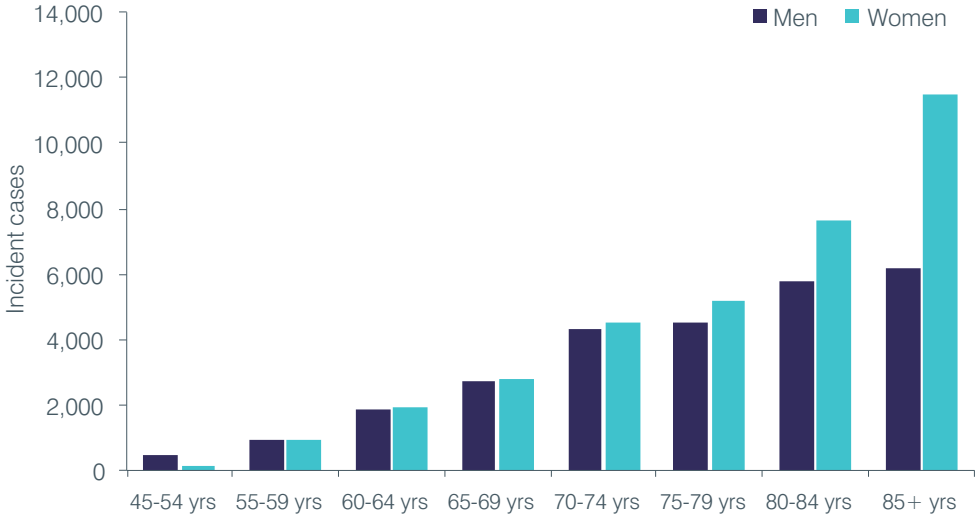


Figure 12 Incident cases of *de novo* heart failure in Australians aged ≥ 45 years according to age categories

Figure 12 above shows that the incident cases of heart failure increase steeply with age, with a small early peak (in men aged 45 to 54 years) and a similar pattern among men and women aged 55 to 74 years. The greater female longevity means that women predominate in the age group ≥ 75 years, reflecting the difference in population dynamics between men and women.

Prevalence (total number of new and existing cases)

NT	All HF	HFrEF	HFpEF
ALL	5,878	3,118	2,760
Men	3,571	2,406	1,165
Women	2,308	712	1,595

WA	All HF	HFrEF	HFpEF
ALL	95,096	47,056	48,040
Men	48,204	31,810	16,393
Women	46,892	15,246	31,646

SA	All HF	HFrEF	HFpEF
ALL	80,017	38,885	41,131
Men	38,920	25,084	13,206
Women	41,727	13,801	27,925

QLD	All HF	HFrEF	HFpEF
ALL	185,510	91,386	94,123
Men	93,442	61,611	31,831
Women	92,068	29,776	62,292

NSW	All HF	HFrEF	HFpEF
ALL	324,386	158,593	165,793
Men	158,480	104,046	54,434
Women	165,906	54,547	111,358

ACT	All HF	HFrEF	HFpEF
ALL	13,337	6,566	6,771
Men	6,690	4,420	2,270
Women	6,647	2,146	4,501

TAS	All HF	HFrEF	HFpEF
ALL	25,171	12,326	12,844
Men	12,408	8,189	4,219
Women	12,763	4,137	8,626

VIC	All HF	HFrEF	HFpEF
ALL	242,805	118,452	124,354
Men	118,108	77,462	40,646
Women	124,697	40,990	83,708

	Population	All HF	HFrEF	HFpEF
ALL	22,728,254	972,199	476,382	495,817
Men	11,312,823	479,192	315,027	164,165
Women	11,415,431	493,007	161,355	331,652

Figure 13 Prevalence of heart failure (HFrEF and HFpEF) in Australians aged ≥ 45 years

Our data show that we now estimate there are close to 480,000 cases of HFrEF (66% men) and an additional 496,000 cases of HFpEF (67% women). Overall, this equates to approximately 1 million Australians aged ≥ 45 years who are affected by heart failure in one form or another.

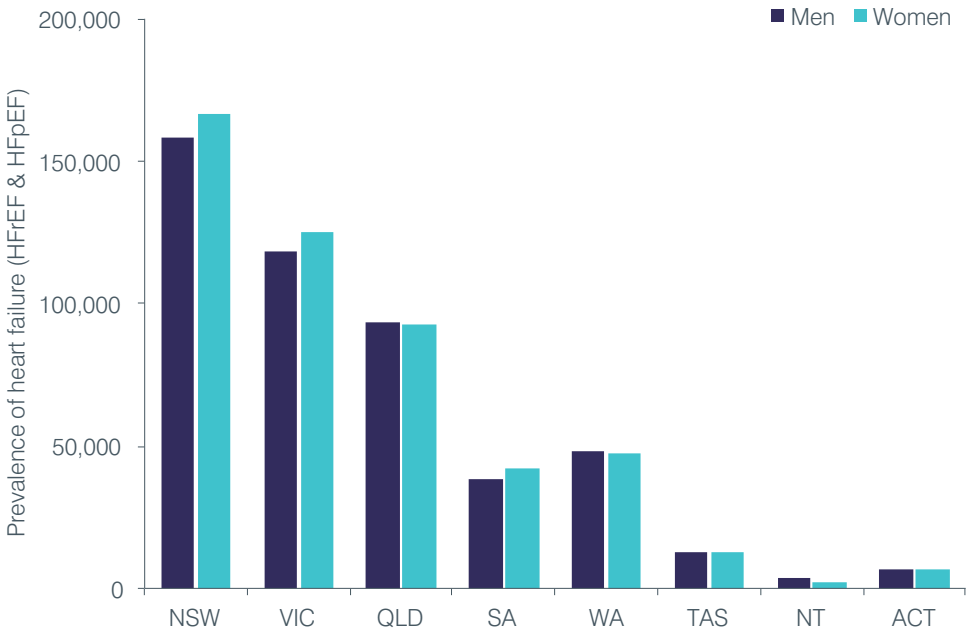


Figure 14 Prevalence of heart failure (HFrEF and HFpEF) in Australians aged ≥ 45 years according to State & Territory

As expected, Figure 14 shows that the greatest burden of prevalent cases of heart failure occurs in the most populous States on the Eastern seaboard of Australia.

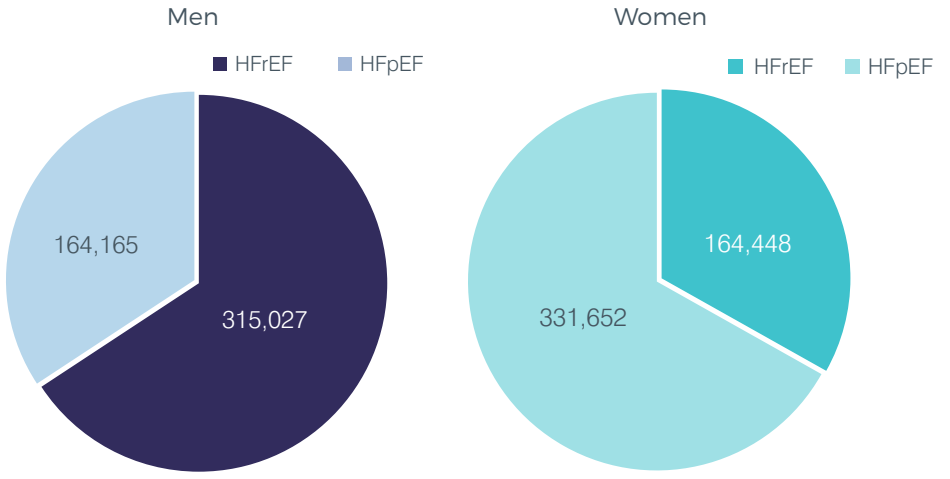


Figure 15 Prevalence of HFrEF and HFpEF in Australians ≥ 45 years according to sex

Figure 15 above summarises the differential profile of the two predominant forms of heart failure according to sex.

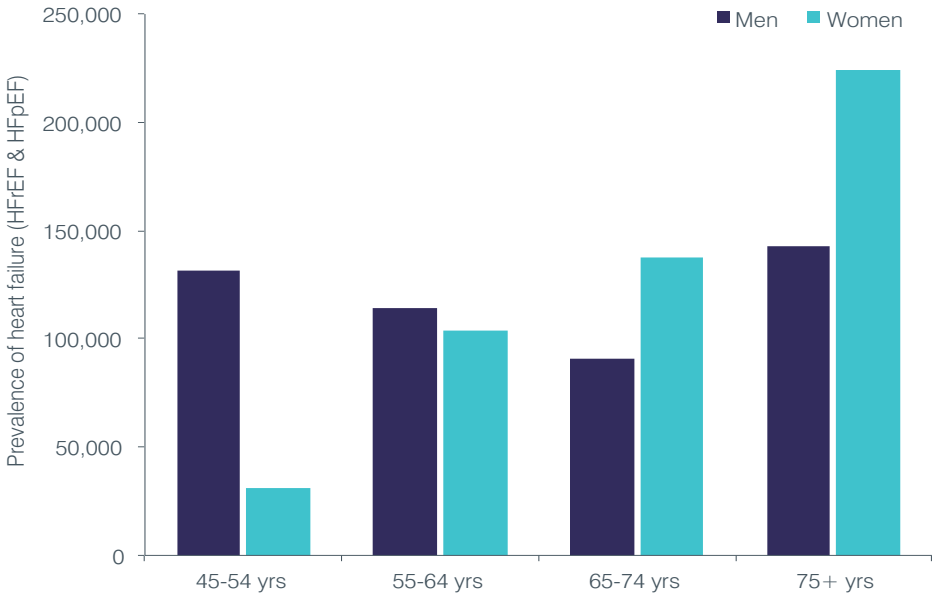


Figure 16 Prevalence of heart failure (HFrEF and HFpEF) in Australians aged ≥ 45 years according to age categories

Figure 16 shows a much more prominent peak in younger men (aged 45 to 54 years) to that suggested by estimated incident cases (Figure 12) by age. However, it should be noted that these are likely to be more reliable given sourced Australian data. Consistent with the clinical paradigm of heart failure, more men are affected (and die at a younger age from vascular disease) than women (with more cases) but more women survive to develop heart failure at an older age (which is more often HFpEF).

