Hidden Hearts

Report Title: **Hidden Hearts: Cardiovascular Risk and Disease in Australian Women**

Principal Investigator: Professor Simon Stewart

Research Team: Dr Lei Chen
Dr Yih-Kai Chan
Dr Yasmin Ahamed
Dr Jocasta Ball
Ms Ashley K Keates
Ms Ja'Shondra Pouncy
Professor Maja-Lisa Løchen
Professor Garry Jennings
Professor John Atherton

Photography/Design: Ms Gabriela Ruberto / Ms Ashley K Keates

Any enquiries should be directed to:

Professor Simon Stewart

Director of the NHMRC Centre of Research Excellence to Reduce Inequality in Heart Disease & Inaugural Director of the Mary MacKillop Institute for Health Research, Australian Catholic University, Level 5, 215 Spring Street Melbourne, Victoria 3000 Australia

T 0438 302 111

E simon.stewart@acu.edu.au

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Executive summary/Key findings

In the absence of a true appreciation of the burden and impact of cardiovascular disease (CVD) among Australian women, coupled with a lack of consistent, Australia-wide data, we compiled this report. Using the best available information, we reveal a number of key figures that should concern all Australians:

- The five most common forms of CVD are highly prevalent in Australian women aged 35 years and over with **410,000**, **177,000** and **162,000** affected by coronary artery disease (CAD), the form of heart failure (HF) most commonly linked to CAD and atrial fibrillation (AF), respectively. An additional minimum of **90,000** and **30,000** women are hospitalised due to stroke and peripheral artery disease (PAD), each year.
- In 2016, **21,000**, **14,000**, **19,000**, **12,000** and **3,000** Australian women will have suffered their first hospital admissions with CAD, HF, AF, stroke and PAD, respectively – see **Figure 1**.
- Tragically, approximately **3,400** Australian women each year will suffer a sudden and fatal cardiac event without ever reaching hospital.
- Every year, these five conditions provoke a minimum of **260,000** (CAD), **73,000** (HF), **122,000** (AF), **90,000** (stroke) and **30,000** (PAD) hospital admissions among Australian women – see **Figure 1**.
- Even with hospital treatment all forms of CVD are deadly and disabling with one in nine (**2,200**) women admitted for the first time with CAD dead within 28-days, and more than one third admitted for the first time with HF or stroke dead within 12 months.
- The annual estimated cost of hospital care for the most common forms of CVD among Australian women alone is more than **$3 billion**.
- Within an ageing population in whom levels of most risk factors are at historically high levels, the burden of CVD among Australian women is set to increase for the foreseeable future.
- There is still much to be learned in best preventing and treating CVD in Australian women; particularly in vulnerable individuals/communities.

Recommendations

Our *Hidden Hearts* report highlights a number of compelling issues surrounding what should be prioritised as one of the most critical (if not the most significant given the lack of attention to date) health issues for Australian women. In response we recommend consideration of the following:

- **Raise Awareness of CVD Campaign**: Building on existing national and international initiatives, a renewed campaign to elevate awareness of the risk and impact of CVD (with a particular focus on correcting the common misperception that CVD is mostly confined to men).
- **Definitive Studies of Cardiovascular Risk and CVD in Australia**: A critical lack of urgency around CVD in women, in part at least, is reflected in the lack of consistent and accurate information around the burden of disease: noting CVD costs >$3 billion per annum. As previously recommended (*2015 Rediscovering Heart Failure Report*) more definitive studies of cardiovascular risk and disease in Australia will help guide cost-effective prevention, treatment and management programs.
- **Expert Guidelines**: Much of the evidence to prevent and treat CVD is male-centric. Urgently needed updates of guidelines for treatment of the most common forms of CVD could incorporate special consideration (and education) of the prevention and management of CVD in women.
- **CVD Prevention and Management Programs**: There are a range of management programs for CVD (notably chronic heart disease) that are particularly suited to cost-effectively improving outcomes for affected women (who often struggle to attend existing medical services). Many programs are subject to fickle funding or not funded at all in some areas.

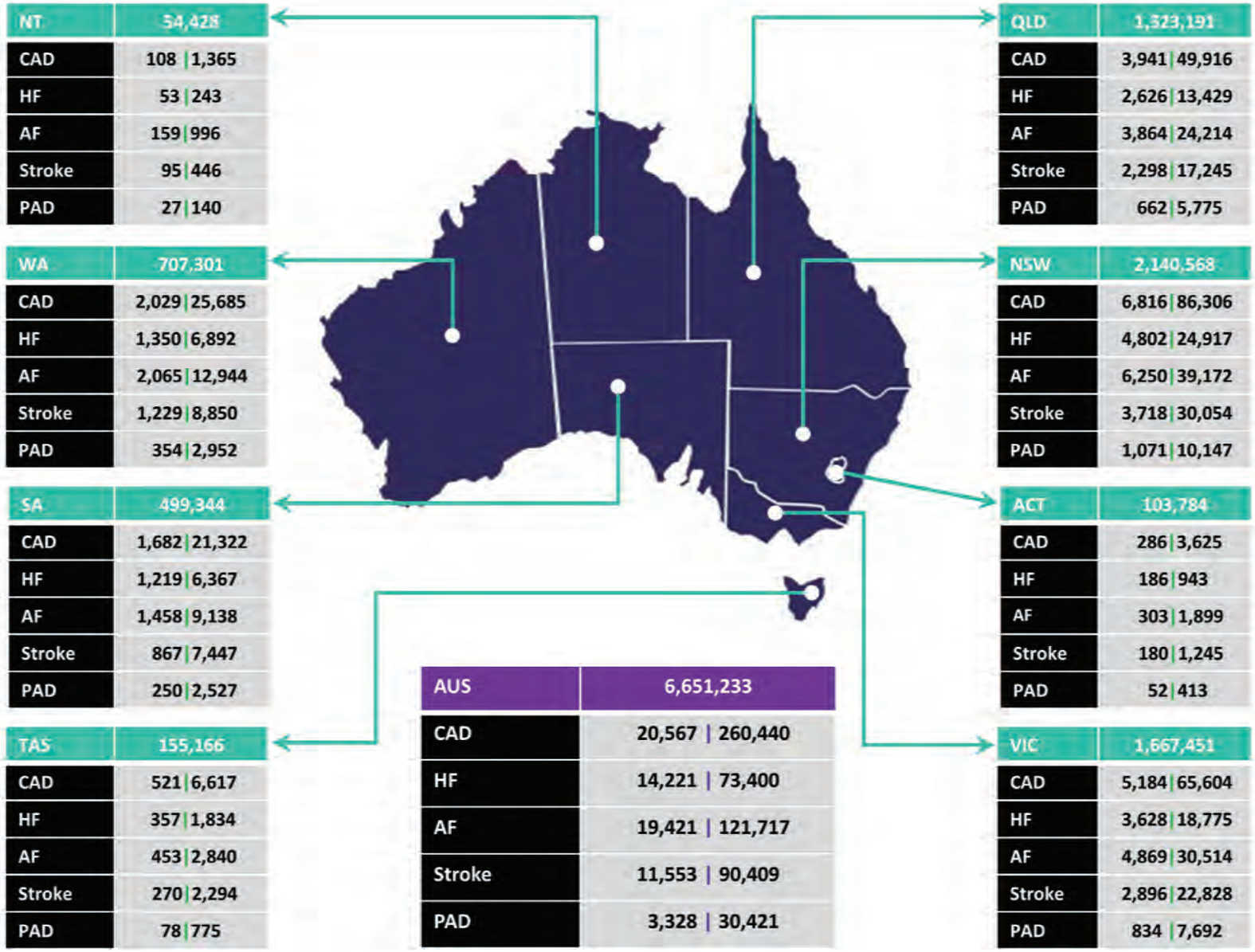


Figure 1: New and all cases of CVD-related hospitalisation among Australian women aged 35 years and over – as at June 30th, 2016

Introduction

Cardiovascular Disease (CVD) refers to all diseases and conditions affecting the heart and blood vessels. In Australia, the most common form of CVD is Coronary Artery Disease (CAD – leading to heart attack). Increasingly more common forms of heart disease closely linked to CAD and hypertension (HT - uncontrolled high blood pressure) include: heart failure (HF) and atrial fibrillation (AF). The other major forms of CVD (beyond heart disease) are cerebrovascular disease (leading to stroke) and peripheral artery disease (PAD– causing pain in the extremities due to lack of blood circulation).

Most forms of CVD are highly preventable. [1-3] As such, there are known modifiable risk factors that need to be addressed and controlled in order to prevent or delay the onset of CVD. These key risk factors are outlined in the **Results**. However, we cannot accurately predict when a potentially devastating cardiovascular event will happen; noting that many individuals have no warning signs before they suffer an event or ignore those warning signs due to lack of awareness.

On a historical basis the relative importance of CVD as a cause of death and disability (i.e. proportion of people affected) has declined over time. Reaching its peak in the late 1960s and 1970s, deaths from CVD have declined by three quarters. [4] Despite this impressive decline (due in part to many new primary and secondary prevention initiatives), CVD still imposes an enormous burden on the Australian population and health care system. This burden applies equally to men and women alike.

The key question, of course, is how big is this burden in Australia? - i.e. how many people are affected, how many hospital admissions and how many deaths are the result of CVD? Unfortunately, there is no simple answer to these questions.

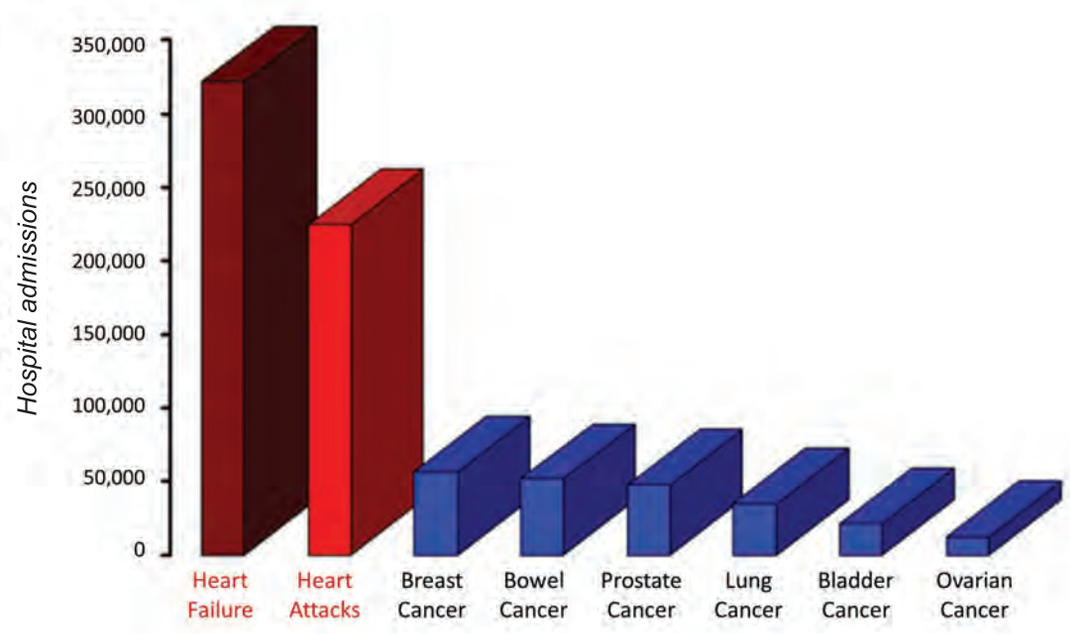


Figure 2: First-ever admissions for cancer (blue) versus heart disease (red) in Sweden (1998-2004)

Consider **Figure 2**, it presents highly accurate data generated from the whole population of Sweden over a decade using data that links the number of individuals to their first hospital admission (for the most common forms of cancer versus heart disease). [5] Overall, this study showed that contrary to popular belief, the number of men and women being hospitalised for these two heart conditions (HF and heart attacks) is much higher than the common forms of cancer. Moreover, with the exception of lung cancer, survival rates (over 5 years) favoured the common forms of cancer; both for individuals and society overall in terms of total lives and premature life-years lost.

