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Methodology for developing tobacco smoking aetiological fractions for Western Australia

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September 2021

Acknowledgements

This report was authored by Emily Coles and Wendy Sun of the Epidemiology Directorate at the Department of Health, Western Australia.

The authors wish to acknowledge the data and methodological advice provided by Robert Tait from the National Drug Research Institute and Steve Whetton from the South Australian Centre for Economic Studies, University of Adelaide.

They also wish to thank the following Department of Health, Western Australia staff and affiliates: Stella Serafino, Tim Landrigan and Alex Xiao for their constructive comments and review, and Laura Kirkland, Candice Patterson, Kate Brameld, Rebekka Bernhard and Nastassia Gregoriadis for their contributions to the project.

Suggested citation

Coles E and Sun W (2021). *Methodology for developing tobacco smoking aetiological fractions for Western Australia*. Perth: Department of Health WA.

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Abbreviations

ABS	Australian Bureau of Statistics
AF	Aetiological fraction
ASR	Age-standardised rate
AIHW	Australian Institute of Health and Welfare
CPS-II	American Cancer Society Cancer Prevention Study II
COD URF	Cause of death unit record file
GFCE	Government final consumption expenditure
ICD-10	International Statistical Classification of Diseases and Related Health Problems (10th revision)
NDRI	National Drug and Research Institute
SIR	Smoking impact ratio
WA	Western Australia

Contents

Background

Tobacco smoking is an established causal risk factor for a range of health conditions and injuries including many cancers (1). Tobacco smoking was also the risk factor responsible for the greatest burden of disease in Western Australia (WA) in 2015, contributing to 9.1% of the total burden of disease, as well as 12.5% to fatal burden of disease, the largest proportion of fatal burden attributed to any risk factor (2). Therefore, while the prevalence of tobacco smoking has declined in WA over time (3), smoking remains a significant contributor to poor health and mortality for many Western Australians.

The Epidemiology Directorate of the Department of Health WA uses condition-specific aetiological fractions (AFs) to estimate the hospitalisations, deaths, bed days and associated costs for different conditions that are attributable to tobacco-smoking in the WA population. An AF is defined as 'the fraction of all cases of a particular disease or other adverse condition in a population that is attributable to a specific risk factor exposure' (4). The methodology for calculating AFs relies on smoking prevalence data and relative risk estimates (for the indirect method) or incident/case report data (for the direct method) for each of the conditions and injuries attributable to tobacco-smoking, broken down by age-group and sex.

The method for using relative risks to determine AFs was described by English et al. in 1995 and is still in use today (5). This method was recently used for both the Australian Burden of Disease Study 2015 (6) and the National Drug Research Institute (NDRI) report to determine the burden of diseases, deaths, and hospitalisations attributable to tobacco smoking for a range of health conditions and injuries (7).

The Epidemiology Directorate previously utilised tobacco AFs produced by the Australian Institute of Health and Welfare (AIHW), which were last updated in 2001 (8). Since this time, the prevalence of smoking has decreased (3) and there has been an increase in conditions known to be at least partially caused by tobacco smoking (7). These changes necessitate estimation of updated tobacco-smoking AFs to ensure reliable estimates can be produced of tobacco-attributable hospitalisations, deaths, bed days and associated costs for WA.

Herein, we describe the methodology used to produce the AFs for WA using 2018 prevalence data and provide estimates of tobacco-attributable hospitalisations (from 2009–2010 to 2018–2019), deaths (from 2009–2010 to 2017–2018), and associated hospital bed days and costs for the WA State, Aboriginal, metropolitan, country and health region populations. The methods used in this report are based on the methods used by the NDRI, including use of the same relative risk estimates (7). Our estimates can be used by government and not-for-profit organisations to understand the impacts of tobacco-smoking in these various WA populations to support public health policy development, advocacy, and program or service planning.

Methods

Conditions

Conditions associated with active and passive (i.e. second-hand) tobacco smoking are listed in Table 1 along with their associated ICD-10 codes (7). These come from a list of conditions used by the NDRI in their report, "Identifying the Social Costs of Tobacco Use to Australia in 2015/16" (7). Each of these conditions have robust evidence to indicate they are at least partially caused by tobacco smoking (7). 22 conditions have been added that were not included in the 2001 AFs (8). These conditions include various cancers, eye and respiratory diseases, reproductive conditions and injuries, for which there is now sufficient evidence to suggest a causal link between their development and exposure to tobacco-smoke.