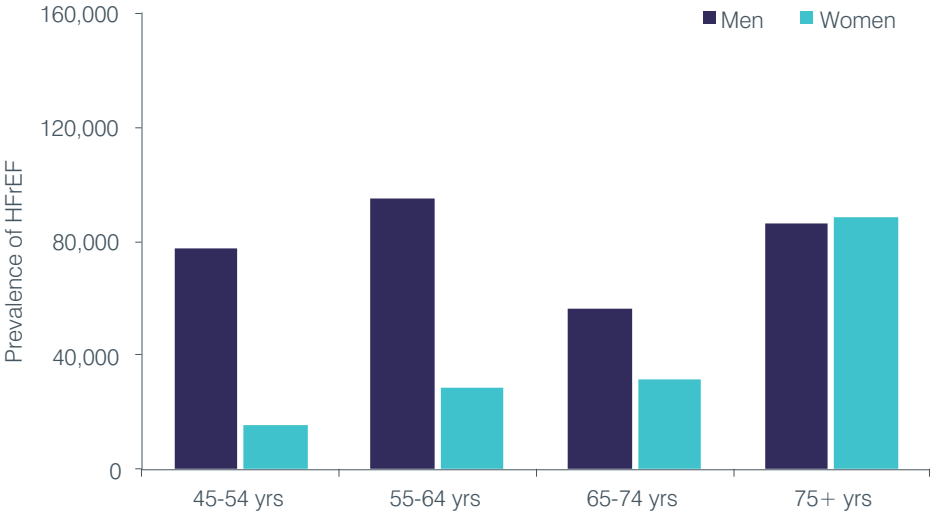


Figure 17 Prevalence of HFrEF in Australians aged ≥ 45 years according to age categories

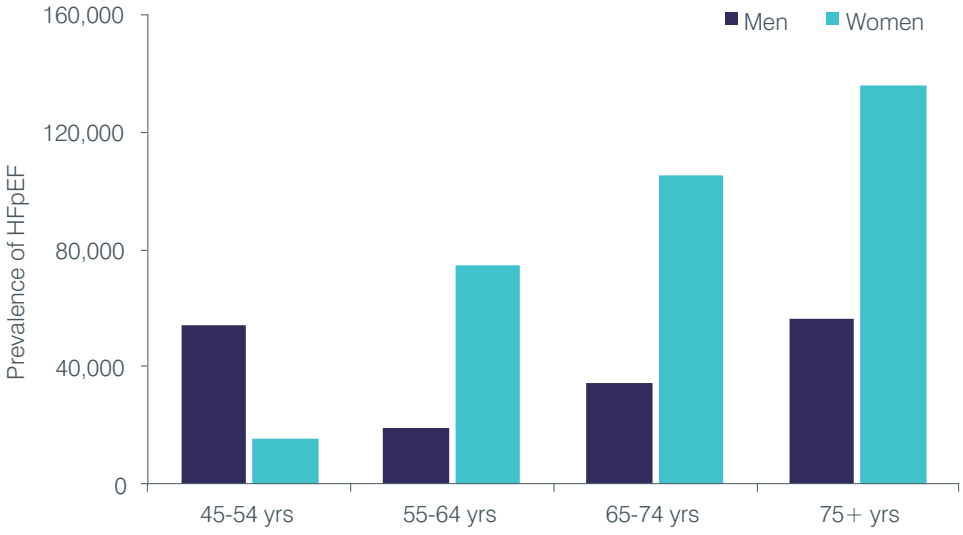


Figure 18 Prevalence of HFpEF in Australians aged ≥ 45 years according to age categories

The two figures above contrast the sex and age distribution of heart failure associated with reduced ejection fraction (Figure 17) as opposed to preserved ejection fraction (Figure 18).

Commentary on heart failure in the Australian Indigenous community

The Heart of the Heart Study led by Professor Alex Brown (Baker IDI/SAHMRI) was the first comprehensive assessment of the prevalence and associated risks of heart failure in the Australian Indigenous population. Four hundred and thirty six subjects aged between 18 to 80 years living in Central Australia were enrolled in this study.

Mean age was 44 ± 14 years and less than one in ten were aged ≥ 65 years. Of the 430 subjects who underwent echocardiography, 23 (5.3%) had heart failure (3 with acute decompensated heart failure and 20 with chronic heart failure). Of the 23 subjects with heart failure, 65% were undiagnosed prior to enrolment into the study. The high proportion of individuals with undiagnosed (and untreated) heart failure implies a delay in diagnosis, such that diagnosis generally occurs at a later stage (if at all), which may contribute to the higher mortality rates observed in the community.

Common comorbidities detected were: 1) BMI ≥ 30kg/m^2 (42%), 2) hypertension (41%) and 3) diabetes (40%). Figure 19 below shows that the cardiovascular risk factor and comorbidity profile of this population is markedly different from that highlighted in the previous section (of general population) and will likely fuel greater levels of heart failure at younger ages in the vulnerable Indigenous communities. [24]

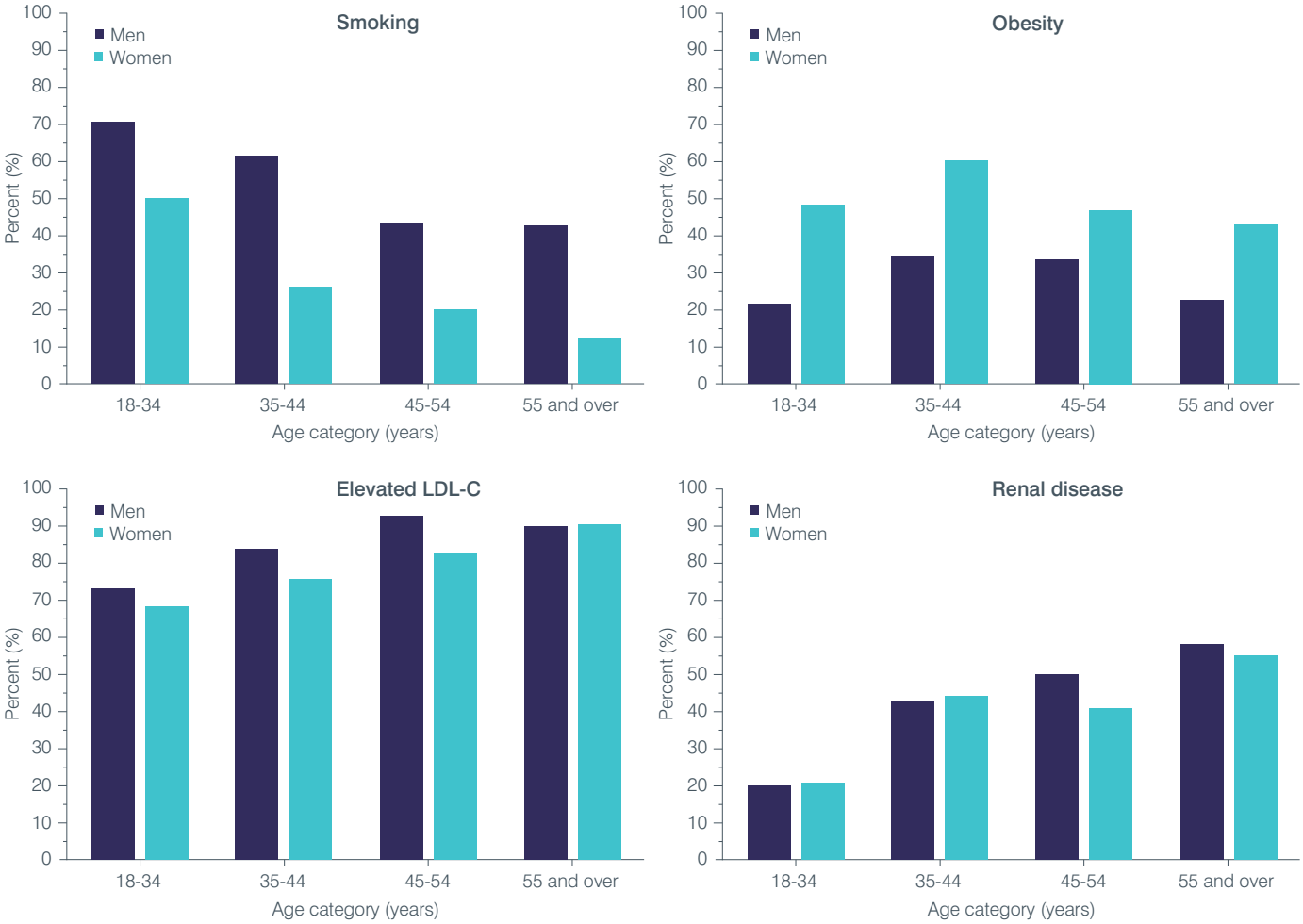


Figure 19 High levels of smoking, obesity, dyslipidaemia and renal disease in the Heart of the Heart cohort [25]

Definitions: Smoking, current smoker; obesity, BMI ≥30kg/m^2; elevated LDL-C >2.5 mmol/L; renal disease, estimated glomerular filtration rate (eGFR) <60 mL/min/1.73m^2 and/or ACR >2.5 mg/mmol for men and >3.5 mg/mmol for women or a documented past history of renal disease

3. Indicative primary care burden of heart failure

Data from the Pressure Points in Primary Care Report, comprising data from over 500,000 patients being managed in primary care during the period 2005 to 2010, suggest that each year approximately 5.7% (n = 505,036) of Australians aged ≥ 45 years are prescribed a diuretic agent, whilst 7.5% (n = 668,658) are prescribed a combination of a diurectic and an angiotensin converting enzyme inhibitor or an angiotensin receptor blocker (the main stays of heart failure management - although this combination may also be prescribed in the setting of hypertension with or without heart failure). A further 2.4% (n = 209,930) are prescribed adjunct beta blockers in the latter group.

Based on the representative nature of the original data, [26] Figure 20 shows the extrapolated number of Australian men and women aged ≥ 45 years with potential heart failure (based on these specific prescribing patterns).

Unfortunately, we have no reliable data on the number of consultations for heart failure in the primary care sector.

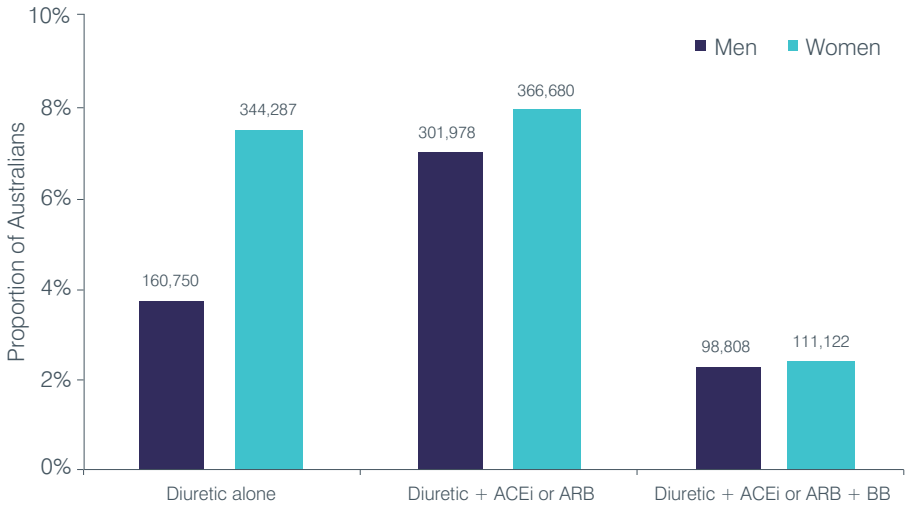
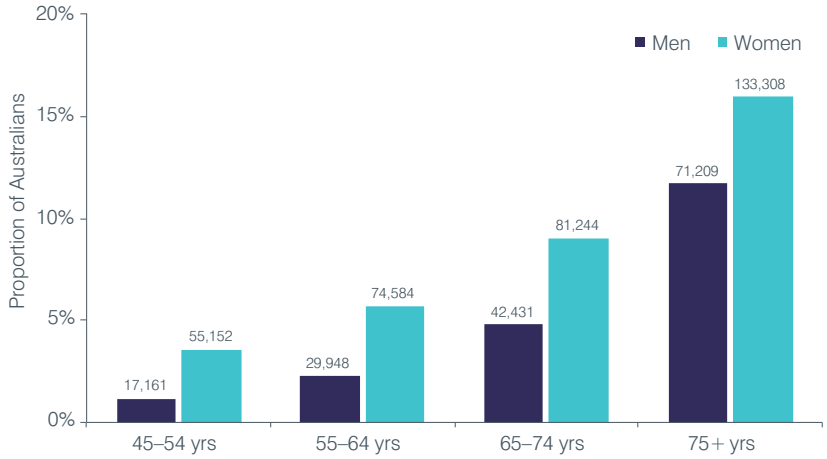


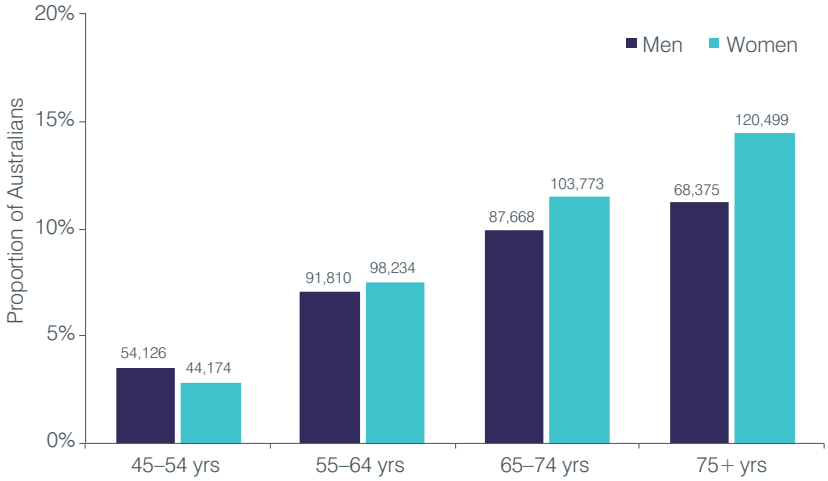
Figure 20 Estimated number of Australians aged ≥ 45 years per annum prescribed a diuretic alone, a combination of diuretic plus angiotensin converting enzyme inhibitor (ACEi) or angiotensin II receptor blocker (ARB) or a combination of diuretic plus ACEi or ARB plus beta blocker (BB) according to sex