Can we replicate such accurate and informative data about one of Australia's biggest health problems?

The simple answer is no! A broad range of countries, including New Zealand, have the capacity to generate such information – thereby identifying key health priorities for action.

FACT 1: Despite its importance to our individual and collective health, when we talk about the enormous burden CVD imposes on Australia, much of the information used to describe that burden is self-reported, second-hand and/or fragmented.

The challenge of women and heart disease in Australia: do we know and care enough?

Despite the best attempts of many prominent individuals and organisations such as the National Heart Foundation of Australia, the majority of Australian women (and indeed men) are under the false impression that heart disease and stroke are largely confined to (middle-aged) men. The recent release of (and media reaction to) the *2016 Jean Hailes for Women's Health Annual Survey* on Australian women's greatest health fears and concerns highlights an alarming lack of concern about CVD in women in particular. Overall, the top health concerns were weight management (23%), cancer (17%), mental/emotional health (15%), menopause (9%) and chronic pain (8%). [6]

Do we have reliable indicators to suggest Australian women should care more about CVD?

As highlighted by **Figure 3** which represents the 20 leading causes of death in Australian women in 2013 (Australian Institute of Health and Welfare [AIHW] data) [7] there are some data that show a stark contrast between perception and reality in regards to women's health. As expected, the common cancers were and will remain so for the foreseeable future, a major cause of death among Australian women; contributing to around ***12,000 deaths*** (17% of all deaths – blue segments) per annum. In comparison, however, ***20,000 deaths*** (27%) were attributable to the most common forms of CVD (red segments). Moreover, CVD is often closely linked to the development of Alzheimer's disease/dementia, diabetes and kidney failure; an additional ***11,000*** **deaths** (15%). As will be described later (particularly regarding CAD-related deaths) these figures are likely to under-estimate the true contribution of CVD to the total number of deaths among Australian women each year.

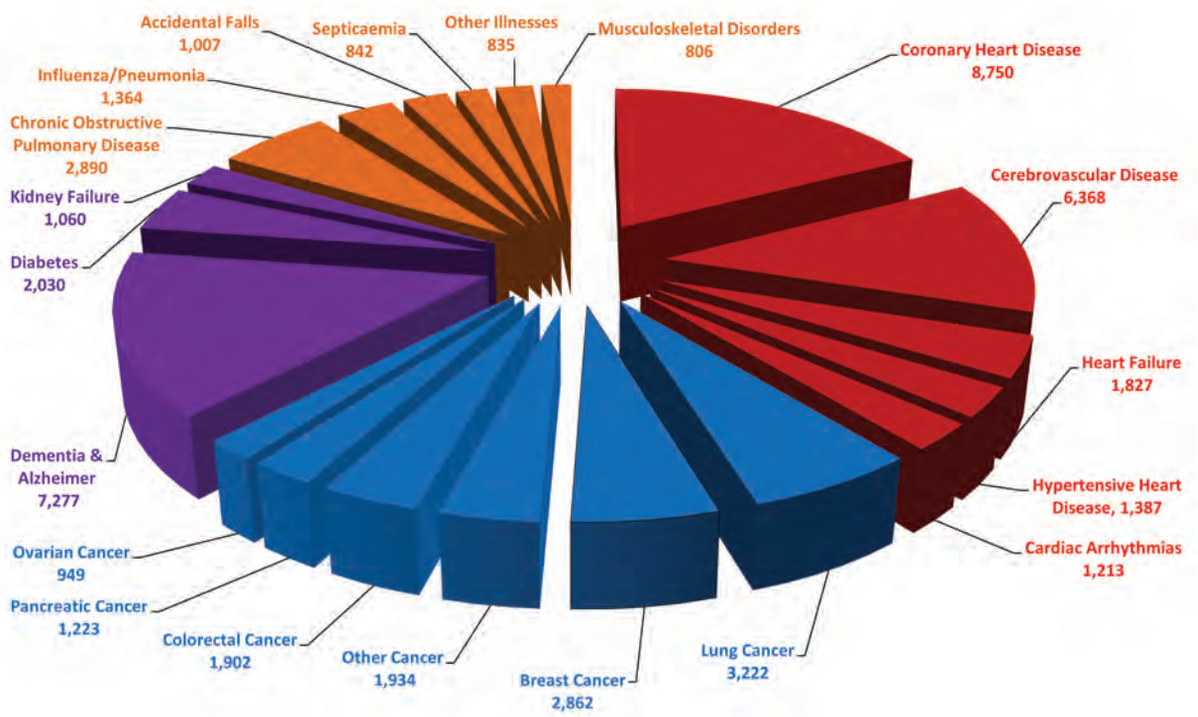


Figure 3: Top 20 causes of death in Australian women (2013) [7]

While these figures do not contradict genuine fears around cancer (particularly those occurring in younger women), they do contradict the common misperception that CVD (particularly heart disease) is a "man's" disease only.

FACT 2: There is a fundamental "disconnect" between the public, political and popular (media) perception and reality of women's health concerns in respect to CVD.

Purpose of the "Hidden Hearts" Report

As noted in the **Introduction**, three critical aspects around the burden and potential impact of CVD in Australia require careful consideration:

There is simply not enough detail and consistency around the data describing the burden of CVD in Australia (i.e. we do not have the same sophisticated systems and levels of surveillance as our international counterparts) to inform the public, politicians and popular consciousness overall (including the media) of the scale of the problem.

A lack of public awareness and consciousness around CVD (particularly in women) means that we have become too complacent in prioritising the most common cause of death in Australian women from an individual to public health perspective.

An ageing population in whom risk factors are at historically high levels means that CVD (in both men and women) threatens to overwhelm our health care systems in the near future.

In response to the above, this report has three simple objectives:

1. To quantify, where possible using the best but most conservative information possible, the likely burden of CVD in Australian women;
2. To identify the key priorities for revealing and responding to the hidden burden of CVD in Australian women; and
3. In the process of delivering the results of our investigation into the burden and priorities surrounding CVD in Australian women, raise awareness around this important health issue and make key recommendations for action.

Hidden Hearts builds on a series of reports focussing on various aspects of the heart health of Australia (**Figure 4**). In particular, *Hidden Hearts* represents a logical extension to our last report presented to the attendees of the "*Rediscovering Heart Failure*" Parliamentary Lunch and Summit in Canberra conducted in October 2015. In that report we identified the need to: **1)** recognise HF as a major health problem for men AND women in Australia; **2)** undertake a definitive epidemiological study of HF and other forms of CVD in Australia and; **3)** Revisit the need for sustainable funding of HF management programs/health services that make a difference for the hundreds of thousands of Australians adversely affected by the syndrome.

Our previous reports

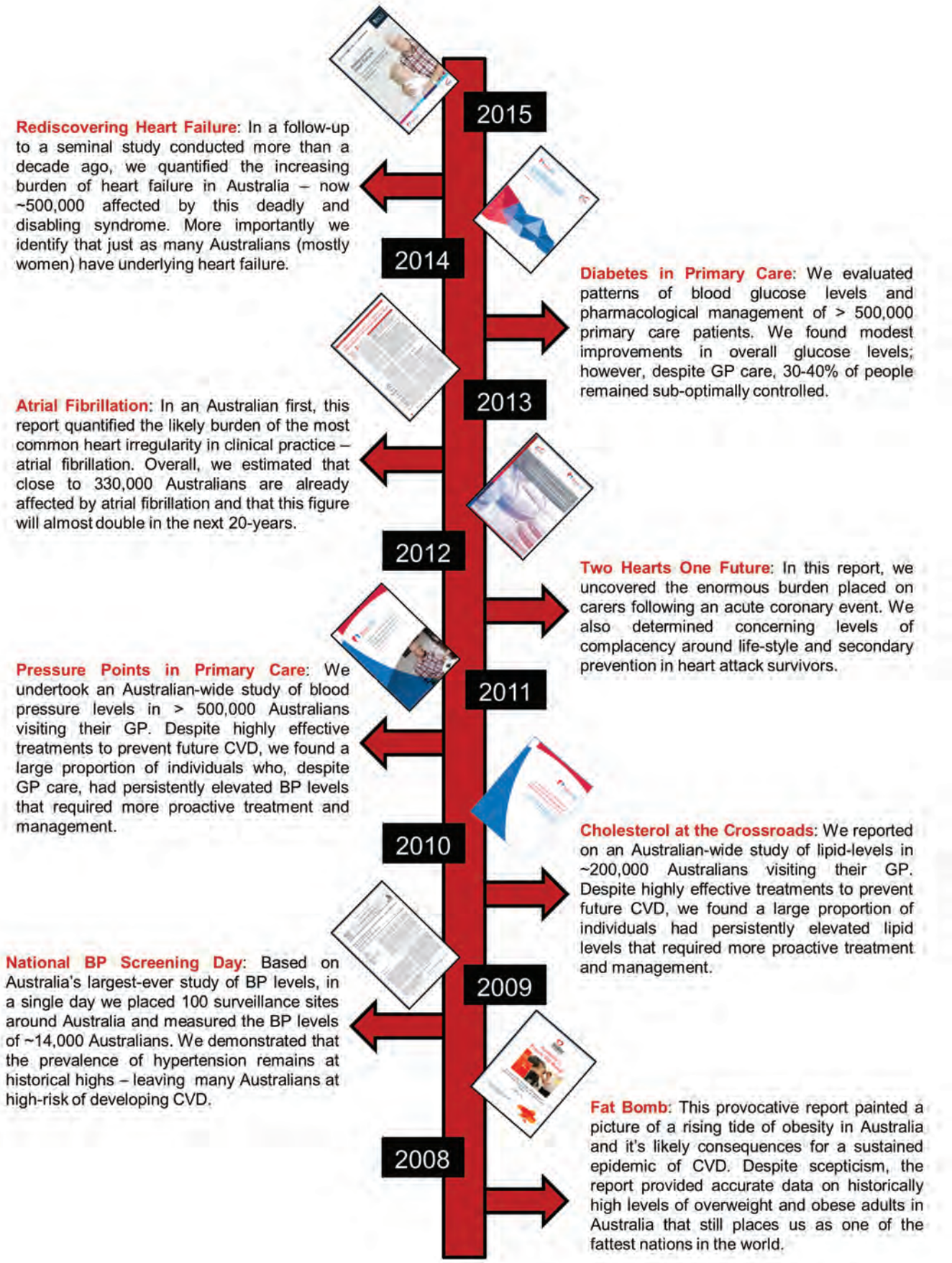


Figure 4: A series of reports examining critical aspects of the heart health of Australians

Report structure

In aiming to reveal the "hidden hearts" of Australian women imposed by CVD, this report provides five distinct sections that underpin the **Executive Summary** and our **Key Recommendations** for action:

- Australia's evolving/ageing population profile.
- Historical trends in the cardiovascular risk profile of Australian women.
- For each of the five major forms of CVD identified (see below) a conservative set of estimates focussing on the number of new and overall cases for hospitalisations associated with that condition (on a State-by-State basis) in addition to indicative figures on the likely number of women affected overall (i.e. whole community estimates) and related deaths.
- The estimated economic cost and future burden of CVD.
- Specific commentary on the management of CVD in women and the pattern of CVD among Australian Indigenous women.