Table 1. Conditions for which exposure to tobacco smoke is an established risk factor, associated ICD-10 codes (adapted from the NDRI report (7)), and age/sex of persons to which AFs were applied

Conditions associated with active smoking		ICD-10 codes	Age (years) and sex
1	Tuberculosis	A15, A16, A19, B90	Persons aged 30+
2	Lip and oral cavity cancer	C00-C09, C14	Persons aged 40+
3	Nasopharynx cancer	C10-C13	Persons aged 40+
4	Oesophageal cancer	C15	Persons aged 40+
5	Stomach cancer	C16	Persons aged 40+
6	Colon and rectum cancer	C18-C20	Persons aged 40+
7	Liver cancer	C22	Persons aged 40+
8	Pancreatic cancer	C25	Persons aged 40+
9	Cancer of nasal cavity	C30	Persons aged 40+
10	Cancer of accessory sinuses	C31	Persons aged 40+
11	Larynx cancer	C32	Persons aged 40+
12	Tracheal, bronchus, and lung cancer	C33-C34	Persons aged 40+
13	Cervical cancer	C53	Females aged 40+
14	Kidney cancer	C64-C65	Persons aged 40+
15	Bladder cancer	C66-C67	Persons aged 40+
16	Myeloid leukaemia	C92	Persons aged 40+
17	Diabetes mellitus type II	E11	Persons aged 30+
18	Cataract	H25-H26	Persons aged 30+
19	Macular degeneration	H35.3	Persons aged 30+
20	Hypertensive heart disease	I11, I13	Persons aged 30+
21	Ischaemic heart disease	I20-I25	Persons aged 30+
22	Atrial fibrillation and flutter	I48	Persons aged 30+
23	Other cardiovascular and circulatory diseases	I46-I47, I49-I52, I77-I79	Persons aged 30+
24	Stroke	I60-I66, I69.0, I69.1, I69.2, I69.3, I69.4	Persons aged 30+
25	Atherosclerosis	I70	Persons aged 30+

26	Aortic aneurysm	I71	Persons aged 30+
27	Peripheral vascular disease	I72-I74	Persons aged 30+
28	Influenza and pneumonia	J10-11, J12-J18	Persons aged 15+
29	Chronic obstructive pulmonary disease	J43-J44	Persons aged 40+
30	Asthma	J45-J46	Persons aged 15+
31	Interstitial lung disease and pulmonary sarcoidosis	J84	Persons aged 40+
32	Other respiratory diseases	J47, J70, J80-J82, J85-J86, J90-J91, J93-J94, J96, J98	Persons aged 40+
33	Peptic ulcer disease	K25-28	Persons aged 30+
34	Rheumatoid arthritis	M05-M06	Persons aged 30+
35	Erectile dysfunction	N48.4	Males aged 30+
36	Female infertility	N97	Females aged 15-49
37	Ectopic pregnancy	O00	Females aged 15-49
38	Premature rupture of membranes	O42	Females aged 15-49
39	Placenta previa and other antepartum haemorrhage	O44, O46	Females aged 15-49
40	Placental abruption	O45	Females aged 15-49
41	Stillbirth	Z37.1, Z37.3, Z37.4, Z37.6, Z37.7	Females aged 15-49
42	Miscarriage/spontaneous abortion	O03	Females aged 15-49
43	Hip fracture*	S72.0	Persons aged 30+
44	Non-hip fracture*	S72.1-S72.9, S02, S12, S22, S32, S42, S52, S82, S92	Persons aged 30+
45	Fire injuries	X00-X01, X04-X09	All persons
46	Tobacco use disorders/toxic effect of tobacco and nicotine	F17, T65.2, Z72.00-Z72.09	All persons
Conditions associated with passive smoking		**ICD-10 codes**	**Age (years) and sex**
1	Lung cancer	C34	Persons aged 30+
2	Otitis media	H65-H67	Children <15 years
3	Ischaemic heart disease	I20-I25	Persons aged 30+
4	Cerebrovascular disease	I60-I69	Persons aged 30+
5	Lower respiratory illness (excludes flu)	J12-18, J20-J22	Children <15 years
6	Asthma (children)	J45-J46	Children <15 years
7	Low birthweight	P05, P07	Children <1 year
8	Orofacial clefts	Q35-Q37	Children <5 years
9	SIDS	R95	Children <1 year

*Transport accident codes (V01-V89.99, V91, V93-V99.99) and homicide and violence codes (X85-Y09.99) were used to exclude fractures that were not attributable to tobacco-smoking.

Some of the conditions that had AFs in 2001 have been excluded on the basis of insufficient evidence (i.e. anal cancer, vulvar cancer, ovarian cancer, penile cancer, respiratory carcinoma in situ, Crohn's disease and ulcerative colitis) (7). Conditions that are presently excluded may be included in future iterations as more evidence becomes available.

Data Sources

The data sources used for this report are summarised in Table 2.

Table 2. Data sources and uses for deriving AFs

Data sources	Data custodians	Data uses
American Cancer Society Cancer Prevention Study II (CPS-II) (9)	N/A	Reference population used to estimate the WA smoking impact ratio.
Cause of death unit record file (COD URF)	Australian Co-ordinating Registry, the Registries of Births, Deaths and Marriages, the Coroners, the National Coronial Information System and the Victorian Department of Justice and Community Safety	Lung cancer mortality rate for the WA population and for Aboriginal people; deaths attributable to smoking.
Health and Wellbeing Surveillance System	WA Department of Health	Current and five-year lagged prevalence of smoking and second-hand smoking for the WA population.
Hospital Morbidity Data Collection	WA Department of Health	Hospitalisations, bed days and costs attributable to smoking.
Midwives Notification System	WA Department of Health	Prevalence of smoking while pregnant and exposure to second-hand smoke in-utero for the WA population and for Aboriginal people.
National Aboriginal and Torres Strait Islander Health Survey 2018–19	Australian Bureau of Statistics (ABS)	Current prevalence* of smoking and second-hand smoking for Aboriginal people.
National Aboriginal and Torres Strait Islander Social Survey 2014–15	ABS	Four-year lagged prevalence** of smoking for Aboriginal people.
National Drug Research Institute	N/A	Relative risk estimates (7).