Overall, these data suggest that around 800,000 Australian adults aged ≥ 45 years are prescribed the combination of drugs typically used to treat heart failure and, of course, its most common precursor or associated comorbidity (i.e. hypertension). The equivalent figures for men and women aged ≥ 65 years are 220,894 men and 309,191 women.

a) Diuretic only



b) Combination of diuretic + ACEi or ARB



c) Combination of diuretic + ACEi or ARB plus BB

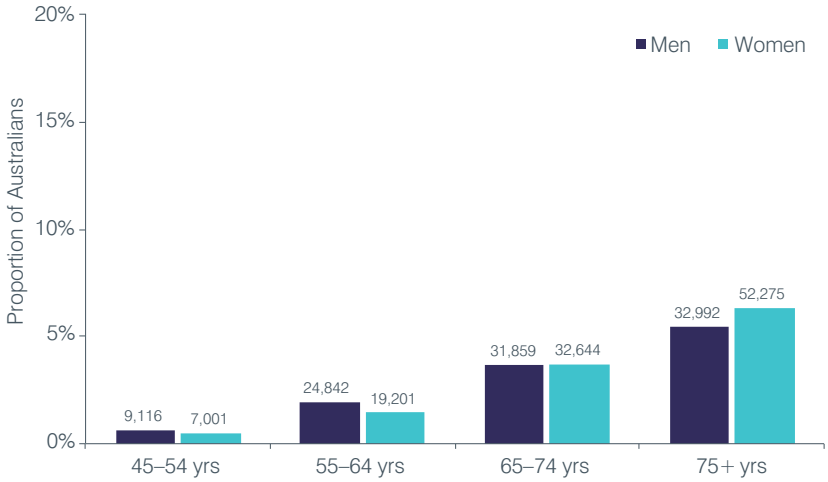


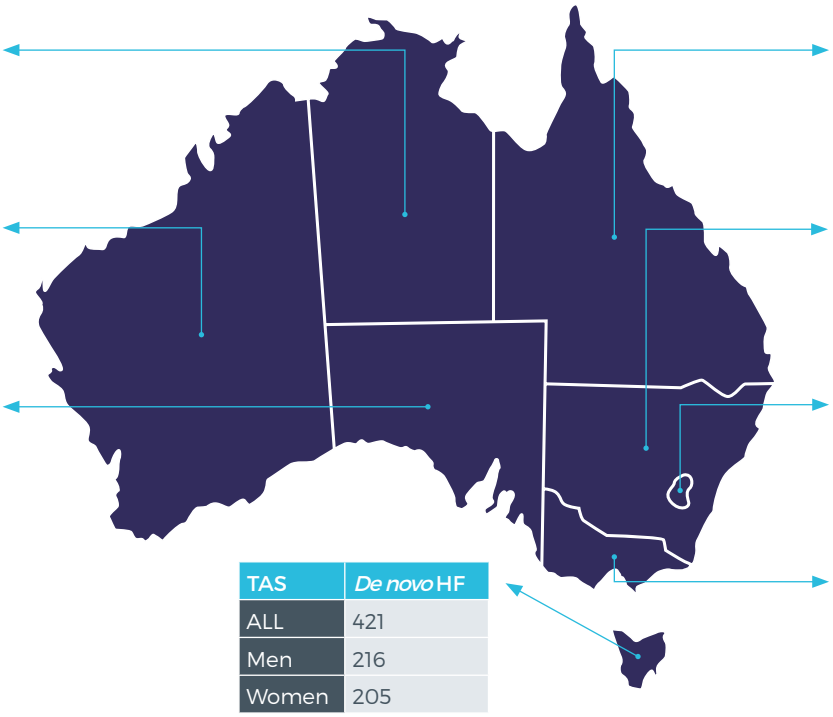
Figure 21 Pattern of prescribed diuretic, angiotensin converting enzyme inhibitor (ACEi) or angiotensin II receptor blocker (ARB) and beta blocker (BB) according to age and sex

4. Hospital burden of heart failure
Incident admissions (*de novo* event) of heart failure

NT	*De novo* HF
ALL	67
Men	41
Women	26

WA	*De novo* HF
ALL	1,505
Men	772
Women	732

SA	*De novo* HF
ALL	1,401
Men	689
Women	712



TAS	*De novo* HF
ALL	421
Men	216
Women	205

QLD	*De novo* HF
ALL	2,998
Men	1,546
Women	1,442

NSW	*De novo* HF
ALL	5,515
Men	2,764
Women	2,751

ACT	*De novo* HF
ALL	206
Men	105
Women	101

VIC	*De novo* HF
ALL	4,111
Men	2,054
Women	2,057

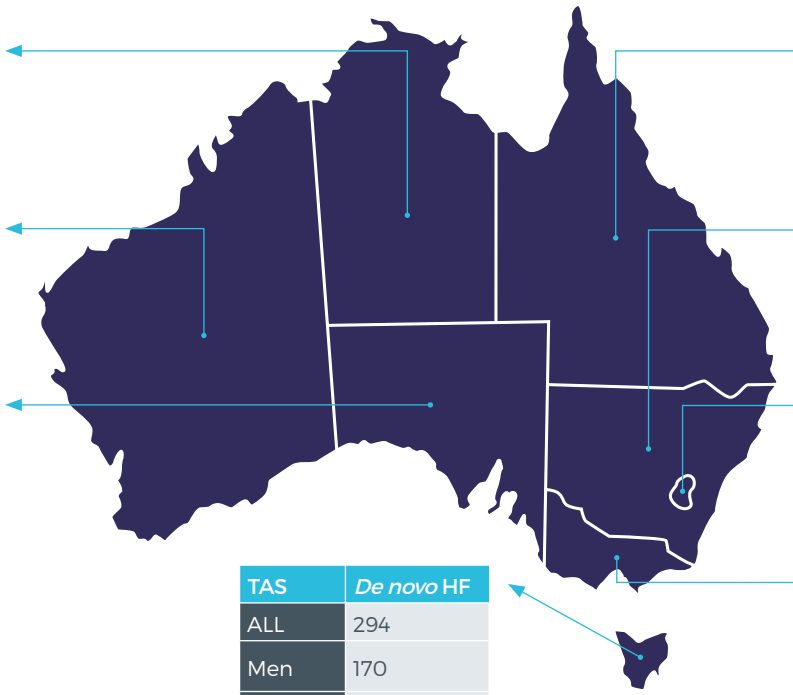
	Primary *de novo* HF hospitalisations
ALL	16,214
Men	8,188
Women	8,026

Figure 22 Estimated Australians admitted for the first time with a primary diagnosis of heart failure per annum

NT	*De novo* HF
ALL	53
Men	36
Women	17

WA	*De novo* HF
ALL	1,060
Men	613
Women	447

SA	*De novo* HF
ALL	955
Men	531
Women	424



TAS	*De novo* HF
ALL	294
Men	170
Women	124

QLD	*De novo* HF
ALL	2,106
Men	1,226
Women	880

NSW	*De novo* HF
ALL	3,806
Men	2,151
Women	1,655

ACT	*De novo* HF
ALL	146
Men	84
Women	62

VIC	*De novo* HF
ALL	2,834
Men	1,594
Women	1,240

	Secondary *de novo* HF hospitalisations
ALL	11,254
Men	6,404
Women	4,850

Figure 23 Estimated Australians admitted for the first time with a secondary diagnosis[#] of heart failure per annum
[#]with a principal diagnosis of a cardiovascular condition (excluding AMI)

NT	*De novo* HF
ALL	120
Men	77
Women	43

WA	*De novo* HF
ALL	2,566
Men	1,386
Women	1,180

SA	*De novo* HF
ALL	2,356
Men	1,220
Women	1,136

TAS	*De novo* HF
ALL	715
Men	386
Women	329

QLD	*De novo* HF
ALL	5,092
Men	2,271
Women	2,321

NSW	*De novo* HF
ALL	9,321
Men	4,914
Women	4,407

ACT	*De novo* HF
ALL	353
Men	189
Women	164

VIC	*De novo* HF
ALL	6,945
Men	3,648
Women	3,297

	Primary *de novo* HF hospitalisations	Secondary *de novo* HF hospitalisations	All *de novo* HF hospitalisations
ALL	16,214	11,254	27,468
Men	8,188	6,404	14,592
Women	8,026	4,850	12,876

Figure 24 Estimated Australians admitted for the first time with heart failure (as primary or secondary diagnosis) per annum

The number of *de novo* hospitalisations for heart failure is estimated to be 27,468 (i.e. ~45% of incident cases) per annum with 60% admitted for the first time with a primary diagnosis of heart failure.

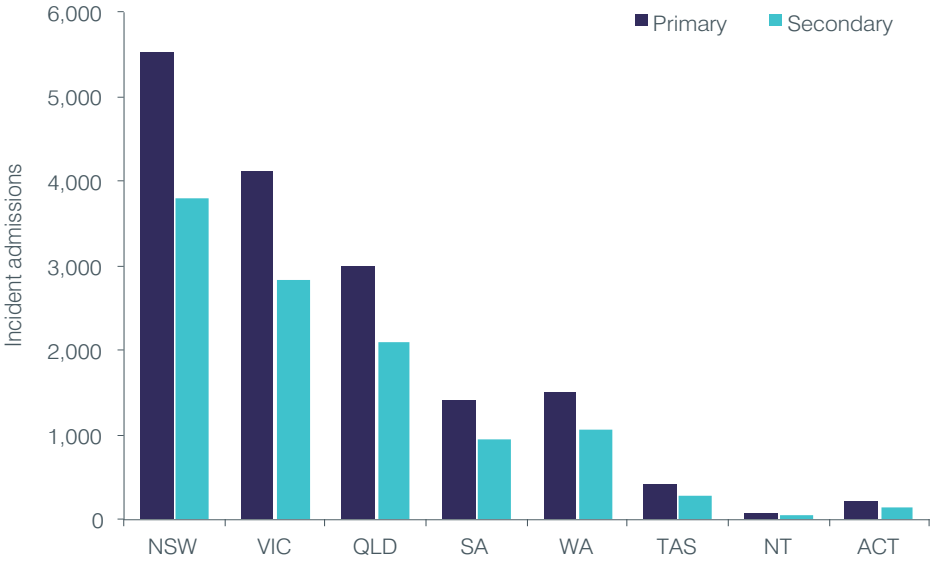


Figure 25 Estimated Australians admitted for the first time with heart failure (as primary or secondary diagnosis) per annum according to State & Territory

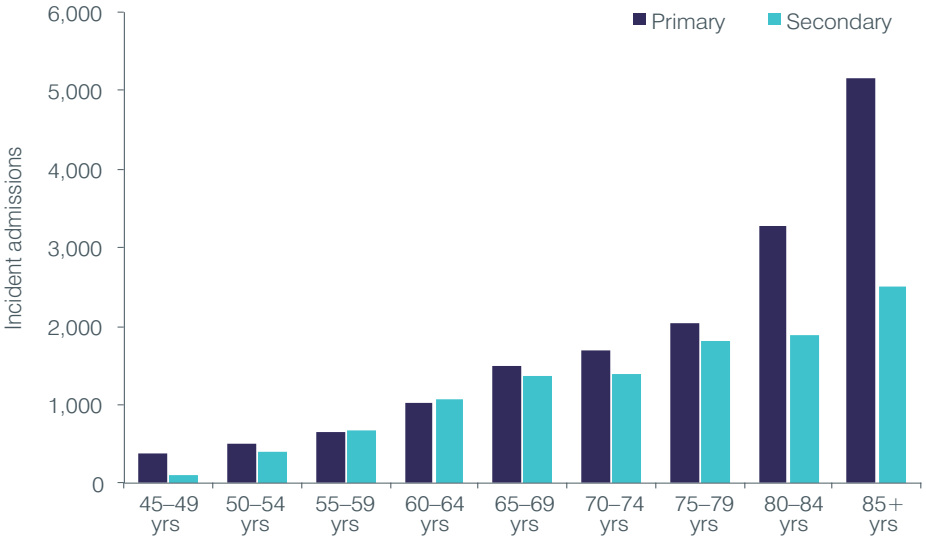


Figure 26 Estimated Australians admitted for the first time with heart failure (as primary or secondary diagnosis) per annum according to age categories

Figure 26 above shows that the incident admissions for heart failure increase steeply with advancing age (especially as primary diagnosis in individuals aged ≥ 65 years).