The five most common forms of CVD in Australia

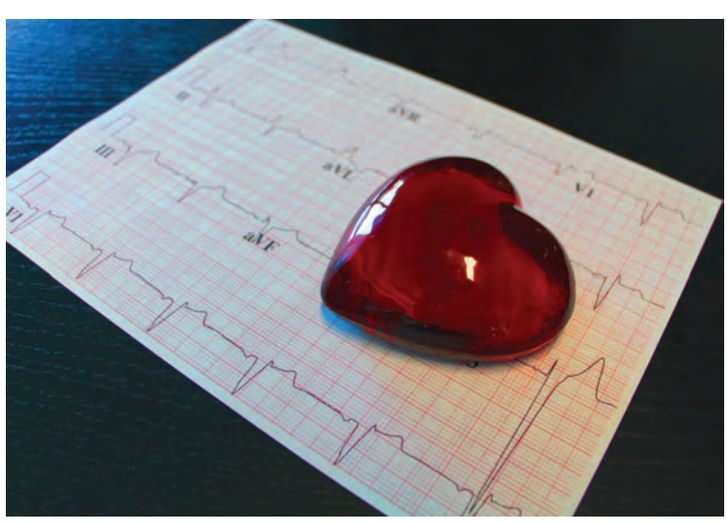
Coronary artery disease (CAD): Is caused by blockages in the blood vessels (coronary arteries) supplying the two main muscles/chambers of the heart (the left and right ventricle). These blockages (known as atherosclerosis or coronary plaques) are closely linked to saturated fat-rich diets and high cholesterol levels. The lack of blood supply can lead to immediate death (sudden cardiac arrest), life-threatening damage to the heart muscle (heart attack/acute myocardial infarction/acute coronary syndrome) or ongoing damage and disability (unstable angina); particularly when a blood "clot" forms in an artery supplying blood to a critical (or large area) of the heart. For our main estimates of the number of women affected by this condition, we report on those hospital admissions where CAD is listed as the primary diagnosis (reason for hospitalisation) only. In addition to these common conditions, there are other conditions that have been traditionally under-diagnosed, but are more common in women (i.e. coronary artery dissection). [8]

Heart failure (HF): Commonly mistaken for heart attack, HF is mainly a chronic condition that is caused by a structural or mechanical inability of the heart to properly pump or relax and therefore supply the rest of the body with sufficient blood supply. The most common causes of HF are CAD and HT. HF comes in two major forms – the first known as HF with a reduced ejection fraction (HFrEF) is mostly associated with heart attacks and occurs more commonly in men. The second form, known as HF with preserved ejection fraction (HFpEF), is more commonly found in older women and associated with uncontrolled HT. Both forms of HF are disabling and deadly. Additionally, although under-diagnosed, a rarer form of HF, Takotsubo cardiomyopathy more commonly occurs in women (90% of cases). [9] For our main estimates of the number of women affected by this syndrome, we report on those hospital admissions where HF is listed as the primary and or contributory (secondary) diagnosis; noting that it is not always coded as the primary reason for admission.

Atrial fibrillation (AF): A fast and irregular heartbeat affecting the top two chambers of the heart (the right and left atria), AF is very closely linked to CAD, HF and stroke. In a classic case of "chicken or the egg" AF is commonly found in individuals who present with a stroke and it is difficult to determine which came first. However, AF is one of the most common and preventable risk factors for stroke. It is found in one in twelve Australians aged 65 years or more (rising to one in five in those over the age of 80 years). For our main estimates of the number of women affected by this condition, we report on those hospital admissions where it is listed as the primary and secondary diagnosis; noting that AF is not always coded as the primary reason for admission.

Cerebrovascular disease: This condition is primarily caused by blockages in the blood vessels supplying the brain; mimicking the same process of atherosclerosis (fatty plaques) that is closely linked to high cholesterol levels. The lack of blood supply can lead to the brain equivalent of a "heart attack" (ischaemic stroke). A second, rarer but more deadly form of stroke is caused by bleeding from weakened vessels in the brain (haemorrhagic stroke). This second form of stroke is mainly caused by uncontrolled HT. Both forms of stroke can cause severe disability and death without timely treatment. For our main estimates of the number of women affected by this condition, we report on those hospital admissions where stroke is listed as the primary diagnosis only.

Peripheral artery disease (PAD): Commonly caused by blockages in the key vessels supplying blood to organs other than the heart and brain (e.g. the kidney and the limbs); it's most common presentation being a critical lack of blood supply to the feet requiring amputation if treatment is not received. It can also manifest as a malformation and subsequent rupture/bleeding of one of the main blood vessels of the body closely linked to uncontrolled HT (an aortic aneurysm) that is deadly if left undetected and untreated. PAD is commonly referred to as the Cinderella of CVD (a term previously reserved for HF) given that awareness of the condition is very low; in many individuals it remains undetected despite a relatively easy and non-invasive method for diagnosing it. For our main estimates of the number of women affected by this condition, we report on those hospital admissions where PAD is listed as the primary diagnosis only.



Methods

In spite of a series of reports routinely released by AIHW that provide key statistics around the health of Australians – including the causes of death summarised in **Figure 3**. A key assumption, as with many official reports, is that these are "concrete" figures that cannot be challenged and reflect actual data. Unfortunately, as highlighted by **Fact 1**, much of the health data describing the burden of CVD in Australia is largely derived from a number of disparate/fragmented sources – many of which are historical and rely on self-report. For example, many people do not know they have "heart failure" and/or mistake the term for "heart attack". And yet many of the estimates of HF in Australia rely on self-report. Moreover, from an administrative perspective, HF is rarely identified as a "cause of death" despite being the primary reason for a premature death in those who develop the syndrome. Until Australia invests in a definitive study of the epidemiology of CVD – a key recommendation of our previous reports including the *Rediscovering Heart Failure Report* – much as it did in undertaking the seminal AusDiab Study (now over a decade old) to define a decade of investment in preventing and managing diabetes, [10, 11] we have to rely on the best available sources (within and outside of Australia) to estimate its burden. Fortunately, resources such as the WA Data Linkage System [12-21] and the 45 and up Study [22] that has many of the same features used to generate the Swedish information highlighted in **Figure 2** are available for this purpose.

Investigational strategy: In order to derive robust and accurate estimates of the current (and future) burden of CVD in Australian women, we applied a combination of population statistics (from the Australian Bureau of Statistics [ABS]) with the best available and validated epidemiological and clinical data-sets. Age standardised rates were calculated by direct method using the standard population and age distribution of the Australian resident population.

Data sources: The following criteria were applied to selecting data (with key input from experts in the field of cardiovascular research) – see **Table 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 after due consideration by the authors relative to those used in previous reports (**Figure 4**).

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.

Data management & analyses: All study data were managed by the Data Management Group at Mary MacKillop Institute for Health Research using standard operating procedures. All analyses were supervised by the Principal Investigator. 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. The study was performed according to the ICH Harmonized Tripartite

Guidelines for Good Clinical Practice. 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.

The 2011 Census of Population & Housing: Population estimates for June 30th, 2016 were applied (**Figure 5**). At the broadest level, all key parameters to outline the burden of CVD are presented on an age and sex-specific basis for the total population. Outputs from the Census/Population estimates are organised into a number of regions including: *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.[23] For the purpose of this report we applied a combination of these areas on a State-by-State basis (minimal level *Greater Capital City Statistical Areas*) to describe the geographical distribution of the CVD conditions of interest on an age and sex-specific basis.

Calculating hospital care costs: We used data from the National Hospital Cost Data Collection (NHCDC) Australian Public Hospitals Cost Report 2013-2014 Round 18 [24] to estimate the indicative (conservative) hospital cost burden of the five major forms of heart disease in Australia women. The average cost of a hospital admission for CAD (diagnostic-related group [DRG] F66A, F66B, F66C and F66D), HF (DRG F62A, F62B and F62C), AF (DRG F76A, F76B and F76C), Stroke (DRG B70A, B70B, B70C and B70D) and PAD (DRG F65A and F65B) was $3,380, $8,344, $4,118, $10,657 and $5,130, respectively.

Study/methodological limitations: The most recent Australian National census data was collected on August 9th, 2011 when Australia's population was at 21,507,717. An updated estimate of the Australia's population as at June 30th, 2016 was 24,359,761. As described in noting the caveats surrounding the interpretation of Australia's set of reports describing the burden of CVD, we would emphasise the equivalent caveats in relying upon and interpreting the data contained in this report. However, we have aimed to provide the most reliable and conservative figures possible, whilst re-emphasising the need to generate definitive data via a prospective, Australia-wide study of CVD.