*2018-19 prevalence was used as a proxy for 2018 prevalence based on data availability and the likelihood that smoking prevalence would be similar for this population from 2018 to 2018–2019.
**Four-year lagged prevalence was used in place of five-year lagged prevalence based on data availability and the likelihood that smoking prevalence would be similar for this population from 2013–2014 to 2014–2015.

Calculating aetiological fractions

AFs can be calculated using either an indirect or direct method. We have used the indirect method to calculate AFs for each of the conditions listed in Table 1, with the exception of fire injuries (AFs obtained from the NDRI) and tobacco use disorders (AFs equal to one as this is wholly attributable to tobacco-smoking). AFs were only calculated for conditions where tobacco smoking had a harmful effect (i.e. contributed to development of the condition), to assess the negative impacts of tobacco smoking on the population.

The indirect method

The indirect method is considered to be the more robust of the two methods for calculating AFs and requires two sets of data; the prevalence of active and passive (i.e. second-hand) exposure to tobacco-smoke in the population, and the relative risks of developing and/or dying from specific conditions due to exposure to tobacco-smoke, broken down by age-group and sex (7).

Prevalence and relative risks

Prevalence of tobacco smoking was estimated for the overall WA population and for Aboriginal people using state and national survey data from the WA Department of Health and the ABS (Table 2). Active smokers were defined as all current smokers in each of the surveys used. The prevalence of second-hand smoke exposure (i.e. passive smoking) was estimated for adults and children, with passive smoking defined as exposure to smoke inside the home. Second-hand exposure to tobacco smoke in-utero was also estimated using data from the WA Midwives Notification System, based on the prevalence of women who smoked during pregnancy.

The impacts of tobacco smoking can be experienced immediately, in the short or longer-term, including years after exposure. To account for variability between exposure to tobacco smoke and development of different conditions, current and five-year lagged prevalence were calculated for 2018 and 2013, respectively, based on methodology used in the NDRI report (7). The 2018 and 2013 prevalence figures were based on 2017–2019 and 2012–2014 prevalence respectively for WA from the Health and Wellbeing Surveillance System (multiple years used to account for small numbers).

Prevalence data for Aboriginal people were sourced from the National Aboriginal and Torres Strait Islander Health Survey 2018-19 and the National Aboriginal and Torres Strait Islander Social Survey 2014–15. In the latter case, four-year lagged prevalence was used in place of five-year lagged prevalence based on data availability and the likelihood that smoking prevalence would be similar for this population from 2013–2014 to 2014–2015. Similarly, 2018–19 prevalence was used as a proxy for 2018 prevalence. Current prevalence of smoking during pregnancy was calculated for all Western Australians and for Aboriginal people using data from the Midwives Notification System for 2018.

Neither current nor five-year lagged prevalence is sufficient for conditions that have a longer lag time between tobacco smoke exposure and disease development (e.g. cancers), particularly as the prevalence of tobacco smoking will have varied in intervening years (6). For these conditions, there is a method (described by Peto et al. 1992 (9)) that can be used to estimate the accumulated risk from exposure to tobacco smoke. This method involves estimation of a smoking impact ratio (SIR), which uses the excess mortality of smokers and never smokers in WA from lung cancer compared to a reference population, to determine the proportion of Western Australians at risk from historical exposure to tobacco smoke. This methodology is used by both the NDRI (7) and the AIHW for the Australian Burden of Disease Study 2015 (6).

The SIR was calculated for the overall WA population and for Aboriginal people according to the following formula:

$$SIR = \frac{C_{LC} - N_{LC}}{S^*_{LC} - N^*_{LC}} \times \frac{N^*_{LC}}{N_{LC}}$$

where:

- *C_{LC} is the age-group and sex-specific lung cancer mortality rate for the WA population of interest*
- *N_{LC} is the age-group and sex-specific lung cancer mortality rate of never-smokers in the same population*

- *S^*_{LC} is the age-group and sex-specific lung cancer mortality rate of smokers in the reference population*
- *N^*_{LC} is the age-group and sex-specific lung cancer mortality rate of never-smokers in the reference population*

The reference population was the American Cancer Society Prevention Study II (CPS-II) (Table 2) (9), which is a large, long-term follow-up study from the United States of smoking and mortality that is commonly used to calculate SIRs (6, 7, 10).

The lung cancer mortality rate for the overall WA population and for Aboriginal people was determined using COD URF data from 2014–2018. A five-year extract was used to account for the problem of small numbers over a one-year period. SIRs were calculated for people aged 40-years and older on the basis of unreliable SIRs (and AFs) for younger age-groups, due to less deaths from lung cancer among younger people (11). In keeping with Peto's methodology, 80+ year-olds were assigned the same lung cancer mortality rate as the preceding age-group (e.g. 75–79 year-olds), in case of unreliable or unstable mortality rates at older ages (9). Lung cancer mortality data for 'never smokers' were unavailable for the overall WA population and for Aboriginal people. Therefore, lung cancer mortality rates from the reference population were used as proxy rates for 'never smokers' in the overall WA population and for Aboriginal people, in accordance with the NDRI methodology (7).