Type of incident admission

NT	*De novo* HF	Emergency	Elective
ALL	120	98	22
Men	77	63	14
Women	43	35	8

QLD	*De novo* HF	Emergency	Elective
ALL	5,092	4,146	947
Men	2,771	2,256	515
Women	2,321	1,890	432

WA	*De novo* HF	Emergency	Elective
ALL	2,566	2,088	477
Men	1,386	1,128	258
Women	1,180	960	219

NSW	*De novo* HF	Emergency	Elective
ALL	9,321	7,587	1,734
Men	4,914	4,000	914
Women	4,407	3,587	820

SA	*De novo* HF	Emergency	Elective
ALL	2,356	1,918	438
Men	1,220	993	227
Women	1,136	925	211

ACT	*De novo* HF	Emergency	Elective
ALL	353	286	66
Men	189	153	35
Women	164	133	31

TAS	*De novo* HF	Emergency	Elective
ALL	715	582	133
Men	386	314	72
Women	329	268	61

VIC	*De novo* HF	Emergency	Elective
ALL	6,945	5,654	1,292
Men	3,648	2,970	679
Women	3,297	2,684	613

	All *de novo* HF hospitalisations	Emergency admission	Elective admission
ALL	27,468	22,360	5,109
Men	14,592	11,878	2,714
Women	12,876	10,481	2,395

Figure 27 Type of incident admission (emergency versus elective)

This figure shows that > 80% of all *de novo* incident admissions for heart failure (as primary or secondary diagnosis) are unplanned/emergency admissions.

Length of hospital stay and in-patient case-fatality

NT	*De novo* HF	LOS	In-patient case-fatality
ALL	120	991	11
Men	77	640	7
Women	43	351	4

QLD	*De novo* HF	LOS	In-patient case-fatality
ALL	5,092	41,959	472
Men	2,771	22,900	261
Women	2,321	19,059	211

WA	*De novo* HF	LOS	In-patient case-fatality
ALL	2,566	21,135	238
Men	1,386	11,449	131
Women	1,180	9,687	107

NSW	*De novo* HF	LOS	In-patient case-fatality
ALL	9,321	76,753	861
Men	4,914	40,584	461
Women	4,407	36,169	400

SA	*De novo* HF	LOS	In-patient case-fatality
ALL	2,356	19,398	217
Men	1,220	10,073	114
Women	1,136	9,325	103

ACT	*De novo* HF	LOS	In-patient case-fatality
ALL	353	2,901	33
Men	189	1,558	18
Women	164	1,343	15

TAS	*De novo* HF	LOS	In-patient case-fatality
ALL	715	5,892	66
Men	386	3,189	36
Women	329	2,702	30

VIC	*De novo* HF	LOS	In-patient case-fatality
ALL	6,945	57,192	642
Men	3,648	30,130	342
Women	3,297	27,061	300

	All *de novo* HF hospitalisations	Length of Stay (days)	In-patient case-fatality
ALL	27,468	226,221	2,540
Men	14,592	120,524	1,370
Women	12,876	105,697	1,170

Figure 28 Length of hospital stay and in-patient case-fatality associated with incident heart failure admissions (primary or secondary diagnosis)

Figure 28 above shows an in-patient case-fatality rate of around 9% and we estimate that the total length of hospital stays associated with any type of incident heart failure admission to be more than a quarter of a million days every year (average length of stay ~8 days).

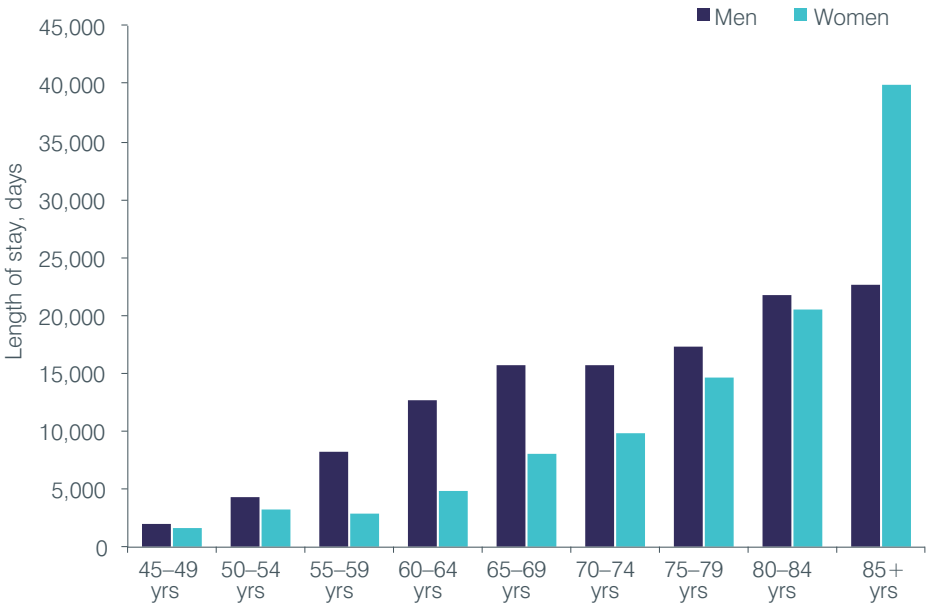


Figure 29 Hospital stay (days) associated with incident heart failure admissions (primary or secondary diagnosis) according to age categories

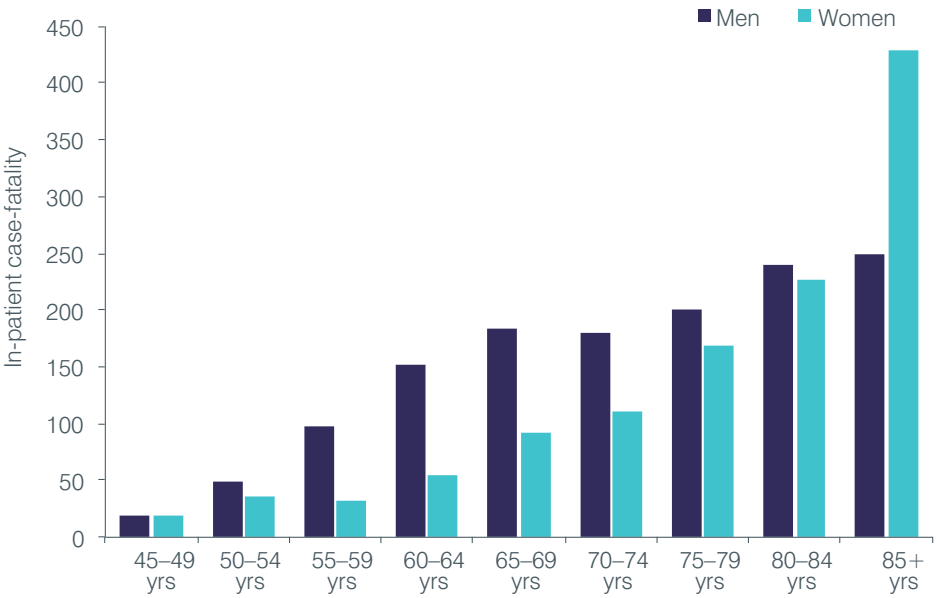


Figure 30 In-patient case-fatalities associated with incident heart failure admissions (primary or secondary diagnosis) according to age categories

Discharge destinations

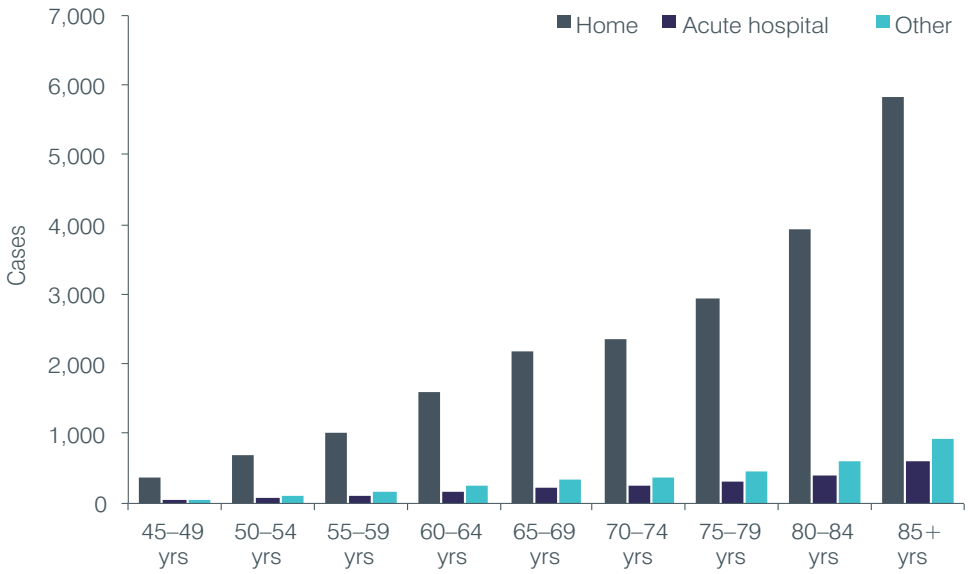


Figure 31 Discharge destinations per annum according to age, among those who survived an incident heart failure admission ("other" predominantly denoting long-term rehabilitation or residential/supported care)

Figure 31 reinforces that most patients admitted for the first time with heart failure and who survive that event return to their own home post-discharge. However, this still leaves a residual component (increasing with age) of individuals who require ongoing management via another acute care facility or, due to general health deterioration require ongoing residential care and support. This latter (and costly) phenomenon becomes increasingly more likely with each repetitive hospital admission.