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Independent Hospital Pricing Authority 2016. National Hospital Cost Data Collection (NHCDC) Australian Public Hospitals Cost Report 2013-2014 Round 18. Retrieved August 2016, available from https://www.ihpa.gov.au/publications/australian-public-hospitals-cost-report-2013-2014-round-18

Results: Australia's population profile

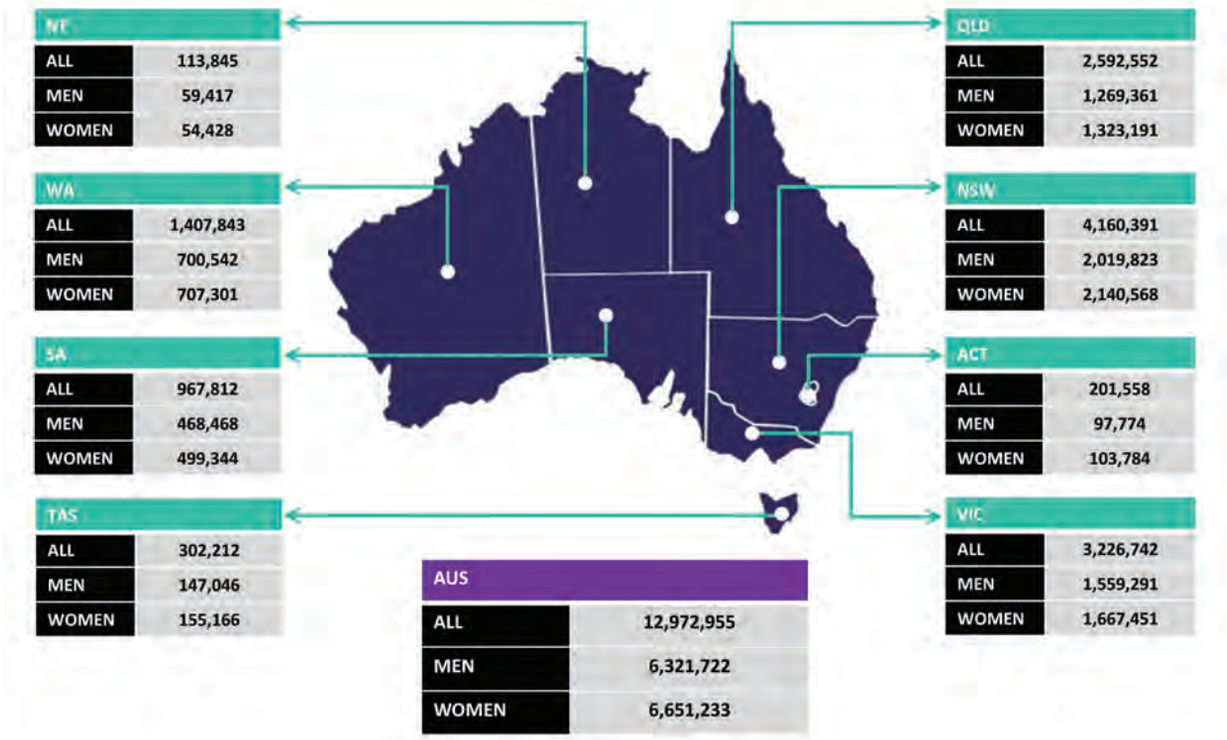

Figure 5: Australia's estimated population aged 35 years and over – as at June 30th, 2016

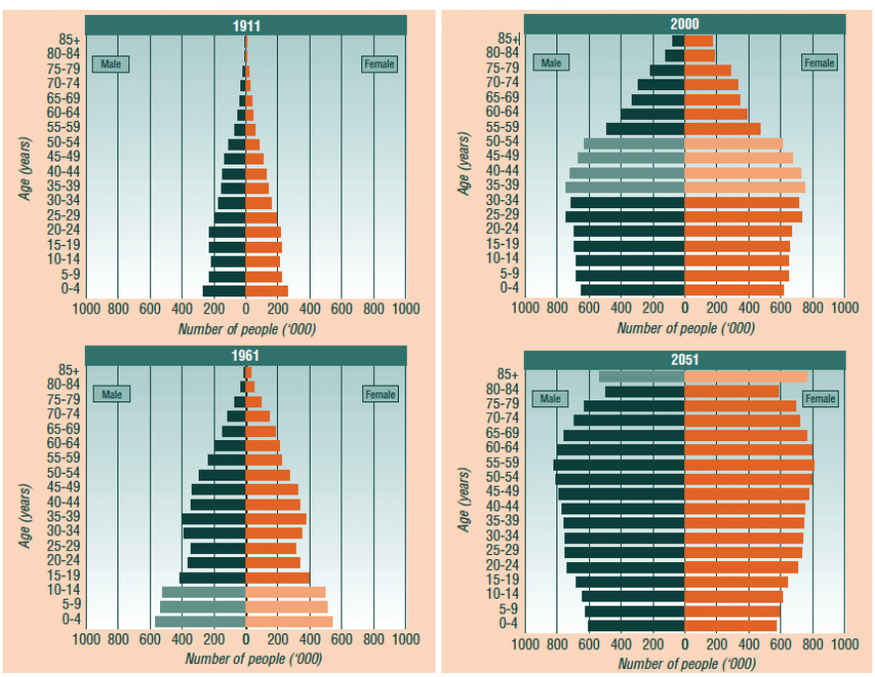

Figure 6: Australia's past, present and future population profile [46]

The disappearing population pyramid: Australia's population is growing and ageing in equal measures; with a greater influx of immigrants, slightly higher birth rates, prolonged longevity and, critically the Post-War Baby Boomer generation becomes progressively older (**Figure 6**). [46]

FACT 3: The most fundamental driver of CVD in Australia is its ageing population. Even as the rate of CVD declines, the number of men and women reaching the age of most risk of developing CVD is increasing.

Results: Risk of CVD in Australian women

Seminal population studies such as the Framingham Study in North America [47] have identified the key risk factors (e.g. smoking, HT and high cholesterol levels) that continue to feed an epidemic of CVD in high-income countries including Australia. For men and women separately, simple risk profiling that takes into account the individual's age (noting the natural history of CVD is biologically different and delayed in women until the onset of menopause [48]) can be fed into an "Absolute CVD Risk Calculator"- the Australian, online version is available at - http://www.cvdcheck.org.au/. This calculator provides a reasonably accurate prediction of an individual developing two of the main forms of CVD (CAD or stroke) based on a "whole" assessment of their sex, age and number of risk factors: from low to medium to high risk of developing CVD within the next 5-years. Unfortunately, to our knowledge, Australia lacks sufficiently detailed risk profiling of the Australian population to report on this important indicator of health. We instead, provide the best available historical and contemporary data on the individual indicators of risk among Australian women.

Sedentary behaviours: are closely linked to other CVD risk factors such as obesity, type 2 diabetes, high cholesterol and HT. These behaviours are associated with an increased risk of all-cause and CVD-related death. Overall, studies (including the most recent National Health Survey (NHS) [26] suggest that Australian women are more likely to be physically inactive or insufficiently active compared to men. In 2014-15, nearly one in three Australian women aged ≥18 years were insufficiently active (undertaking less than 150 minutes of moderate physical activity per week) and 17.2% reported no exercise at all. [26] Women face numerous barriers (e.g. body image, lack of time, caring responsibility) to being physically active and this represents a major health issue (**Figure 7**) and challenges to address high levels of risk for CVD and to maintain optimal general health.

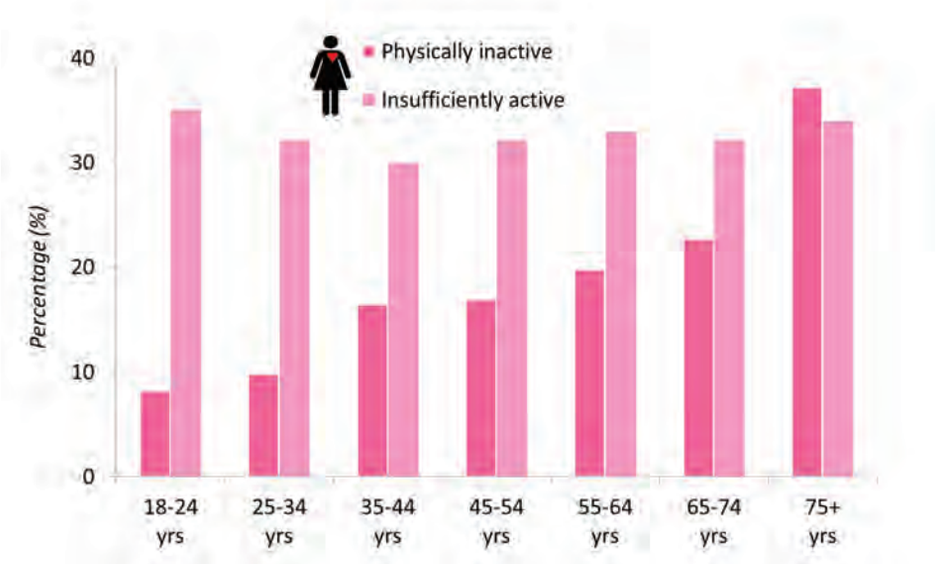

Figure 7: Proportion of Australian women who are physically inactive or insufficiently active according to age categories (2014-15 NHS)

The obesity crisis: An inevitable consequence of our collective appetite for excessive food consumption/fatty diets and sedentary behaviours, and a major component of the future cardiovascular risk of Australia's population is its increasingly obese profile. Fortunately, this trend has plateaued with around one in four adults being obese (body mass index [BMI] ≥30 kg/m^2) and around two-thirds being overweight (BMI 25.0-29.9 kg/m^2) (**Figure 8**). Excess body fat is the fourth largest contributor to the burden of CVD and is closely linked to the development of type 2 diabetes and HT. [49]

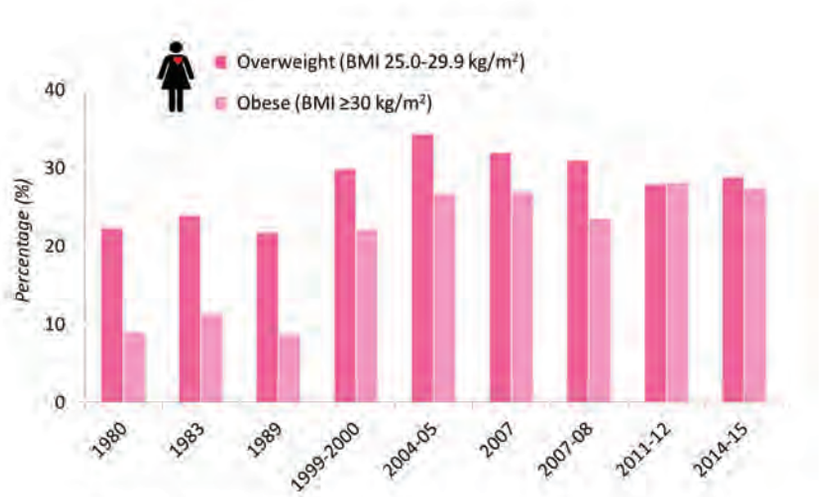

Figure 8: Historically high levels of being overweight or obese in Australia [10, 11, 25, 26, 29, 32, 50]

Declining smoking rates: Smoking has long been known to damage blood vessels and promote blood clots and is one of the biggest contributors to preventable CVD-related events and deaths globally. [49] Fortunately, the campaign to increase the cost of smoking and reduce its attractiveness through plain packaging and health warnings is working. Accordingly, in contrast to our expanding waistlines, fewer Australian women are smoking each year (**Figure 9**); with recent figures suggesting 12.1% of Australian women currently smoke and with fewer first-time smokers than ever before. [26]

Figure 9: Prevalence of smokers in Australian women from successive national house-holds surveys [26, 31]

Fatty diets and lipid levels: Elevated (abnormal) levels of damaging fats in our blood vessels contribute to the plaques/blockages that restrict the amount of blood being supplied to critical organs such as the heart and brain. These blockages promote blood clots that can completely cut-off blood supply to the affected area. Although self-reported dyslipidaemia in the Australian population is very low, national surveys consistently suggest that between 40-50% of adults are at high-risk of atherosclerosis due to abnormal lipid levels, which is defined as having total cholesterol ≥5.5 mmol/L, high density lipoprotein (HDL) cholesterol <1.3 mmol/L (women), low density lipoprotein (LDL) cholesterol ≥3.5 mmol/L or triglycerides ≥2.0 mmol/L. As shown by data derived from the 2011-12 NHS (**Figure 10**), a significant proportion (>55%) of Australian women have at risk blood lipid levels irrespective of treatment. [28]