Relative risks were sourced from the NDRI report, "Identifying the Social Costs of Tobacco Use to Australia in 2015/16" (7). These relative risk estimates came from various sources, including the Global Burden of Disease Study and US Surgeon General reports (7).

Aetiological fractions

We calculated the AFs for conditions linked to tobacco smoking as follows:

$$AF = \frac{\sum_c P_c(RR_c - 1)}{\sum_c P_c(RR_c - 1) + 1}$$

where:

- *c is the consumption category used (e.g. SIR, five-year lagged prevalence, current prevalence),*
- *P_c is the prevalence of exposure to tobacco smoke*
- *RR_c is the relative risk of the condition associated with exposure to tobacco smoke compared to no exposure to tobacco smoke for each category of age and sex*

AFs were calculated for each of the conditions in Table 1 (with the exception of fire injuries and tobacco use disorder) for the overall WA population and Aboriginal people, by age-group (0, 1–5, 5–14, 15–19, 20–24, 25–29, 30–34, 35–59, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79 and 80+ years) and sex (male or female). This resulted in two sets of AFs, one for each of the WA State and WA Aboriginal populations for both active and passive tobacco smoke exposure. AFs were not present across all categories for age and sex for each of the conditions listed (e.g. low birthweight has an AF of 0 in all age-categories other than the 0 years age-group).

The direct method

The direct method is used when relative risk estimates are unavailable and involves the use of studies that determine the contribution of tobacco-smoking to conditions or injuries on a case-by-case basis (e.g. use of incident report data to determine the proportion of fires that were caused by a cigarette or discarded match) (7). The AFs for fire injuries were provided by the NDRI and are the same as those used in their 2019 report (7). The methods for calculating AFs using the direct method, as well as adjusting for differences in the study population versus the reference

population (from which AFs are derived), and the limitations around the use of AFs estimated using the direct method, are described in detail in the NDRI report (7).

Estimating hospitalisations and deaths attributable to tobacco smoking

SAS Enterprise Guide (version 8.1) was used to apply the AFs to WA inpatient (Hospital Morbidity Data Collection) and mortality (COD URF) data to determine the number of hospitalisations and deaths attributable to tobacco smoking in WA, as well as associated bed days and costs.

The AFs for different conditions were assigned to hospital and death records based on age, sex and primary diagnosis codes (for hospital data) or cause of death codes (for death data), with the exception of injuries. Fractures attributable to tobacco-smoking were identified using both primary diagnosis codes (or cause of death codes) and external cause codes, excluding causes that were unlikely to be attributable to smoking (e.g. transport accidents and homicide/violence). AFs were assigned to fire injuries using external cause codes. AFs were applied based on ICD-10 codes for COD URF data and ICD-10-AM codes for Hospital Morbidity Data Collection data.

Total hospitalisations attributable to tobacco-smoking for each of the 2009–2010 to 2018–2019 financial years were estimated by summing the AFs across each of the hospitalisations for conditions or injuries for each year. There were three conditions, for which there was an overlap of AFs between active and passive smoking (i.e. tracheal, bronchus and lung cancer (active) and lung cancer (passive); ischaemic heart disease (active) and ischaemic heart disease (passive); stroke (active) and cerebrovascular disease (passive)). The AFs for these conditions were summed to check they did not exceed one (in which case hospitalisations or deaths would have exceeded actual hospitalisations or deaths). Other conditions that were included in both active and passive smoking (e.g. asthma), did not have overlap based on the age groups used to calculate the AFs. Active and passive AFs were summed to estimate the combined effects of active and passive smoking in WA.

Bed days and costs were estimated by multiplying the AFs by bed days (i.e. length of stay data) or costs and summing these figures for each financial year. Both the average cost per diagnosis related group (costs) and costs adjusted by the government final consumption expenditure (adjusted costs) are provided. Adjusted costs are estimated by applying the 2018–2019 government final consumption expenditure (GFCE) deflator from the AIHW (12) to account for inflation, enabling comparison of costs between financial years. Total deaths attributable to tobacco smoking for each of the 2009–2010 to 2017–2018 financial years were determined by summing the AFs for tobacco-attributable deaths for each year.

The tobacco-attributable hospitalisations and deaths for the WA metropolitan, country, and health region populations were estimated using the AFs for the WA State (Appendix 1). This was achieved using location variables within the hospital and deaths datasets that identified the region of the patient's place of residence at the time they were hospitalised or died. Region-specific AFs were not derived due to low lung cancer mortality figures for some of these smaller populations, which led to unreliable SIRs (used to estimate tobacco-attributable hospitalisations and deaths from cancers, chronic obstructive pulmonary disease, interstitial lung disease and pulmonary sarcoidosis, and other respiratory diseases). Therefore, it was more robust to apply WA AFs to avoid underestimation of the hospitalisations and deaths attributable to tobacco smoking in these populations.