NT	*De novo* HF	Ischaemic	Non-ischaemic
ALL	120	42	78
Men	77	27	50
Women	43	15	28

WA	*De novo* HF	Ischaemic	Non-ischaemic
ALL	2,566	898	1,668
Men	1,386	485	901
Women	1,180	413	767

SA	*De novo* HF	Ischaemic	Non-ischaemic
ALL	2,356	825	1,532
Men	1,220	427	793
Women	1,136	398	739

QLD	*De novo* HF	Ischaemic	Non-ischaemic
ALL	5,092	1,782	3,310
Men	2,771	970	1,801
Women	2,321	812	1,509

NSW	*De novo* HF	Ischaemic	Non-ischaemic
ALL	9,321	3,262	6,058
Men	4,914	1,720	3,149
Women	4,407	1,542	2,864

ACT	*De novo* HF	Ischaemic	Non-ischaemic
ALL	353	123	229
Men	189	66	123
Women	164	57	106

TAS	*De novo* HF	Ischaemic	Non-ischaemic
ALL	715	250	465
Men	386	135	251
Women	329	115	214

VIC	*De novo* HF	Ischaemic	Non-ischaemic
ALL	6,945	2,431	4,515
Men	3,648	1,277	2,372
Women	3,297	1,154	2,143

	All *de novo* HF hospitalisations	Ischaemic	Non-ischaemic
ALL	27,468	9,613	17,855
Men	14,592	5,107	9,485
Women	12,876	4,506	8,370

Figure 32 Estimated pattern of ischaemic versus non-ischaemic incident heart failure admissions (primary and secondary diagnosis) per annum

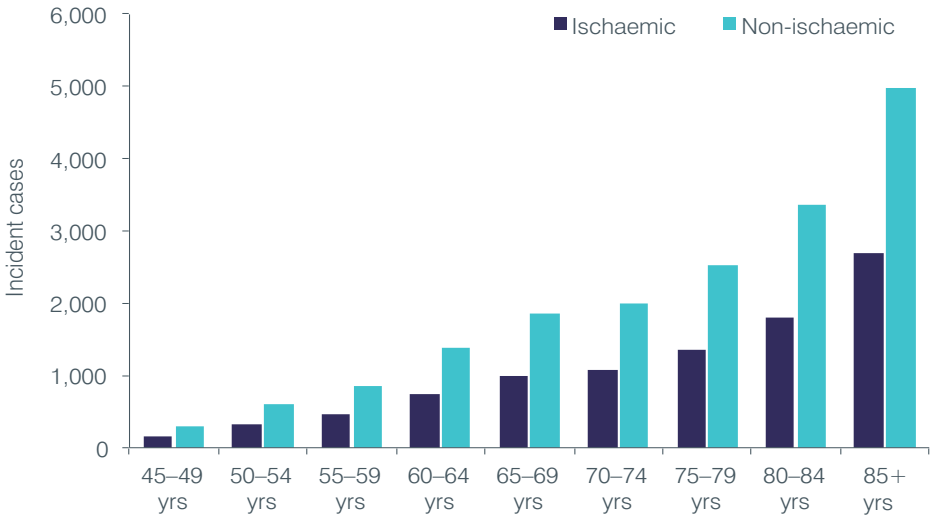


Figure 33 Ischaemic versus non-ischaemic *de novo* heart failure admissions (primary and secondary diagnosis) according to age categories

Table 7 Pattern of comorbidity according to sex and ischaemic versus non-ischaemic *de novo* heart failure admissions

	Men		Women		Total
	Ischaemic	Non-ischaemic	Ischaemic	Non-ischaemic	
All *de novo* HF admissions	5,107	9,485	4,507	8,370	27,468
Prior MI	2,166 (42%)	-	1,906 (42%)	-	4,072 (15%)
Hypertension	2,639 (52%)	3,356 (35%)	2,796 (62%)	3,896 (46%)	12,686 (46%)
Atrial fibrillation	1,697 (33%)	3,397 (36%)	1,449 (32%)	3,098 (37%)	9,641 (35%)
Diabetes	1,412 (28%)	1,967 (21%)	1,199 (28%)	1,659 (20%)	6,237 (23%)
Renal failure	777 (15%)	1,155 (12%)	515 (11%)	810 (10%)	3,257 (12%)
Chronic airways limitations	1,403 (27%)	2,722 (29%)	959 (21%)	1,940 (23%)	7,024 (26%)
Peripheral vascular disease	1,166 (23%)	1,115 (12%)	731 (16%)	732 (9%)	3,744 (14%)
Cerebrovascular disease	1,108 (22%)	1,331 (14%)	851 (19%)	1,142 (14%)	4,434 (16%)
Cardiomyopathy	37 (1%)	240 (3%)	11 (<1%)	40 (<1%)	328 (1%)
Rheumatic heart disease	280 (5%)	426 (4%)	274 (6%)	529 (6%)	1,509 (5%)

Readmissions

NT	*De novo* HF	Readmissions
ALL	120	45
Men	77	29
Women	43	16

WA	*De novo* HF	Readmissions
ALL	2,566	957
Men	1,386	517
Women	1,180	440

SA	*De novo* HF	Readmissions
ALL	2,356	879
Men	1,220	455
Women	1,136	424

QLD	*De novo* HF	Readmissions
ALL	5,092	1,900
Men	2,771	1,034
Women	2,321	866

NSW	*De novo* HF	Readmissions
ALL	9,321	3,477
Men	4,914	1,833
Women	4,407	1,644

ACT	*De novo* HF	Readmissions
ALL	353	131
Men	189	70
Women	164	61

TAS	*De novo* HF	Readmissions
ALL	715	267
Men	386	144
Women	329	123

VIC	*De novo* HF	Readmissions
ALL	6,945	2,591
Men	3,648	1,361
Women	3,297	1,230

	All *de novo* HF hospitalisations	Readmission within 12-month
ALL	27,468	10,246
Men	14,592	5,443
Women	12,876	4,803

Figure 34 Hospital readmissions within 12-month following an incident admission for heart failure (primary and secondary diagnosis)

The number of recurrent hospital admissions within 12-month following an incident admission for heart failure (any diagnosis) is estimated to be more than 10,000 separations (i.e. ~37% of *de novo* heart failure admissions).

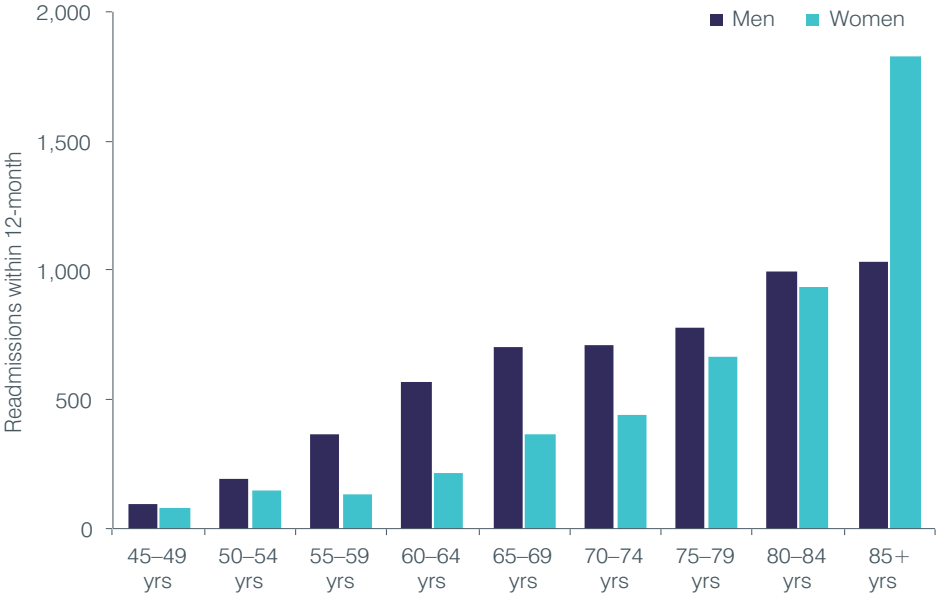


Figure 35 Pattern of 12-month readmissions according to sex and age categories

Reflective of increasing complexity (often with multi-morbidity) the risk of readmission in heart failure increases markedly with age in both men and women; noting the volume of readmissions among men aged up to 75 years and women aged 85+ years (Figure 35).

Mortality within 30-day, 1-year and 5-year

NT	*De novo* HF	30-day	1-year
ALL	120	14	37
Men	77	9	24
Women	43	5	13

QLD	*De novo* HF	30-day	1-year
ALL	5,092	589	1,554
Men	2,771	325	846
Women	2,321	265	709

WA	*De novo* HF	30-day	1-year
ALL	2,566	297	783
Men	1,386	162	423
Women	1,180	134	360

NSW	*De novo* HF	30-day	1-year
ALL	9,321	1,076	2,844
Men	4,914	574	1,499
Women	4,407	501	1,345

SA	*De novo* HF	30-day	1-year
ALL	2,356	272	719
Men	1,220	142	372
Women	1,136	129	347

ACT	*De novo* HF	30-day	1-year
ALL	353	41	107
Men	189	22	58
Women	164	19	50

TAS	*De novo* HF	30-day	1-year
ALL	715	82	218
Men	386	45	118
Women	329	37	100

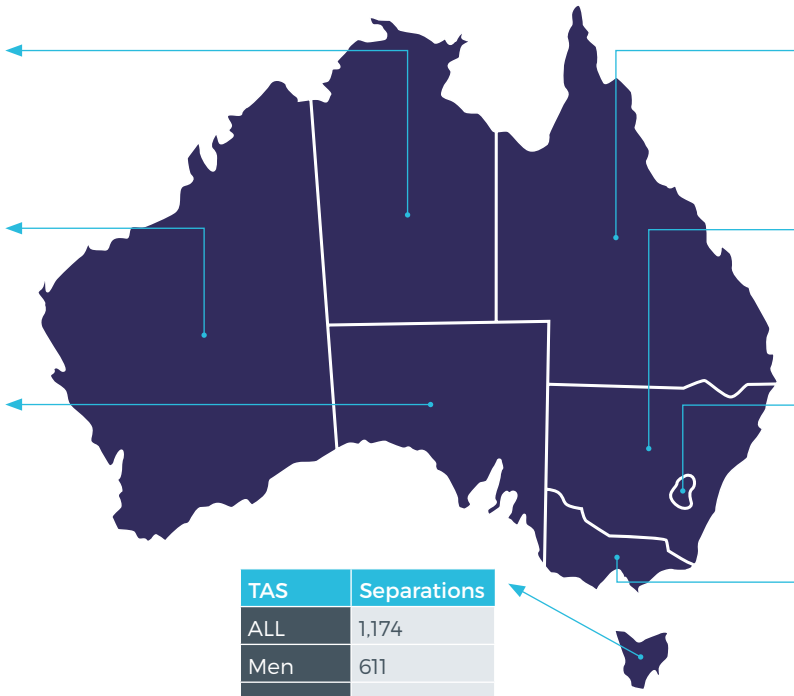
VIC	*De novo* HF	30-day	1-year
ALL	6,945	801	2,120
Men	3,648	426	1,113
Women	3,297	375	1,006

	All *de novo* HF hospitalisations	30-day mortality	1-year mortality	5-year mortality
ALL	27,468	3,172	8,383	13,702
Men	14,592	1,706	4,452	7,094
Women	12,876	1,466	3,930	6,608

Figure 36 Projected pattern of accumulative 30-day, 1-year and 5-year case-fatality (total number of Australians aged ≥ 45 years) following an incident heart failure admission (primary and secondary diagnosis)

We estimate that heart failure is attributable to more than 3,000 deaths (i.e. ~12% mortality rate) within 30-day following an incident admission. The accumulative cases of death are likely to exceed 8,300 (31%) and 13,000 (50%) people at 1-year and 5-year post-index admission, respectively.