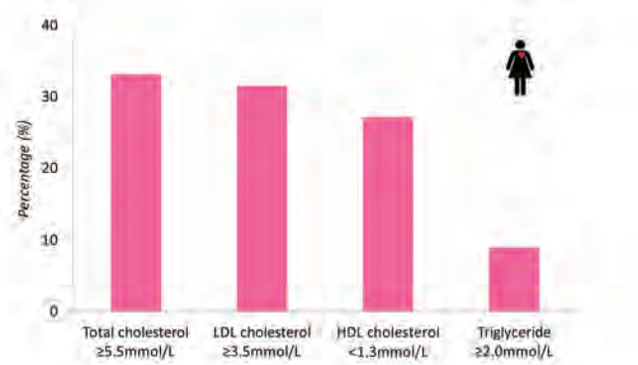

Figure 10: Proportion of Australian women with at risk lipid level (2011-12 NHS)

Hypertension: as blood pressure rises, the heart has to work harder to circulate blood. The walls of the blood vessels become damaged leaving them vulnerable to plaques. HT is now the largest contributor to the burden of CVD in Australia. Data from the 2011-12 NHS showed that 29.1% of Australian adult women were either being treated for HT or had uncontrolled elevated blood pressure (**Figure 11**). [27] Notably, these figures are more favourable than previously reported and discordant with a very large study of blood pressure levels in primary care (>500,000 Australians) showing persistently high levels overall. [51] Pregnant mothers can develop pre-eclampsia, pregnancy induced hypertension, during their second trimester and this increases CVD risk in both the mother and pre-term infants. [52] Pre-eclampsia affects up to 5% of pregnancies and its risk is increased two to four-fold among women with type 1 or type 2 diabetes. [53]

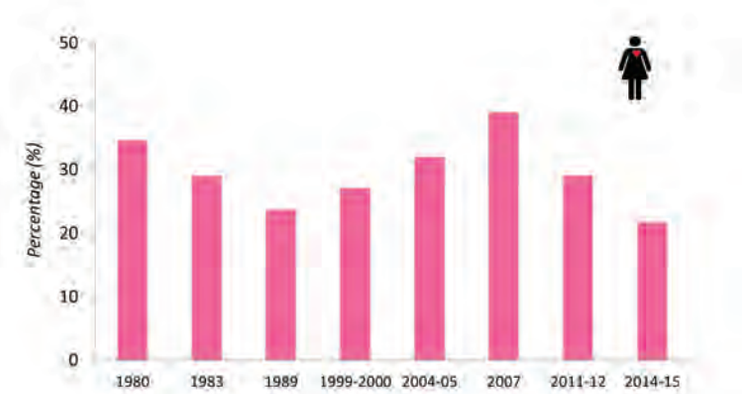

Figure 11: Reported prevalence of hypertension in a series of national studies between 1990 and 2015 [10,11, 25-27, 50]

Diabetes: The AusDiab Study was instrumental in uncovering the rising health risk of metabolic disorders and type 2 diabetes in Australia. [10, 11] Type 2 diabetes is closely linked to a rising tide of sedentary behaviours and obesity. Persistently high levels of glucose/sugar in the blood cause damage to the blood vessels and key organs. 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 (a marker of average blood sugar levels in the previous three months, an HbA1c of 6.5% is recommended as the cut-point for diagnosing diabetes) remain high and relatively unchanged at around 7.0% between 2005 and 2013 (**Figure 12**). [30] This places affected individuals at very high-risk of developing all forms of CVD [30]. Data from the 2011-12 NHS also showed that around 4% of Australian women were diagnosed with type 2 diabetes (based on self-report history and/or having elevated fasting glucose or HbA1c). A further 5.3% of Australian women had pre-diabetes, which was defined as an HbA1c level of ≥6.0% and <6.5%. [28] In addition, women with gestational diabetes have excess CVD risk. [52] Post-pregnancy blood glucose levels usually return to normal. Despite this, there is still an increased risk of both the mother and child developing type 2 diabetes in the future.

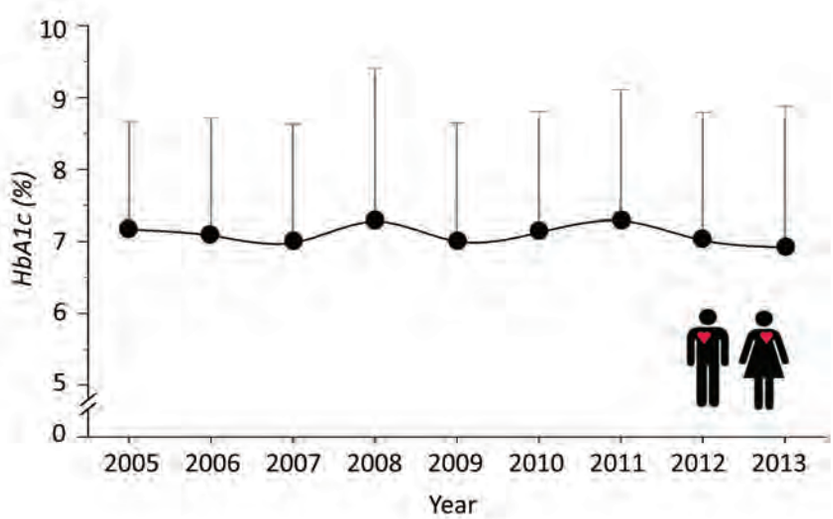

Figure 12: Average annual HbA1c levels between 2005 and 2013

A mixture of mainly bad but some good news: Apart from highly encouraging trends in respect to smoking levels, there is a real prospect that in both Australian men and women, historical declines in nearly all forms of CVD, with improved survival rates for those fortunate to survive to hospital care, will be reversed due to historically high levels of sedentary behaviours, obesity, HT, dyslipidaemia and the development of early forms of CVD (including diabetes).

FACT 4: Australia's fragmented health profile studies and reports lack the coordination and detail to provide accurate information on the "absolute risk" profile of Australian men and women that takes into account the impact of multiple risks.

Results: CVD in Australian women

Coronary artery disease

Figure 14 shows the estimated number of new (incident/de novo) and "all" (both new and pre-existing cases of) hospitalisations associated with a primary diagnosis of CAD among Australian women aged ≥35 years each year. On this basis, we conservatively estimate that close to **21,000 women** are newly diagnosed and treated with the condition each year and taking into account pre-existing cases (approximate ratio of 1:12), more than **260,000 women** (4% of those aged ≥35 years) are hospitalised with CAD (approximately half being heart attacks) every year.

The above figures do not take into account two important components of the burden this condition imposes overall given that: **1)** the overall number of Australian women living in the community with CAD is more likely to be around **410,000**; **2)** a significant manifestation of CAD is sudden fatal events (sudden cardiac death) that occur without warning. The overall number of sudden cardiac deaths among Australian women each year is likely to be around **3,400**. For those women who survive to receive hospital treatment, the proportion of deaths due to CVD (whilst improving markedly with the introduction of more effective acute management) is still high. Within 28 days, of those women admitted for their first coronary event each year **2,200** (around 11%) will have died. While there are less women suffering acute cardiac events linked to CAD overall (when compared to men), those women aged 35-54 years have a higher risk of dying of CVD or other causes in the medium to longer term (**Figure 13**). [14]

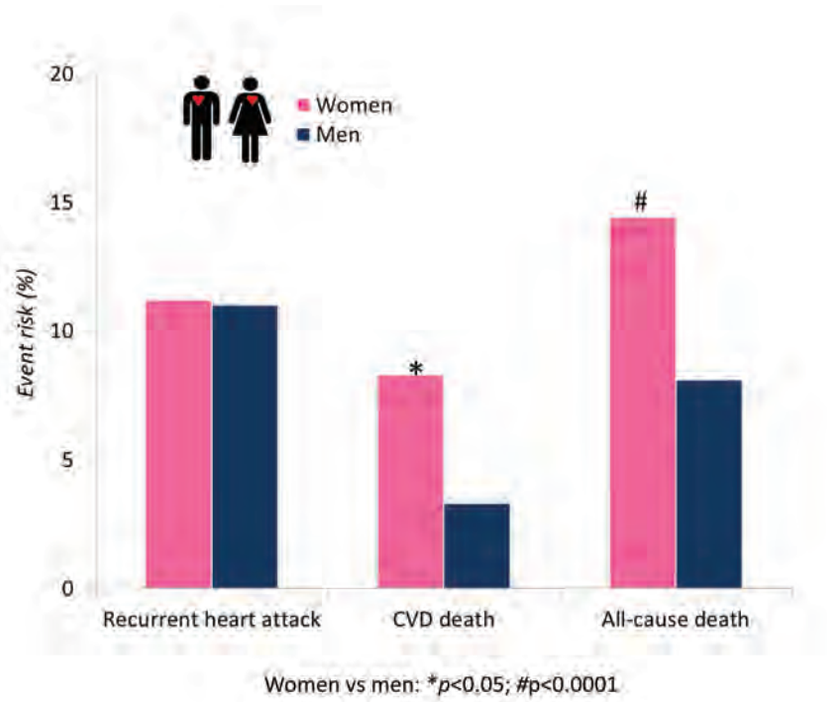

Figure 13: Risk of recurrent heart attack, CVD and all-cause death within 8 years following a first heart attack in Australians aged 35 to 54 years

Figure 14: New and all cases of hospitalisation for CAD in Australians aged 35 years and over – as at June 30th, 2016

Heart failure

Figure 16 shows the estimated number of new (incident/de novo) and "all" (both new and pre-existing cases of) hospitalisations associated with a primary and secondary diagnosis of HF among Australian women aged ≥35 years each year. A primary diagnosis of HF is typically associated with an acute and frequently deadly episode of HF, while a secondary diagnosis might indicate the presence (but substantive influence) of underlying chronic HF. On this basis, we conservatively estimate that close to **14,000 women** are newly diagnosed and treated with the syndrome each year and, taking into account pre-existing cases, (approximate ratio of 1:5), more than **73,000 women** are hospitalised with HF (often with concurrent heart attacks and AF) every year. Within 12 months, almost 30% of those hospitalised with their first HF admission will have died.

As highlighted in our *Rediscovering Heart Failure Report*, [38] the burden of the syndrome should not be measured solely through hospital episodes; particularly as it is a long-term, chronic condition that requires ongoing management to limit its adverse impact on activities of daily living and quality of life. Overall, we estimate there are **177,000 women** per annum living in the community with a form of HF most closely linked with CAD and previous heart attack (heart failure with reduced ejection fraction – HFrEF). Moreover, as shown in **Figure 15**, many more women are living with HF typically associated with long-term HT (heart failure with preserved ejection fraction – HFpEF). Regardless of the type of HF, it is not a benign condition given that typical survival rates are worse than the most common forms of cancer (<50% survival over 5-years) and we estimate that around **4,300 women** die within 12-months of their first hospitalisation with the syndrome. The burden of HF will continue to rise in both Australian men and women for the foreseeable future.