Results

Tobacco-attributable hospitalisations and costs

In the ten-year period from 2009–2010 to 2018–2019, there were an estimated 114,324 tobacco-attributable hospitalisations in WA (Table 3). The State had an estimated 579,604 bed days attributable to tobacco smoking across WA for this period, which cost an estimated $991 million before adjusting for inflation.

Table 3. Estimated numbers of tobacco-attributable hospitalisations, bed days, costs and inflation-adjusted costs, WA, 2009–2010 to 2018–2019

Financial year	Number	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	10,189	55,688	73,944,565	91,177,023
2010–2011	10,476	55,584	74,396,603	90,506,816
2011–2012	10,839	54,740	76,719,417	91,115,697
2012–2013	11,066	55,801	92,880,636	107,128,762
2013–2014	10,638	55,672	93,636,413	105,091,373
2014–2015	11,125	55,055	98,038,527	107,498,384
2015–2016	11,781	60,300	111,399,984	119,784,929
2016–2017	12,456	62,825	124,083,333	131,027,807
2017–2018	12,665	60,491	119,493,623	123,062,434
2018–2019	13,087	63,448	126,673,018	126,673,018

Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes, that represents government spending on public hospitals and some public hospital services, private hospitals and patient transport services (12).

There were an estimated 83,945 tobacco-attributable hospitalisations in metropolitan WA from 2009–2010 to 2018–2019 (Table 4). Metropolitan WA had an estimated 429,279 bed days attributable to tobacco smoking during this period, which cost an estimated $744 million before adjusting for inflation.

Table 4. Estimated numbers of tobacco-attributable hospitalisations, bed days, costs and inflation-adjusted costs, metropolitan WA, 2009–2010 to 2018–2019

Financial year	Number	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	7,394	40,793	54,841,969	67,622,649
2010–2011	7,567	40,557	54,777,886	66,639,764
2011–2012	7,997	40,923	57,516,334	68,309,185
2012–2013	8,040	40,809	69,014,459	79,601,452
2013–2014	7,775	40,885	69,910,427	78,462,881
2014–2015	8,104	40,532	72,834,539	79,862,434
2015–2016	8,778	45,184	85,283,775	91,702,984
2016–2017	9,270	47,051	94,582,570	99,875,998
2017–2018	9,447	45,578	90,609,455	93,315,608
2018–2019	9,574	46,966	94,739,063	94,739,063

Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes, that represents government spending on public hospitals and some public hospital services, private hospitals and patient transport services (12).

There were an estimated 30,243 tobacco-attributable hospitalisations in country WA from 2009–2010 to 2018–2019 (Table 5). Country WA had an estimated 149,663 bed days attributable to tobacco smoking over during this period, which cost an estimated $246 million before adjusting for inflation.

Table 5. Estimated numbers of tobacco-attributable hospitalisations, bed days, costs and inflation-adjusted costs, country WA, 2009–2010 to 2018–2019

Financial year	Number	Bed days	Costs ($)	Adjusted cost ($)
2009–2010	2,793	14,884	19,086,622	23,534,676
2010–2011	2,902	14,971	19,550,382	23,783,919
2011–2012	2,833	13,792	19,145,326	22,737,917
2012–2013	3,018	14,946	23,800,800	27,451,903
2013–2014	2,850	14,722	23,535,366	26,414,552
2014–2015	3,005	14,422	25,067,857	27,486,685
2015–2016	2,988	15,077	26,005,891	27,963,324
2016–2017	3,166	15,704	29,310,212	30,950,593
2017–2018	3,202	14,829	28,685,861	29,542,596
2018–2019	3,489	16,318	31,687,399	31,687,399

Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes, that represents government spending on public hospitals and some public hospital services, private hospitals and patient transport services (12).

There were an estimated 18,554 tobacco-attributable hospitalisations for WA Aboriginal people from 2009–2010 to 2018–2019 (Table 6). The WA Aboriginal population had an estimated 85,727 bed days attributable to tobacco smoking over this period, which cost an estimated $169 million before adjusting for inflation.

Table 6. Estimated numbers of tobacco-attributable hospitalisations, bed days, costs and inflation-adjusted costs, WA Aboriginal people, 2009–2010 to 2018–2019

Financial year	Number	Bed days	Costs ($)	Adjusted cost ($)
2009–2010	1,559	7,564	11,793,070	14,541,393
2010–2011	1,659	8,131	11,986,747	14,582,417
2011–2012	1,715	7,937	12,139,768	14,417,776
2012–2013	1,654	7,745	14,962,248	17,257,495
2013–2014	1,727	7,497	15,844,934	17,783,315
2014–2015	1,891	8,255	17,168,163	18,824,740
2015–2016	1,906	8,784	19,191,719	20,636,257
2016–2017	2,070	9,775	21,010,445	22,186,320
2017–2018	2,079	9,078	20,696,708	21,314,839
2018–2019	2,294	10,962	23,827,090	23,827,090

Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes, that represents government spending on public hospitals and some public hospital services, private hospitals and patient transport services (12).