All (non-elective) hospital admissions (*de novo* or recurrent event) of heart failure



NT	Separations
ALL	176
Men	106
Women	70

QLD	Separations
ALL	8,291
Men	4,345
Women	3,946

WA	Separations
ALL	4,159
Men	2,154
Women	2,005

NSW	Separations
ALL	15,284
Men	7,807
Women	7,477

SA	Separations
ALL	3,850
Men	1,939
Women	1,911

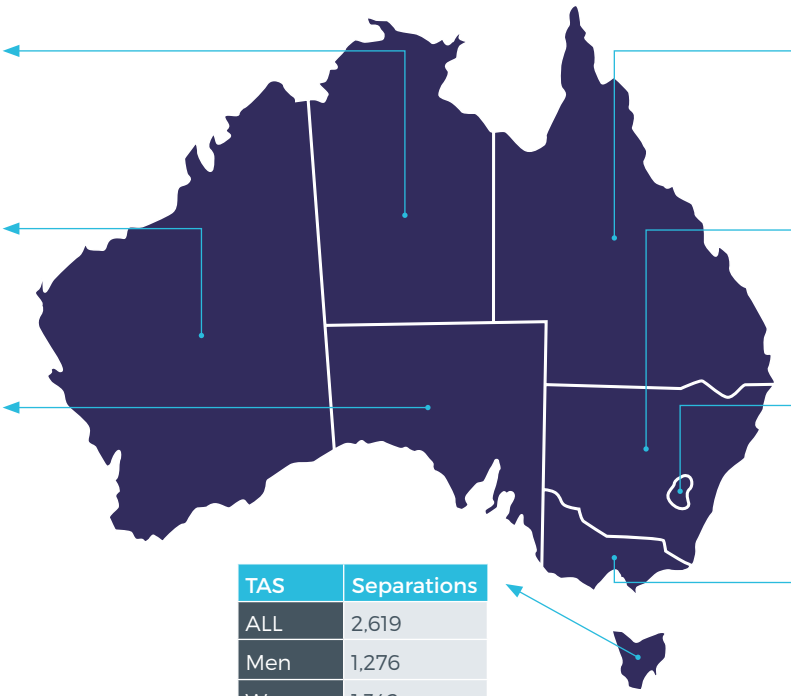
ACT	Separations
ALL	564
Men	289
Women	275

TAS	Separations
ALL	1,174
Men	611
Women	563

VIC	Separations
ALL	11,396
Men	5,796
Women	5,601

	All hospitalisations (primary diagnosis) of HF
ALL	44,894
Men	23,047
Women	21,847

Figure 37 Estimated total number of hospital separations associated with a primary diagnosis of heart failure (*de novo* or recurrent event) among Australians aged ≥ 45 years (per annum)



NT	Separations
ALL	793
Men	422
Women	371

WA	Separations
ALL	10,424
Men	5,116
Women	5,307

SA	Separations
ALL	8,116
Men	3,885
Women	4,231

TAS	Separations
ALL	2,619
Men	1,276
Women	1,342

QLD	Separations
ALL	20,081
Men	9,810
Women	10,271

NSW	Separations
ALL	33,626
Men	16,248
Women	17,378

ACT	Separations
ALL	1,502
Men	719
Women	782

VIC	Separations
ALL	25,294
Men	12,121
Women	13,173

	All hospitalisations (secondary diagnosis) of HF
ALL	102,454
Men	49,598
Women	52,856

Figure 38 Estimated total number of hospital separations associated with a secondary diagnosis[#] of heart failure (*de novo* or recurrent event) among Australians aged ≥ 45 years (per annum)

[#]*with a primary diagnosis of a cardiovascular condition (excluding AMI)*

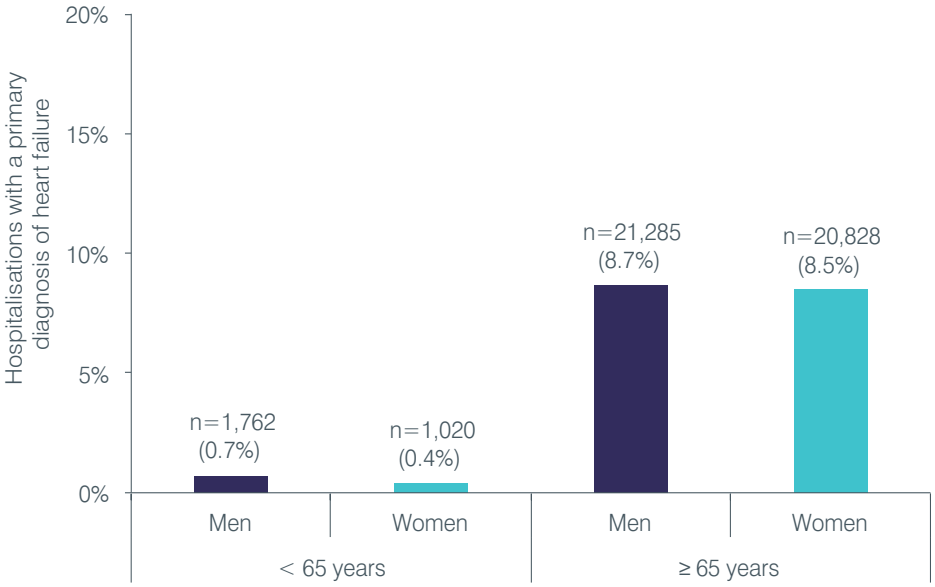


Figure 39 Pattern of hospitalisations (non-elective) with a primary diagnosis of heart failure as a function of individuals with heart failure (HFrEF or HFpEF) according to age and sex

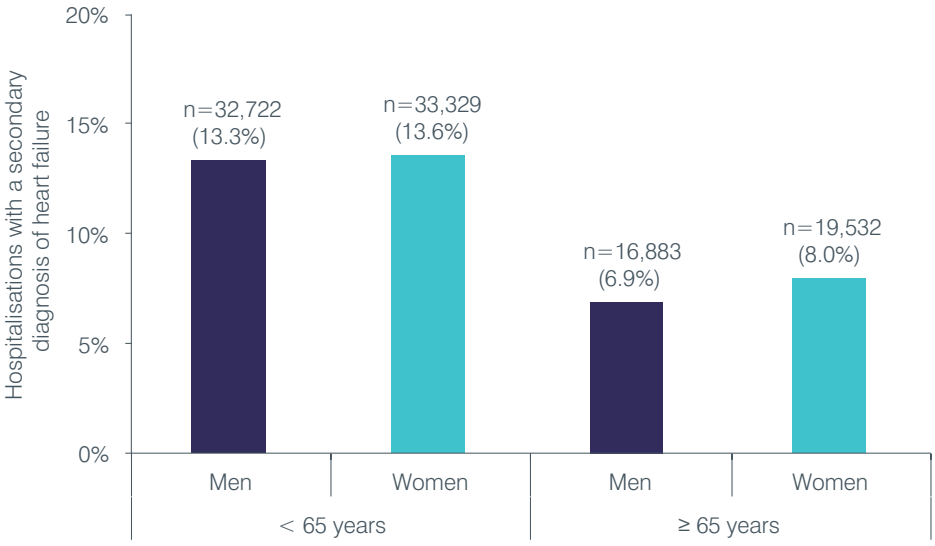
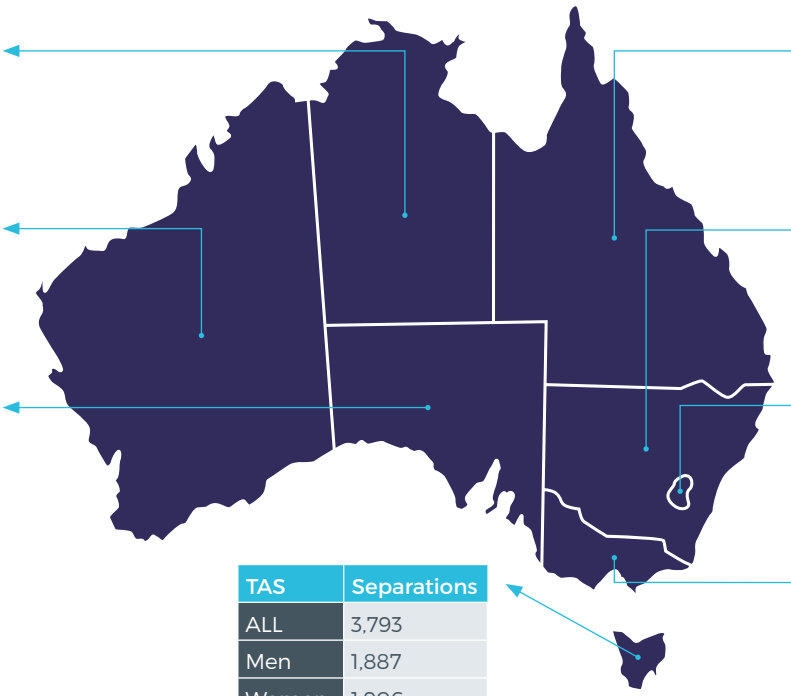


Figure 40 Pattern of hospitalisations (non-elective) with a secondary diagnosis[#] of heart failure as a function of individuals with heart failure (HFrEF or HFpEF) according to age and sex

[#]with a primary diagnosis of a cardiovascular condition (excluding AMI)



NT	Separations
ALL	969
Men	528
Women	441

WA	Separations
ALL	14,582
Men	7,270
Women	7,312

SA	Separations
ALL	11,966
Men	5,825
Women	6,141

TAS	Separations
ALL	3,793
Men	1,887
Women	1,906

QLD	Separations
ALL	28,372
Men	14,155
Women	14,217

NSW	Separations
ALL	48,910
Men	24,055
Women	24,855

ACT	Separations
ALL	2,065
Men	1,008
Women	1,057

VIC	Separations
ALL	36,691
Men	17,916
Women	18,774

	All hospitalisations (primary diagnosis) of HF	All hospitalisations (secondary diagnosis) of HF	All hospitalisations (primary or secondary diagnosis) of HF
ALL	44,894	102,454	147,347
Men	23,047	49,598	72,644
Women	21,847	52,856	74,703

Figure 41 Estimated total number of hospital separations (non-elective) associated with primary or secondary diagnosis of heart failure (*de novo* or recurrent event) among Australians aged ≥ 45 years (per annum)

The above data show that we estimate > 147,000 adult Australians aged ≥ 45 years were admitted to hospital with either a primary (~45,000 separations) or secondary (~102,000 separations) diagnosis of heart failure each year.

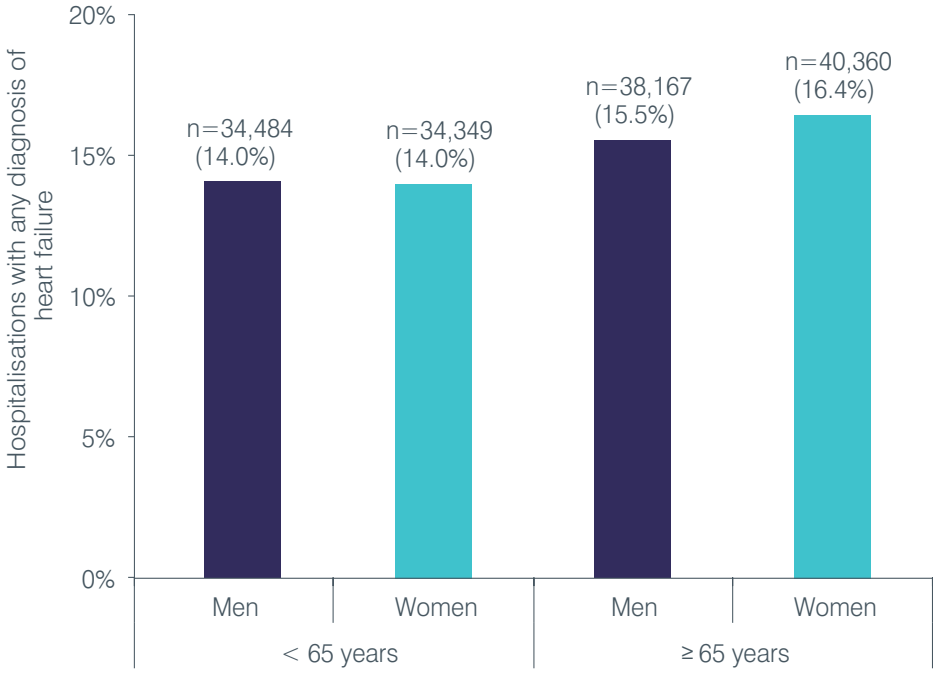


Figure 42 Pattern of hospital admissions (non-elective) with primary or secondary diagnosis of heart failure as a function of individuals with heart failure (HFrEF or HFpEF) according to age and sex

Length of stay (LOS)

NT	Separations	LOS
ALL	969	6,209
Men	528	3,380
Women	441	2,829

QLD	Separations	LOS
ALL	28,372	192,376
Men	14,155	95,175
Women	14,217	97,201

WA	Separations	LOS
ALL	14,582	98,575
Men	7,270	48,674
Women	7,312	49,901

NSW	Separations	LOS
ALL	48,910	335,287
Men	24,055	163,167
Women	24,855	172,119

SA	Separations	LOS
ALL	11,966	82,534
Men	5,825	39,713
Women	6,141	42,821

ACT	Separations	LOS
ALL	2,065	13,899
Men	1,008	6,727
Women	1,057	7,172

TAS	Separations	LOS
ALL	3,793	25,920
Men	1,887	12,776
Women	1,906	13,143

VIC	Separations	LOS
ALL	36,691	251,313
Men	17,916	121,506
Women	18,774	129,807

	Primary or secondary diagnosis of HF	LOS (days)
ALL	147,347	1,006,113
Men	72,644	491,119
Women	74,703	514,994

Figure 43 Total days of hospital stay (non-elective) associated with primary or secondary diagnosis of heart failure (*de novo* or recurrent) per annum

We estimate that heart failure is attributable to over 147,000 hospital admissions and over 1 million days (34% as a principal diagnosis) in hospital per annum.