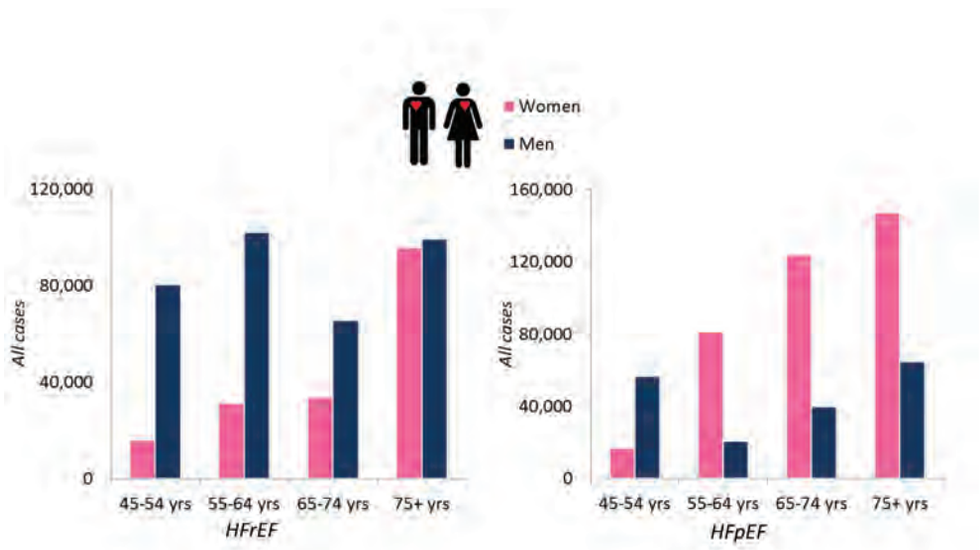

Figure 15: All cases of heart failure (HFrEF and HFpEF) in Australians aged 45 years and over

NT	
ALL	146 | 702
MEN	93 | 459
WOMEN	53 | 243

QLD	
ALL	5,825 | 31,188
MEN	3,199 | 17,759
WOMEN	2,626 | 13,429

WA	
ALL	2,982 | 15,908
MEN	1,632 | 9,016
WOMEN	1,350 | 6,892

NSW	
ALL	10,301 | 56,043
MEN	5,499 | 31,126
WOMEN	4,802 | 24,917

SA	
ALL	2,574 | 14,110
MEN	1,355 | 7,743
WOMEN	1,219 | 6,367

ACT	
ALL	405 | 2,154
MEN	219 | 1,211
WOMEN	186 | 943

TAS	
ALL	789 | 4,242
MEN	432 | 2,408
WOMEN	357 | 1,834

VIC	
ALL	7,757 | 42,192
MEN	4,129 | 23,417
WOMEN	3,628 | 18,775

AUS	
ALL	30,779 | 166,539
MEN	16,558 | 93,139
WOMEN	14,221 | 73,400

Figure 16: New and all cases of hospitalisation for HF most commonly linked to CAD in Australians aged 35 years and over – as at June 30th, 2016

Atrial fibrillation

Figure 18 shows the estimated number of new (incident/de novo) and "all" (both new and pre-existing cases of) hospitalisations associated with a primary and secondary diagnosis of AF among Australian women aged ≥35 years each year. A primary diagnosis of AF is typically associated with an acute episode or attempts to revert the heart back into its normal rhythm (sinus rhythm). A secondary diagnosis of AF is typically found in women who have been admitted with a heart attack, HF and/or a stroke, meaning that it is a major contributing factor to that event. On this basis, we conservatively estimate that close to **19,000 women** are newly diagnosed and treated with the condition each year and, overall (approximate ratio of 1:6), approximately **122,000 women** are hospitalised with AF (often in association with HF and cause of up to 1/3 of strokes) each year. Within 12 months of their first admission for AF around 15% will have died (almost 3,000 women).

Beyond the estimated 122,000 Australian women hospitalised with the condition, we estimate there are at least **162,000 women** aged 55 years or older living with AF in the community. This represents 4.8% of women in this age group suffering from this condition [40]. Reflective of global patterns, the number of cases of AF among women aged ≥80 years is greater than that among age-matched men. With the increasing awareness of gender differences in risk factors, natural history, preventive strategies and treatments for AF has been the increasing awareness of differences in the health outcomes and prognosis of women compared to men. Overall, women with AF have been found to have an approximately five-fold increase in the risk of a cardiovascular event compared with an approximately two-fold increased risk in men. [54] Furthermore, AF is associated with almost double the risk of a cardiovascular-related death in women compared to men. [55] The risk of death conferred by AF does not significantly vary with age; in both younger and older age groups, the mortality of women has been found to be substantially greater than for their counterparts without AF. [56] As shown in **Figure 17** admissions for AF (both new and all cases) are rising.

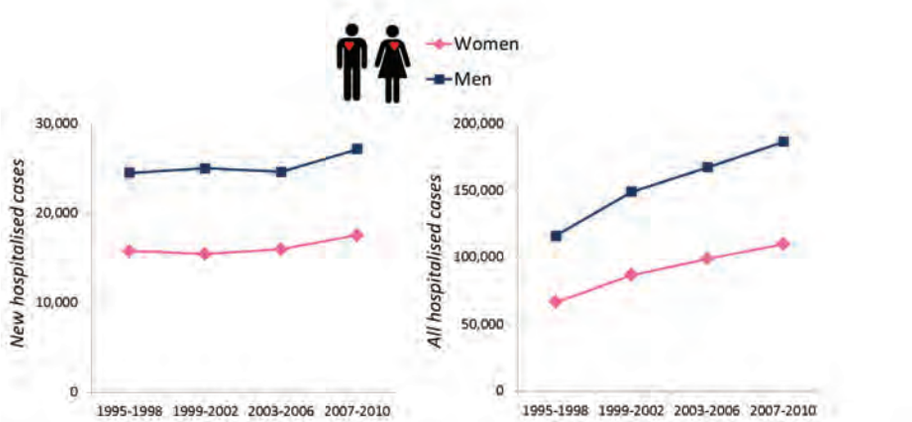

Figure 17: Historical trend of new (left panel) and all (right panel) cases of hospitalisation for AF

Figure 18: New and all cases of hospitalisation for AF in Australians aged 35 years and over – as at June 30th, 2016

Cerebrovascular disease/stroke

Figure 20 shows the estimated number of new (incident/de novo) and "all" (both new and pre-existing cases of) hospitalisations associated with a primary diagnosis of stroke (all-types excluding subarachnoid haemorrhage and often with a concurrent diagnosis of AF). On this basis, we conservatively estimate that close to **12,000 women** are newly treated for their first stroke each year and, taking into account pre-existing cases, (approximate ratio of 1:8), more than **90,000 women** are hospitalised with a stroke event each year. Of those who suffer a first stroke event, one in five will not survive to return home, with over 30% dead within 12 months (around **4,000 women**). Those who do survive often have impaired function and quality of life and requiring ongoing care and rehabilitation. **Figure 19** shows the types of stroke that women experience. [42] Importantly, compared to men, they are more likely to experience the relative rarer but more deadly form of stroke linked to intracerebral/subarachnoid haemorrhage (bleeding within the brain). It also worth noting that cerebrovascular disease is also associated with mini or transient events (trans-ischaemic attacks) that are in themselves distressing and disabling; providing a warning of a more serious stroke event.

It has long been recognised that female sex is an independent and major risk factor for AF-related stroke (particularly ischaemic stroke) [57] and blood clots forming in other parts of the body. [58-60] This has even prompted the development of specific management guidelines for the prevention of stroke in women. [57] A number of population-based epidemiological and clinical studies have demonstrated the association between female sex and risk of AF-related stroke and thromboembolism. [61-67] In AF patients not receiving oral anticoagulation therapy for prevention of thrombotic events, women were associated with up to a 2-fold increased risk of stroke. [61-64]

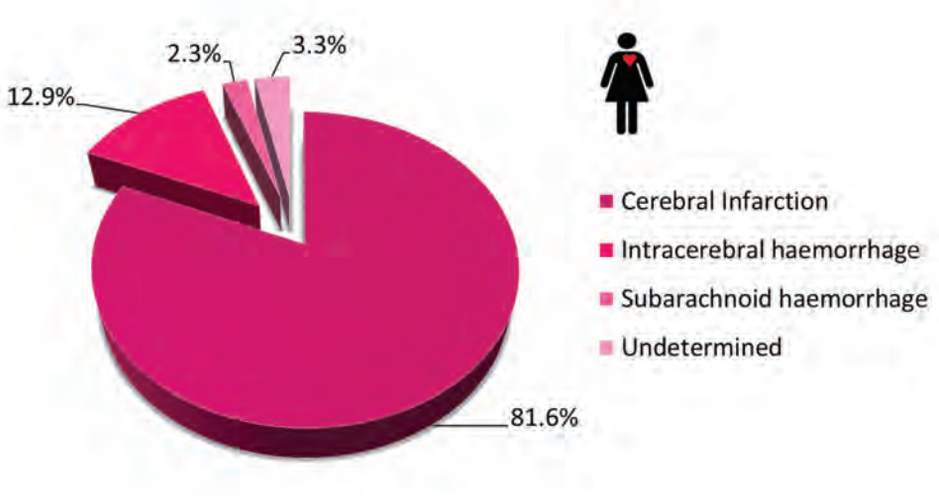

Figure 19: Pattern of strokes among Australian women aged 35 years and over

Figure 20: New and all cases of hospitalisation for stroke in Australians aged 35 years and over – as at June 30th, 2016

Peripheral artery disease

Figure 22 shows the estimated number of new (incident/de novo) and "all" (both new and pre-existing cases) hospitalisations associated with a primary diagnosis of PAD. On this basis, we conservatively estimate that more than **3,000 women** are newly treated for their first presentation of the condition each year and, taking into account pre-existing cases, (approximate ratio of 1:10), more than **30,000 women** are hospitalised with PAD each year.

As noted earlier, PAD is the Cinderella of CVD and all our estimates (including 30,000 Australian women being admitted to hospital with the condition each year) are likely to be very conservative. Unfortunately, there are no reliable national data available on the number of Australians who have PAD in the general population. Using recent global estimates [45] around 8% of Australian adult women are likely to have a sub-clinical form of PAD (defined as ankle brachial index [ABI] ≥0.9, where ABI is the ratio of the measured blood pressure at the ankle to the measured blood pressure at the arm); the prevalence increasing with age. As shown in **Figure 21**, the majority of cases of PAD in Australian women are likely to be asymptomatic (with no symptoms); with effective treatment delayed until presentation with more advanced disease.