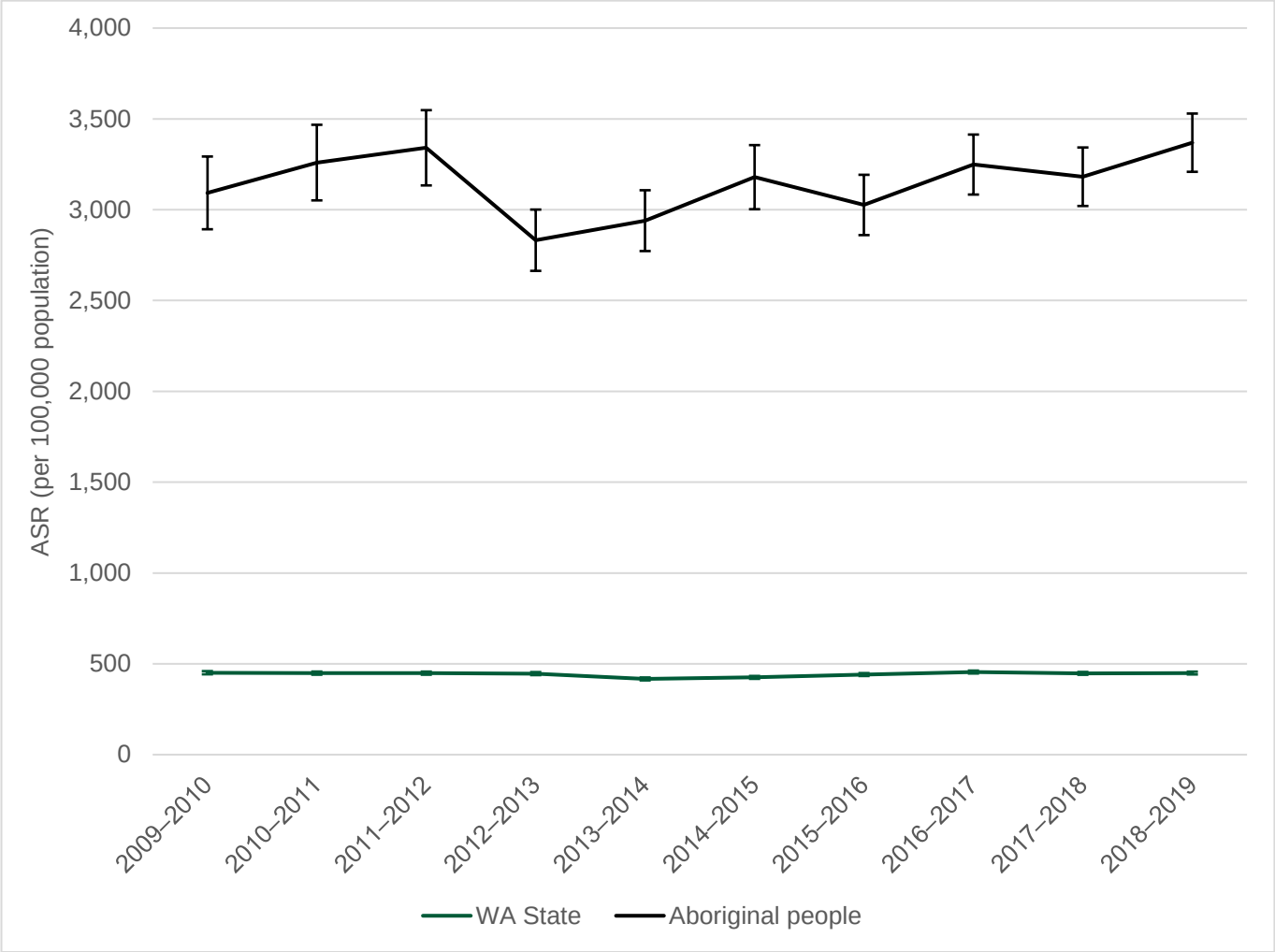
The tobacco-attributable hospitalisation rates for the WA State fluctuated from 2009–2010 to 2018–2019, decreasing from 2009–2010 (451 per 100,000) to 2013–2014 (417 per 100,000) and generally increasing from 2013–2014 to 2018–2019 (449 per 100,000) (Figure 1). The tobacco-attributable hospitalisation rates in the metropolitan area were also variable, generally decreasing from 2009–2010 (416 per 100,000) to 2013–2014 (388 per 100,000) and increasing from 2013–2014 to 2018–2019 (416 per 100,000). Similarly, the tobacco-attributable hospitalisation rates in country WA changed with time, generally decreasing from 2009–2010 (576 per 100,000) to 2013–2014 (514 per 100,000) and increasing from 2013–2014 to 2018–2019 (567 per 100,000). The rates of tobacco-attributable hospitalisations in the metropolitan and country areas were lower and higher respectively than the WA State rates across all financial years.

Figure 1. Age-standardised rates (ASRs) of tobacco-attributable hospitalisations for the WA State, metropolitan and country areas, from 2009–2010 to 2018–2019

Bars represent lower and upper confidence limits for ASRs; see Appendix 1 for ASRs for WA State, metropolitan and country.