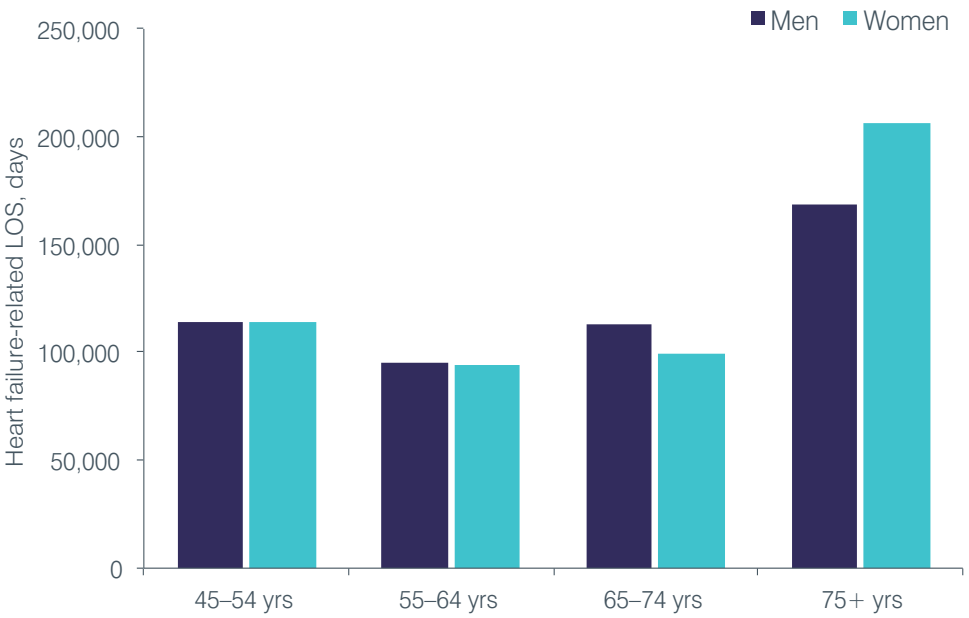


Figure 44 Pattern of hospital length of stay (non-elective) with primary or secondary diagnosis of heart failure according to age and sex

Consistent with international data, the greatest burden of heart failure lies in hospital stay among those aged 65 years or more and in particular those aged 75 years or more. However, the burden imposed by hospital stay among those aged less than 65 years is not insubstantial.

Acute versus chronic manifestations of heart failure

Professor Peter Macdonald from St Vincent's hospital in Sydney recently led the ***NSW Heart Failure Snapshot;*** a prospective audit of consecutive patients admitted to 25 participating facilities across NSW between 8th July and 8th August 2013 with an admission diagnosis of acute heart failure.

As presented at the World Congress of Cardiology 2014, a total of 811 patients were recruited, the mean age of the study group was 77 ± 13 years and 58% were men. The predominant form of heart failure was that with reduced ejection fraction (i.e. HFrEF) and two thirds had ischaemic heart disease, with one quarter of cases with hypertensive heart failure. [15] More specific details are pending the full publication of these data.

Data from the WHICH? Trial cohort recruited from three tertiary hospitals in South Australia, New South Wales and Queensland, also provide contemporary data on the balance between acute and chronic presentations of those with underlying chronic heart failure (Figure 45). [28] Among men, mean age of those admitted with acute heart failure/acute pulmonary oedema was similar 71 ± 14 years. Alternatively, women admitted with acute heart failure were markedly younger than the rest (69 ± 16 versus 78 ± 10 years). Overall, 78% of men admitted with acute heart failure had reduced ejection fraction (or LVSD). In women, this figure was 75%.

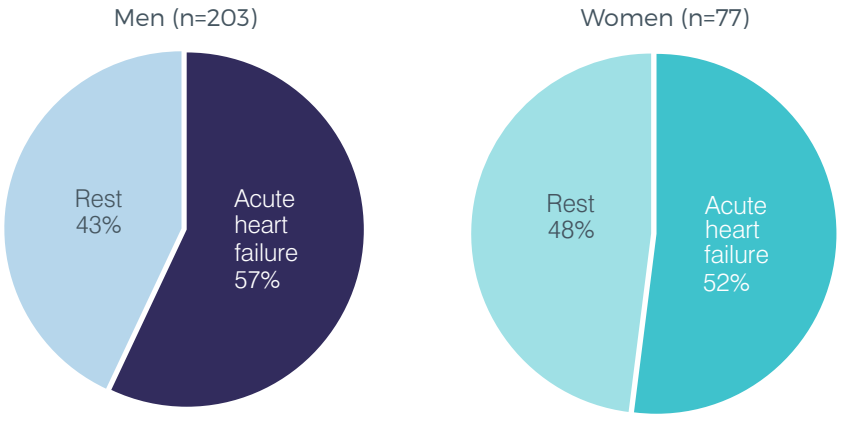


Figure 45 Pattern of acute versus chronic heart failure presentation in the WHICH? Trial cohort according to sex

5. Financial burden imposed by heart failure

The same methods used to estimate heart failure-related hospitalisation and community care costs in the recently reported WHICH? Trial [28] (see Methods section for specific costs and data-sources) were applied in the current report to estimate components of heart failure-related health care activity (including in-patient care and associated community management costs) in consultation with Professor Paul Scuffham (Griffith University).

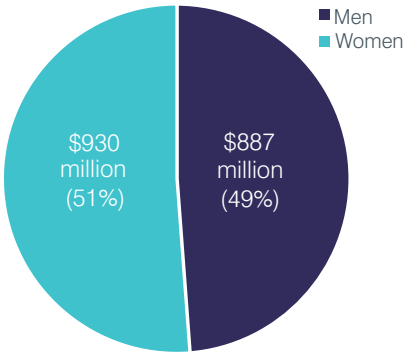


Figure 46 Estimated cost of in-patient care (plus device based therapy) according to sex

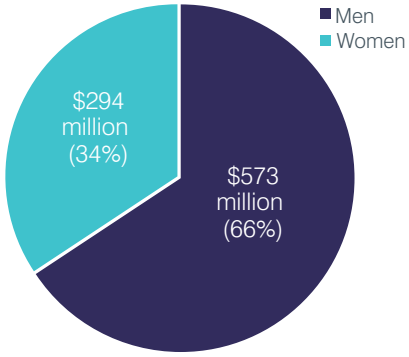


Figure 47 Estimated cost of associated community care (with up-titration of therapy and management of heart failure) according to sex

Cost of in-patient care (non-elective $1.82 billion or >1 million days of hospital stay per annum)

Cost of community care ($867 million, conservative measure from 476,382 HFrEF individuals)

Total health care expenditure

The estimated total direct cost of heart failure in 2012 was $2.68 billion per annum ($1.46 billion for men versus $1.22 billion for women; Figure 48). As expected, the direct cost of in-patient care (non-elective) imposed by heart failure remains high and contributed to around two thirds (68% or $1.82 billion) of the total health care expenditure irrespective of gender.

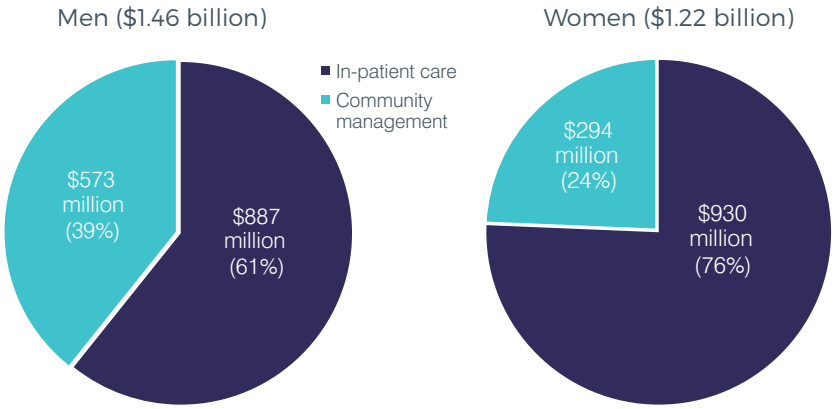


Figure 48 Estimated direct health care cost of heart failure according to type of care and sex

6. Future burden imposed by heart failure

NT	2012	2020	2030
ALL	5,878	3,118	2,760
Men	3,571	2,406	1,165
Women	2,308	712	1,595

WA	2012	2020	2030
ALL	95,096	47,056	48,040
Men	48,204	31,810	16,393
Women	46,892	15,246	31,646

SA	2012	2020	2030
ALL	80,017	38,885	41,131
Men	38,920	25,084	13,206
Women	41,727	13,801	27,925

QLD	2012	2020	2030
ALL	185,510	91,386	94,123
Men	93,442	61,611	31,831
Women	92,068	29,776	62,292

NSW	2012	2020	2030
ALL	324,386	158,593	165,793
Men	158,480	104,046	54,434
Women	165,906	54,547	111,358

ACT	2012	2020	2030
ALL	13,337	6,566	6,771
Men	6,690	4,420	2,270
Women	6,647	2,146	4,501

TAS	2012	2020	2030
ALL	25,171	12,326	12,844
Men	12,408	8,189	4,219
Women	12,763	4,137	8,626

VIC	2012	2020	2030
ALL	242,805	118,452	124,354
Men	118,108	77,462	40,646
Women	124,697	40,990	83,708

Prevalence	2012	2020	2030
ALL	972,199	1,195,505	1,534,136
Men	479,192	582,381	736,181
Women	493,007	613,124	797,956

Figure 49 Current and projected estimations of the prevalence of all forms of heart failure (Australians aged ≥ 45 years)

Based on a progressively ageing population profile of Australia, we predict that around 1.2 million Australians will have developed or be adversely affected by heart failure in 2020 and as many as 1.5 million Australians will be affected by the syndrome in 2030 (Figure 49).