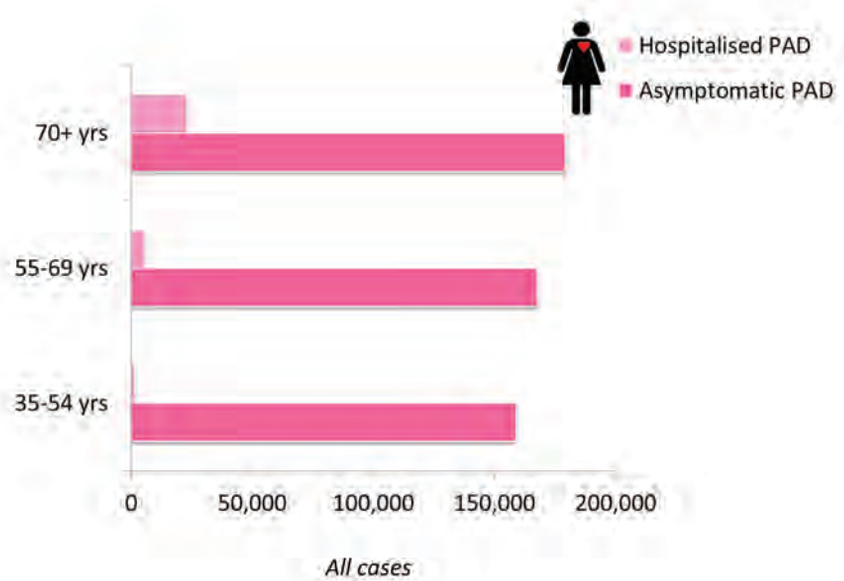

Figure 21: Estimated prevalent cases of asymptomatic and hospitalised PAD in Australian women according to age categories

FACT 5: All our estimates on the burden of CVD in Australian women (from the community to the hospital and in respect to the number of deaths) are likely to be very conservative without generating more definitive data from a definitive epidemiological study of CVD in Australia.

NT	
ALL	82 | 469
MEN	55 | 329
WOMEN	27 | 140

QLD	
ALL	1,844 | 16,290
MEN	1,182 | 10,515
WOMEN	662 | 5,775

WA	
ALL	1,007 | 8,299
MEN	653 | 5,347
WOMEN	354 | 2,952

NSW	
ALL	2,952 | 27,860
MEN	1,881 | 17,713
WOMEN	1,071 | 10,147

SA	
ALL	686 | 6,824
MEN	436 | 4,297
WOMEN	250 | 2,527

ACT	
ALL	143 | 1,130
MEN	91 | 717
WOMEN	52 | 413

TAS	
ALL	215 | 2,183
MEN	137 | 1,408
WOMEN	78 | 775

VIC	
ALL	2,286 | 20,939
MEN	1,452 | 13,247
WOMEN	834 | 7,692

AUS	
ALL	9,215 | 83,994
MEN	5,887 | 53,573
WOMEN	3,328 | 30,421

Figure 22: New and all cases of hospitalisation for PAD in Australians aged 35 years and over – as at June 30th, 2016

Results: CVD and costs in Australian women

Each year it is estimated that CVD hospitalisation consumes $3 billion in health care expenditure; with a cost of $5.9 billion overall reported for 2004-05. [49] As highlighted in this report, despite popular opinion/ perception, Australian women with CVD contribute substantially to this economic and social burden; from an individual to societal perspective (**Figure 23**). Based on our conservative figures, we estimate that the total cost of providing inpatient care for CAD and stroke in women is $880 million and $964 million, respectively, per annum, followed by HF ($612 million), AF ($501 million), and PAD ($156 million); noting the potential for some double-counting. Community-based, out-of-hospital care and treatment are likely to add a minimum of one-third or more in health care costs to each condition and the social cost.

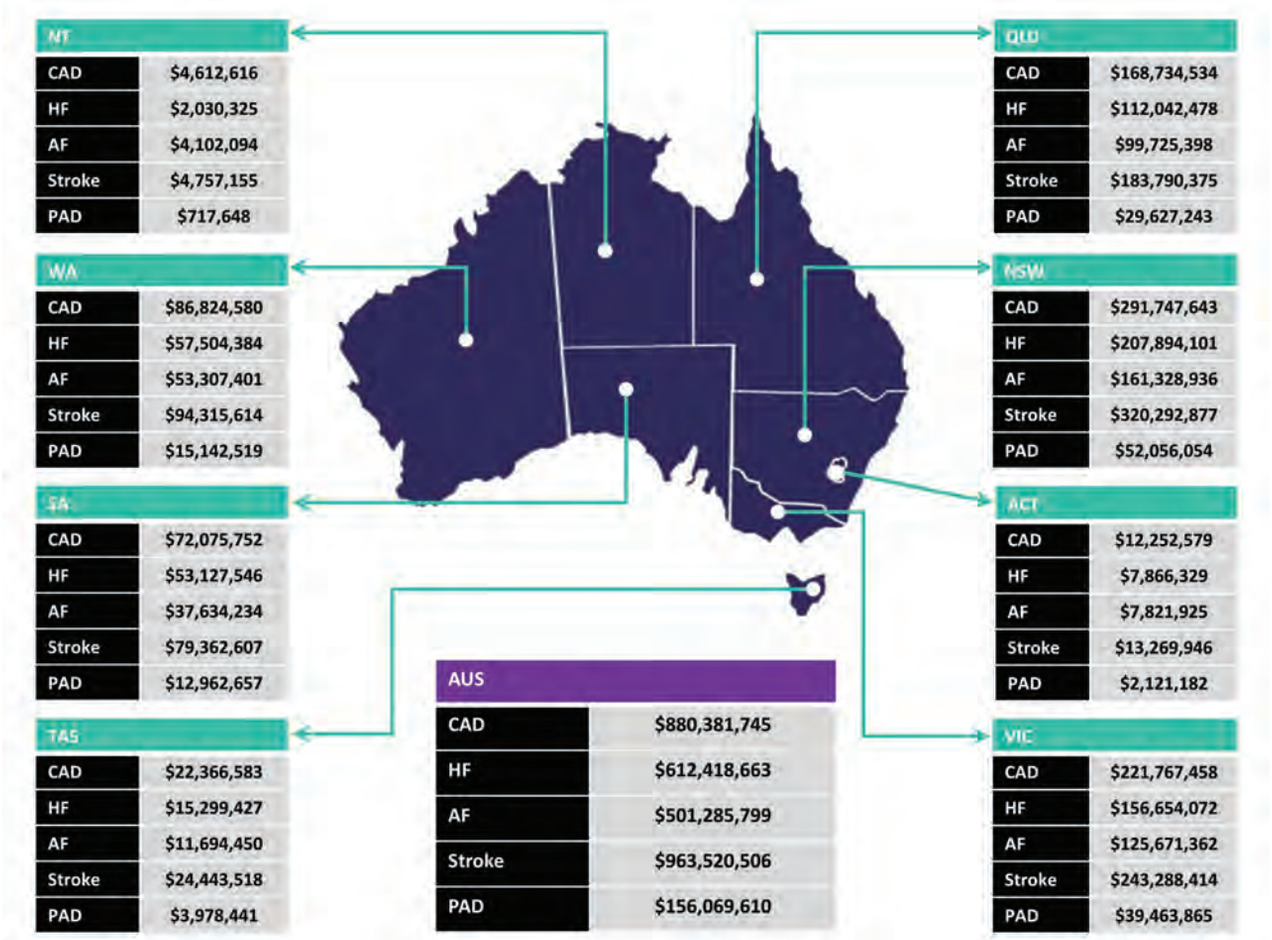

Figure 23: Estimated costs of in-patient care for CVD in Australian women aged 35 years and over – as at June 30th, 2016

FACT 6: Even applying conservative estimates of those Australian women hospitalised with CVD, the cost of providing hospital care is enormous; mandating more efforts to understand where effective prevention and treatment can be cost-effectively applied.

Results: Future burden of CVD

Purely based on a progressively ageing population of Australia in whom CVD risk factors remain high, we predict that the annual number of new and prevalent (both new and pre-existing) cases of all types of CVD will continue to grow for the foreseeable future without a dramatic development in our ability to reverse current trends in most risk factors (**Figures 24, 25**).

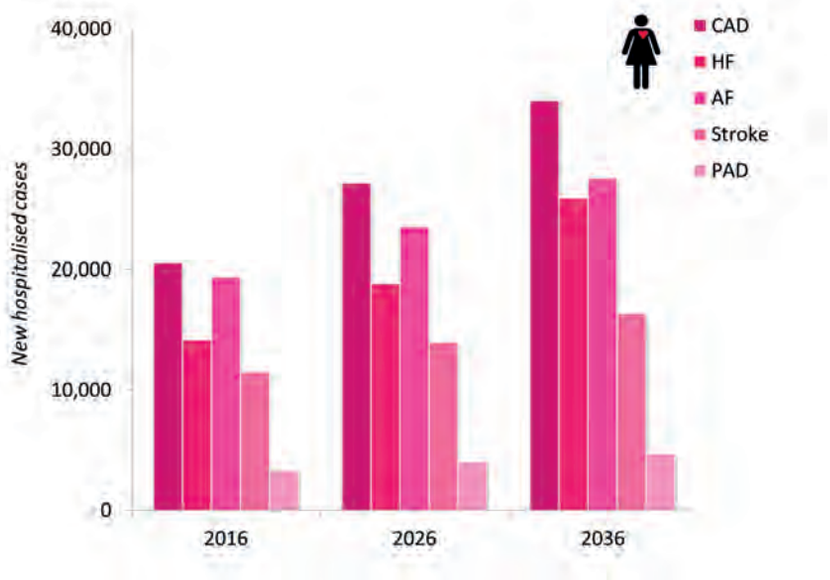

Figure 24: Current and projected estimates of new hospitalised cases of different types of CVD in Australian women aged 35 years and over

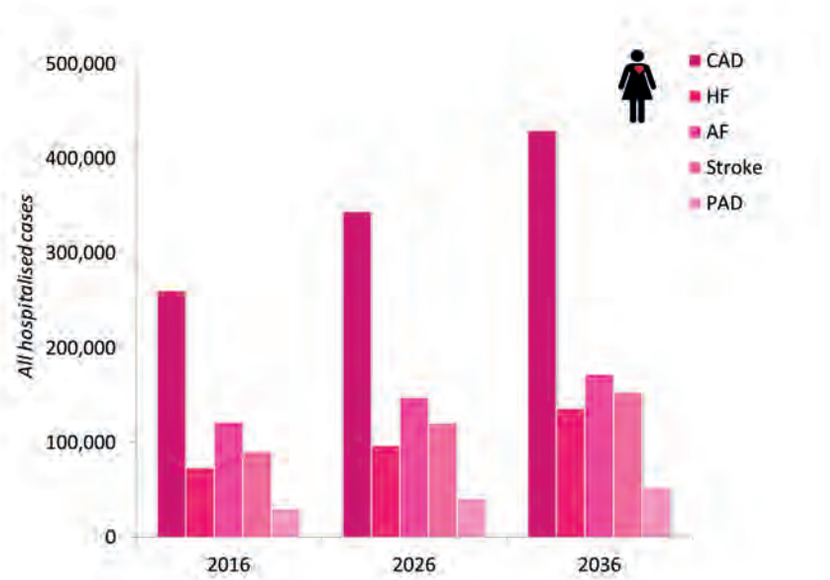

Figure 25: Current and projected estimates of prevalent hospitalised cases of different types of CVD in Australian women aged 35 years and over

FACT 7: The future burden of CVD in Australian women (and men) will continue to dramatically increase without substantive efforts to prevent new cases and effectively manage pre-existing cases.