The tobacco-attributable hospitalisation rates for the WA Aboriginal population was 6.3–7.5 times greater than the WA State hospitalisation rates at all time points from 2009–2010 to 2018–2019 (Figure 2). These rates fluctuated across the ten-year period, peaking for 2018–2019 (3,369 per 100,000) and dropping to a low of 2,832 per 100,000 for 2012–2013.

Figure 2. ASRs of tobacco-attributable hospitalisations for the WA State and Aboriginal people, from 2009–2010 to 2018–2019



Bars represent lower and upper confidence limits for ASRs; see Appendix 1 for ASRs for WA State and Aboriginal people.

The numbers, rates, bed days, costs, and inflation-adjusted costs of tobacco-attributable hospitalisations for the WA health regions are included in Appendix 1.

Tobacco-attributable deaths

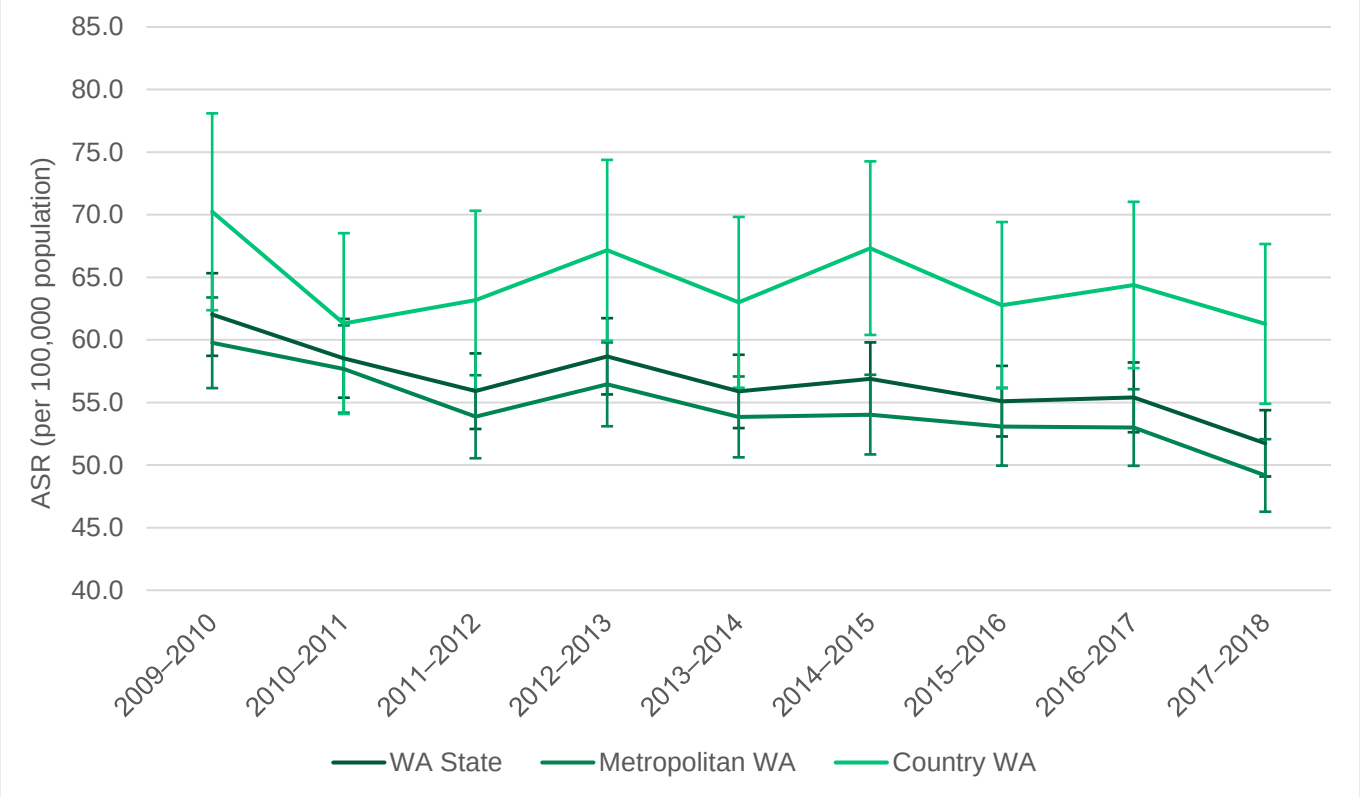
In the 9-year period from 2009–2010 to 2017–2018, there were an estimated 12,952 tobacco-attributable deaths in WA, as well as 704, 9,910 and 3,040 tobacco-attributable deaths in Aboriginal people, metropolitan and country WA respectively (Table 7).