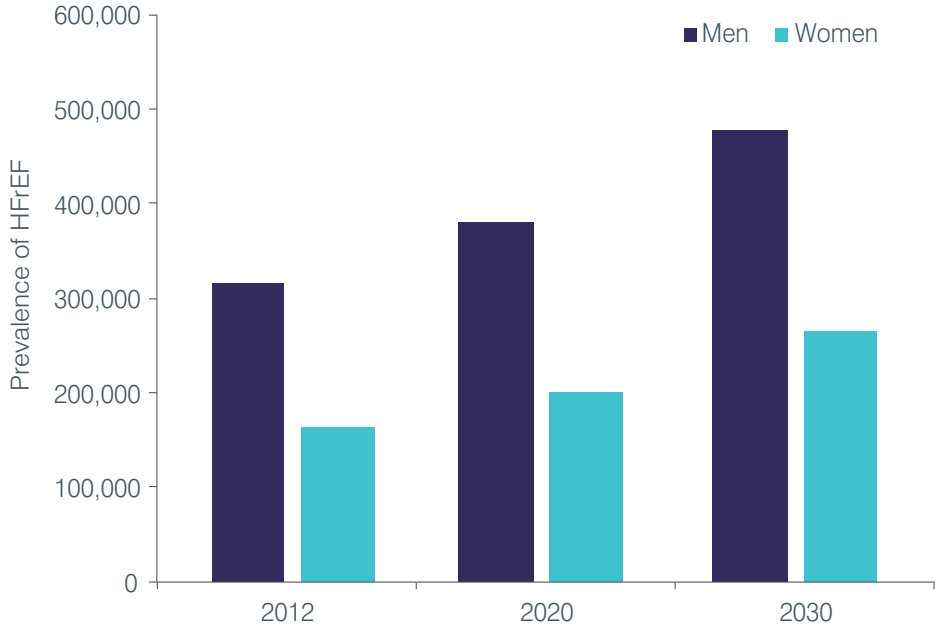


Figure 50 Current and projected estimates of prevalent cases of HFrEF according to sex

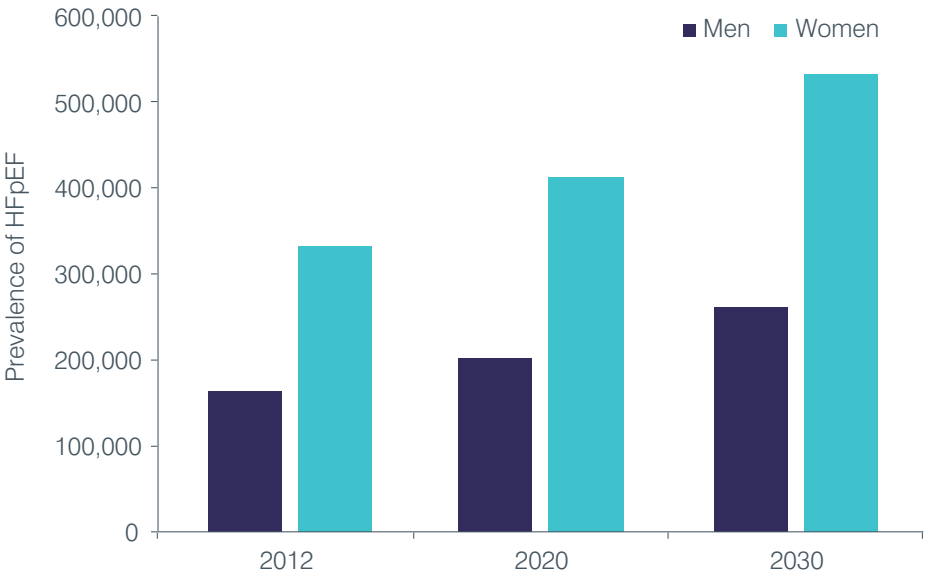


Figure 51 Current and projected estimates of prevalent cases of HFpEF according to sex

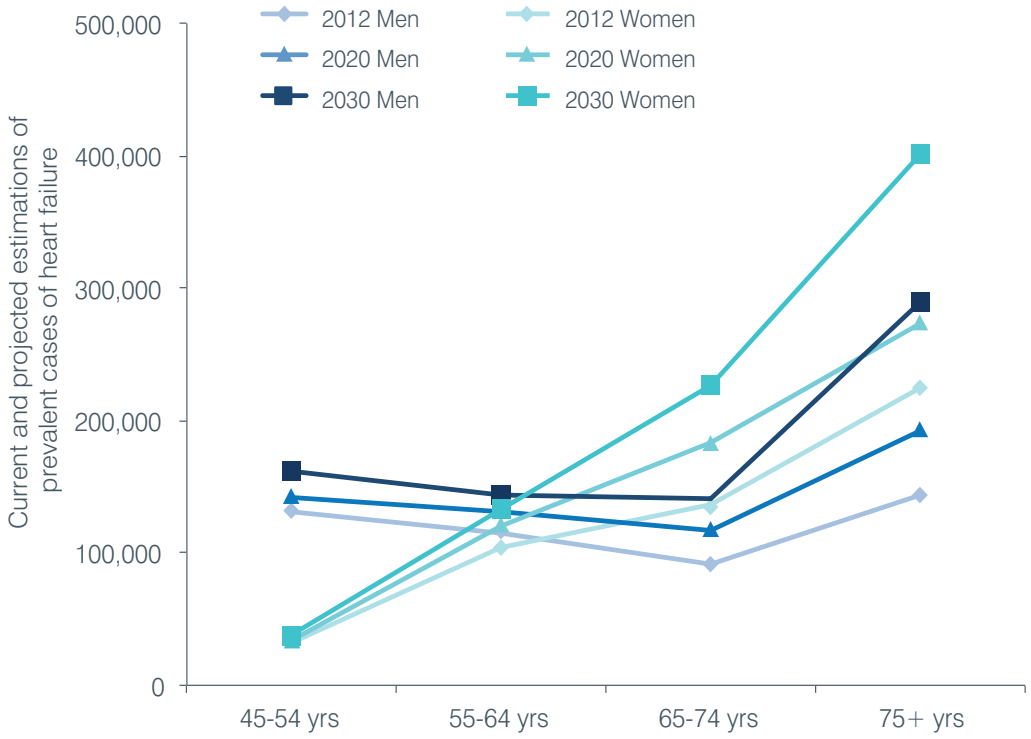


Figure 52 Projected pattern of prevalent cases of heart failure (primary or secondary diagnosis) according to sex and age categories

Without substantial and cost-effective initiatives to address high levels of antecedent risk in the Australian population, the burden of heart failure will continue to rise over the next 10-15 years. Individuals aged 75 years or more in particular (noting the dramatic rise in older women affected by heart failure) will exert an increasing and enormous burden on the health care sector during this period (Figure 52).

NT	2012	2020	2030
ALL	120	172	251
Men	77	109	153
Women	43	63	98

QLD	2012	2020	2030
ALL	5,092	6,674	8,466
Men	2,771	3,695	5,225
Women	2,321	2,979	3,241

WA	2012	2020	2030
ALL	2,566	3,917	5,107
Men	1,386	1,915	2,837
Women	1,180	2,002	2,270

NSW	2012	2020	2030
ALL	9,321	11,391	15,089
Men	4,914	6,153	8,153
Women	4,407	5,238	6,936

SA	2012	2020	2030
ALL	2,356	2,818	3,677
Men	1,220	1,504	1,967
Women	1,136	1,314	1,710

ACT	2012	2020	2030
ALL	353	466	669
Men	189	253	359
Women	164	213	310

TAS	2012	2020	2030
ALL	715	877	1,155
Men	386	485	633
Women	329	392	522

VIC	2012	2020	2030
ALL	6,945	8,666	11,798
Men	3,648	4,664	6,352
Women	3,297	4,002	5,446

All *de novo* HF hospitalisations	2012	2020	2030
ALL	27,468	34,526	47,257
Men	14,592	18,777	25,679
Women	12,876	15,749	21,578

Figure 53 Current and projected estimates of incident heart failure admissions (primary or secondary diagnosis) per annum

We predict that the annual number of *(de novo)* incident heart failure admissions will continue to rise to nearly 35,000 (in 2020) and to more than 47,000 by 2030 (nearly double the numbers in 2012).

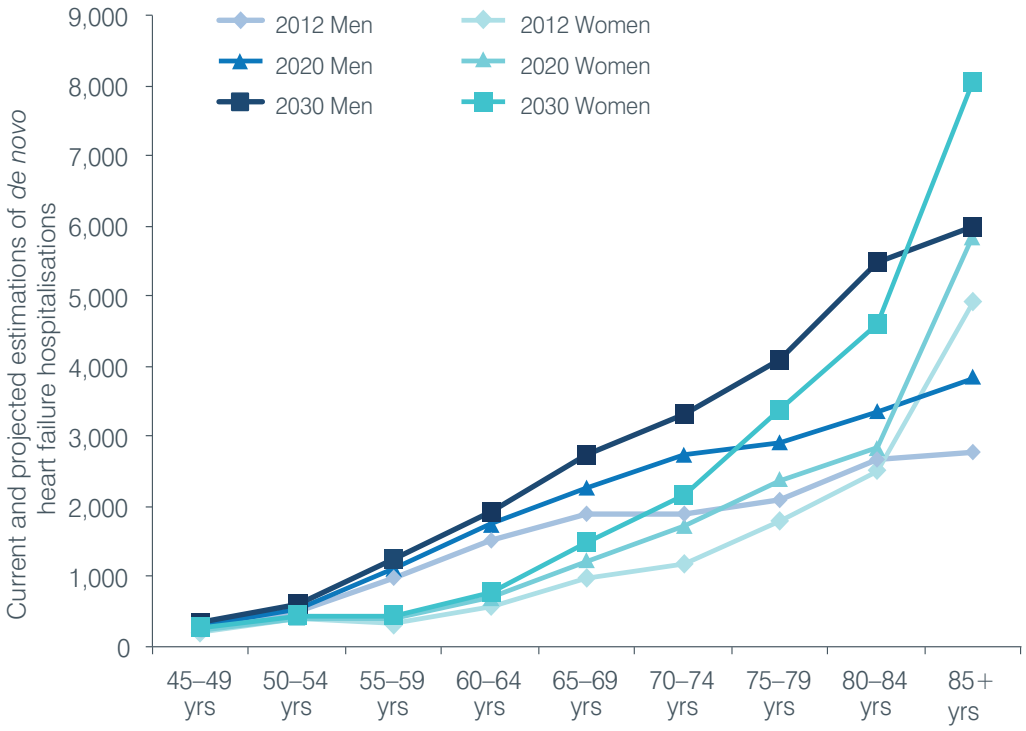


Figure 54 Projected pattern of incident heart failure admissions (primary or secondary diagnosis) according to sex and age categories

Conclusions

To the best of our knowledge this report represents the most comprehensive and contemporary assessment of the burden of heart failure in Australia. Our team have endeavoured to quantify the exact burden of disease associated with heart failure from an epidemiological, health services and health expenditure perspective. We have examined the most-recent relevant Australian-based sources of data describing the disease burden via systematic review and externally validated by an Australian panel of heart failure experts. All evidence-based data were extrapolated (where required) to the Australian health care system and whole population on an age and gender-specific basis.

What we know now...

- Each year, more than 60,000 Australians aged ≥ 45 years develop heart failure with clinically overt signs and symptoms.
- With high mortality rates more typically seen in those with advanced forms of heart failure, our data suggest a minimum prevalent population of 350,000 to 400,000 Australians per annum.
- We estimate that nearly 1 million Australians are now affected by any form of heart failure (clinically overt or latent).
- There is a disproportionally high prevalence of heart failure at younger ages in the vulnerable Indigenous communities.
- Heart failure attributes to ~150,000 hospital admissions and in excess of 1 million days in hospital per annum.
- The annual direct cost of managing heart failure in the community is close to $900 million and double that ($1.8 billion) for emergency hospitalisation.

What we predict

- The prevalent pool of chronic heart disease (including heart failure and atrial fibrillation) will continue to increase, fuelled by underlying cardiovascular risk factors including hypertension, dyslipidaemia and a new wave of diabetes and obesity.
- Within an ageing Australian population in whom cardiovascular risk factors and antecedent heart disease remains high, this already enormous burden of heart failure is likely to rise over the next 10-15 years.
- The annual number of incident heart failure admissions will continue to grow to approximately 50,000 by 2030 (nearly double the numbers in 2012).
- As many as 1.5 million Australians will be adversely affected by the syndrome in 2030 without a dramatic development in our ability to prevent it.

What we need to do

- Prevention is key – systematically screen at-risk individuals for heart failure or antecedent structural heart disease and initiate evidence-based measures to positively influence its natural history as early as possible.
- For high-risk individuals including those with hypertension, diabetes, chronic kidney disease, coronary artery disease and vascular disease, renewed efforts to prevent progressive cardiac dysfunction should be the focus of research efforts and preventative health care programs.
- Apply/optimise proven strategy of heart failure management including 'gold-standard' therapeutics, devices, tele-monitoring and nurse-led multidisciplinary program of care that can cost-effectively improve outcomes in heart failure.
- Without a dramatic change, more older and sicker Australians will develop this deadly and disabling syndrome – it represents an enormous detrimental public health problem now and for the foreseeable future.
- We hope our report succinctly highlights a critical public health issue and can influence the thinking of governments and health authorities around a more coordinated and systematic strategy (from optimal prevention to cost-effective management) to combat the individual and societal impact of heart failure.

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