Commentary: Management of CVD in women

It is well recognised that the natural history and profile of women with CVD are typically different from their male counterparts. [68] Current management guidelines reflect a male bias due to the poor representation of women in clinical trials of new therapies. Women are more likely to display dose-related adverse drug events from CVD pharmacotherapies due to smaller body size, higher body fat, different metabolism and more kidney dysfunction. [69, 70] Disparity also exists in cardiac rehabilitation with women failing to attend more often than men in addition to clinicians tending to refer men more frequently. [71]

Coronary artery disease: This typically develops 7-10 years later in women (around 72 years) compared to men (around 65 years). [69] However, it is becoming increasing more common in younger women due to factors such as increasing obesity rates. [72] Difficulty in interpreting severity of symptoms is most predictive in female patients who delay seeking care. [73] Diagnostic testing is often less reliable in women compared to men. [74] A gender difference has also been identified in the application of coronary interventions in Australian women compared to their male counterparts. [75]

Heart failure: The pattern of HF is different in women with substantially more cases of HFpEF linked to older age and untreated HT. This form of HF has the least treatment options and yet is both deadly and disabling. Following diagnosis, women exhibit worse quality-of-life and depression than men. [76] It has been found that a diagnosis of HF in women is less frequently based on objective diagnostic tests (e.g. echocardiography) when compared to men.

Atrial fibrillation: Women with AF are typically older, more clinically complex with a higher symptom burden and often a lack of social support and education. [77] In women, AF is more commonly associated with HT, obesity, thyroid and renal dysfunction. [77] Furthermore, treatment guidelines do not fully acknowledge the greater risk for negative health consequences and higher symptom burden (managed with heart rate/rhythm control) in women. [77] As a result, women are at greater risk for experiencing serious AF-related complications such as stroke and HF.

Stroke: Strokes are more prevalent in women than men but with onset at a later age. [78] The burden from stroke in women is increasing due to increasing dietary risks and HT. [79] Treatments for stroke tend to produce differing benefits in women. [78]

Peripheral artery disease: Differences between women and men with PAD are less defined than for other CVDs. Risk factors for PAD are similar to those for other CVDs. Recently, it has been found that women experience atypical pain and less symptomatic PAD compared to men. [80]

FACT 8: Evidence-based management for most forms of CVD are based on clinical trials that have a higher proportion of younger men and/or less complex cases.

Commentary: CVD among Indigenous women

CVD is 1.2-fold more common among Indigenous versus non-Indigenous peoples; the difference being magnified for those living in remote areas. [81] In 2012-2013, more Indigenous women (14%) reported having CVD than Indigenous men (11%) [81] and more women died from stroke compared to men. [82] Young and middle-aged Indigenous peoples are more likely to die from CVD than non-Indigenous people. Specifically, the death rates for all CAD (the leading cause of CVD-related deaths) were found to be 7-13 times higher for Indigenous peoples in the 25-39 and 40-54 years age-brackets than for their non-Indigenous counterparts. [83] The main drivers of these deleterious facts can be attributed primarily to the extremely high risk factor profiles present in both sexes. These are primarily comprised of obesity, smoking, HT, diabetes, alcohol abuse and depression or mental health issues. [17, 84-87]

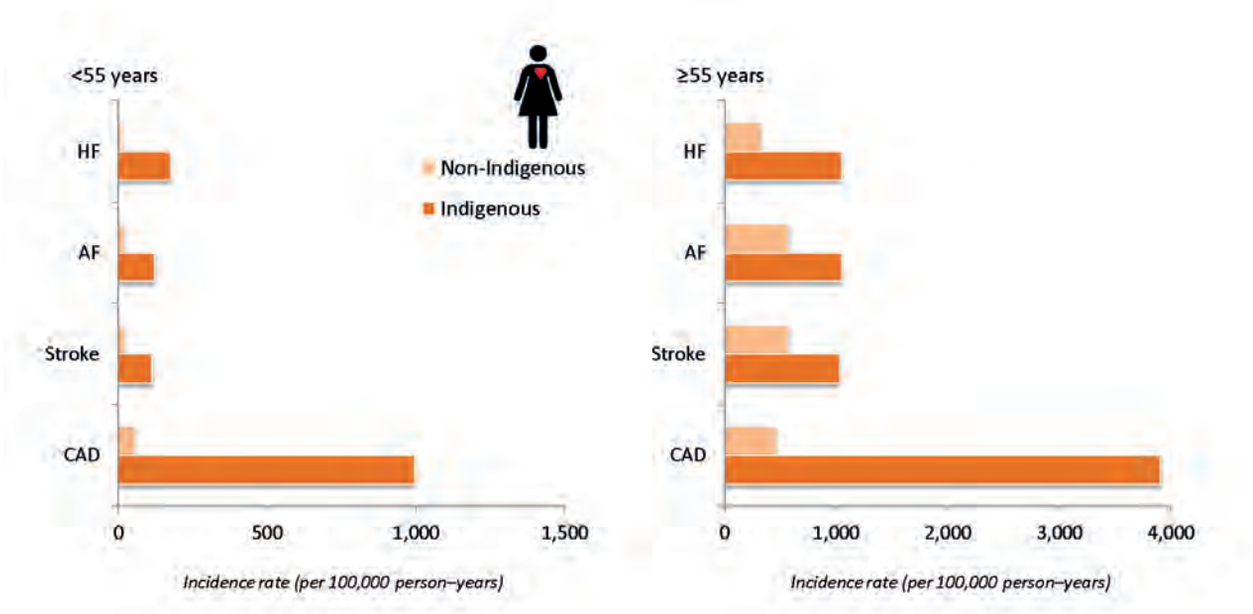

Figure 26: Comparison of new cases of hospitalisation for CVD in Indigenous vs non-Indigenous Australian women according to age categories

Overall, the differential between Indigenous and non-Indigenous CVD burden is considerable and independent of the type of CVD-related disease (**Figure 26**). [17, 18, 20, 37] This highlights the need to focus on reducing the risk factors found this population, particularly in women and younger age groups.

Similarly, previous studies have shown higher levels of CVD risk in vulnerable communities (i.e. those with lower education status, socially disadvantage or from minority ethnic background) relative to the general population. [88]

FACT 9: CVD disproportionately affects the Indigenous peoples of Australian and in particular Indigenous women who develop and die from CVD at a much younger age.

Conclusions

To the best of our knowledge this report represents the most comprehensive and contemporary assessment of the burden of CVD in Australian women.

We have endeavoured to quantify the burden of CVD in women from an epidemiological, health services and health expenditure perspective. We have examined the most-recent and relevant Australian-based sources of data describing the disease burden via expert review of data generated by a systematic search of the literature. All evidence-based data were extrapolated (where required) to the Australian health care system and whole population on an age-specific basis.

What we know now…

- Each year, close to **21,000 Australian women** aged ≥35 years develop CAD with clinically overt signs and symptoms requiring their first hospital admission. Of those fortunate to reach hospital, **2,200** will have died within 28-days.
- Tragically, we estimate that a further **3,400 Australian women** suffer a sudden and fatal cardiac event without ever reaching hospital each year.
- Overall, there are more than **410,000 Australian women** living with CAD each year who accumulate **260,000 hospital admissions** each year.
- As reported previously, we estimate that **73,000 Australian women** are hospitalised with HF overall each year, with **4,300** of the 14,000 women admitted for the first time dying with 12 months.
- Overall, there are more than **177,000 Australian women** living with the form of HF mostly commonly linked to CAD, with many more living with the form of HF most commonly linked to HT.
- Each year, **122,000 Australian women** are hospitalised with AF and this represents the majority of those living in the community (at least **162,000 Australian women** overall) with the condition.
- Each year **90,000 Australian women** are admitted to hospital with a potentially deadly and disabling stroke. Of the 12,000 women admitted for the first time around **4,000** will have died within 12 months of that admission.
- An additional **30,000 Australian women** are admitted to hospital with PAD each year.
- The annual in-patient cost of managing CVD in Australian women alone is more than **$3 billion**.
- Much of the management pathways for Australian women have been derived from clinical trials testing treatment modalities in predominantly younger, less clinically complex men.
- Indigenous women (and other vulnerable groups) bear a disproportionate burden of CVD – developing CVD in greater numbers and at a younger age.

What we predict

- Within an ageing Australian population in whom cardiovascular risk factors and antecedent heart disease remains high, this already enormous burden of CVD is likely to rise over the next 10-15 years.
- The prevalent pool of all forms of CVD will continue to increase, fuelled by underlying cardiovascular risk factors including HT, dyslipidaemia and a new wave of diabetes and obesity.

Some of the things we need to do

- Raise awareness – CVD is highly preventable or at least can be markedly delayed if risk factors are addressed early and early forms of CVD are treated early. Many women (and indeed men) underestimate the likely impact of CVD on their longevity and quality of life.
- Quantify the problem better – current sources of health information simply don't provide the same level of detail as those found elsewhere in the world. Cost-effective programs require more accurate data on the scope and impact of CVD.
- Develop gender-specific guideline – there is an urgent need to develop and update guidelines for treatment of the most common forms of CVD which take into account special consideration and education of the prevention and management of CVD in women.
- Invest in evidence-based, primary and secondary prevention programs that are proven to – **a**) minimise the harmful impact of common risk factors (e.g. better managing hypertension in the primary care setting), **b**) prevent progressive CVD in vulnerable and high-risk individuals (including those with diabetes, chronic kidney disease, early forms of CAD and/or living in vulnerable communities) and **c**) cost-effectively minimise recurrent hospital admissions and prolong survival in Australian women and men already unfortunate enough to be affected by chronic forms of CVD through dedicated multidisciplinary, disease management programs.
- Targeted research – both clinical services and research programs specifically dedicated to improving CVD related outcomes; from increasing awareness to effective CVD prevention and management in women is a high priority.

Ultimately, 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 CVD among Australian women.

FACT 10: CVD represents an enormous health issue for Australian women. It requires a dedicated response, from the community to governments to minimise already high rates of highly preventable cardiovascular events.

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Abbreviations and acronyms

ABI	Ankle Brachial Index
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AF	Atrial Fibrillation
AIHW	Australian Institute of Health and Welfare
AUS	Australia
BMI	Body Mass Index
CAD	Coronary Artery Disease
CVD	Cardiovascular Disease
DRG	Diagnostic Related Group
HbA1c	Haemoglobin A1c
HDL	High Density Lipoprotein
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HT	Hypertension
ICH	International Conference for Harmonisation
LDL	Low Density Lipoprotein
NHCDC	National Hospital Cost Data Collection
NHMRC	National Health and Medical Research Council
NHS	National Health Survey
NSW	New South Wales
NT	Northern Territory
PAD	Peripheral Artery Disease
QLD	Queensland
SA	South Australia
TAS	Tasmania
VIC	Victoria
WA	Western Australia

Notes

Hidden Hearts: Cardiovascular Risk and Disease in Australian Women

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