Table 7. Estimated numbers of tobacco-attributable deaths, WA State, Aboriginal people, metropolitan and country areas, 2009–2010 to 2017–2018

Financial year	WA State	Aboriginal people	Metropolitan WA	Country WA
2009–2010	1,376	75	1,060	315
2010–2011	1,350	74	1,065	284
2011–2012	1,339	73	1,029	310
2012–2013	1,450	65	1,110	340
2013–2014	1,422	71	1,086	336
2014–2015	1,499	82	1,127	372
2015–2016	1,490	86	1,138	352
2016–2017	1,542	100	1,172	369
2017–2018	1,484	79	1,122	362

There was a decline in the rate of tobacco-attributable deaths in WA between 2009–2010 (62 per 100 000) and 2017–2018 (52 per 100,000) (Figure 3). A decline in the rate of tobacco-attributable deaths was also observed in metropolitan WA over the same period, from 60 per 100 000 deaths to 49 per 100 000 deaths. Similarly, the rate of tobacco-attributable deaths declined in country WA from 2009–2010 (70 per 100,000) to 2017–2018 (61 per 100,000). In 2017–2018, the rate of tobacco-attributable deaths in country WA (61 per 100,000) was higher compared to the WA State (52 per 100,000) and metropolitan WA (49 per 100,000).

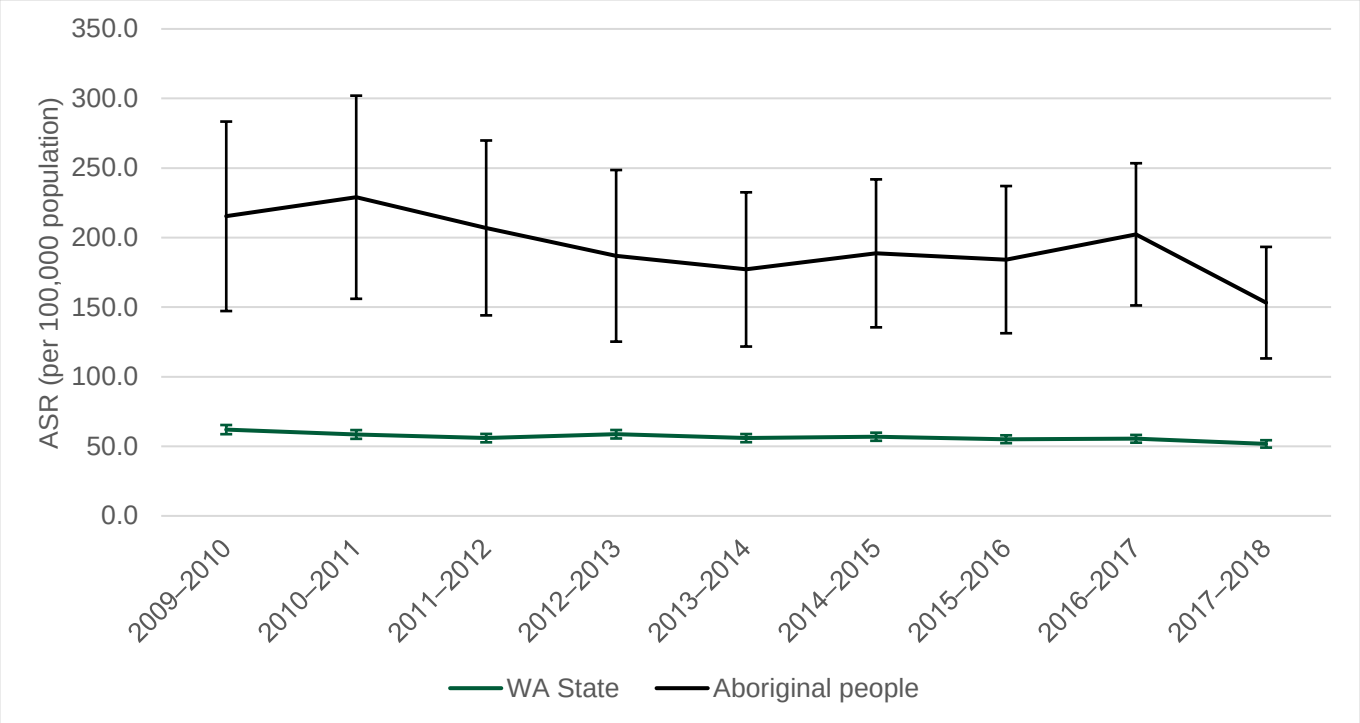
Figure 3. ASRs of tobacco-attributable deaths in metropolitan, country and WA, 2009–2010 to 2017–2018



Bars represent lower and upper confidence limits for ASRs; see Appendix 1 for ASRs for WA State, metropolitan and country.

There was a general decline in the rate of tobacco-attributable deaths among WA Aboriginal people from 2009–2010 (215 per 100,000) to 2017–2018 (153 per 100,000) (Figure 4). The rate of tobacco-attributable deaths was 3.0–3.9 times higher in the WA Aboriginal population compared to the WA State population across all time points.

Figure 4. ASRs of tobacco-attributable deaths in the WA State and Aboriginal people, 2009–2010 to 2017–2018



Bars represent lower and upper confidence limits for ASRs; see Appendix 1 for ASRs for WA State and Aboriginal people.

The numbers and rates of tobacco-attributable deaths for the WA health regions are included in Appendix 1.

Limitations

Application of prevalence data across a range of years assumes that smoking prevalence has remained fairly stable over time. This is true across most years, however, the prevalence of smoking was significantly higher for Western Australians in 2009 and 2010 compared to 2018 (3), which may lead to underestimation of the harms attributable to tobacco-smoking in the 2009–2010 financial year.

The lung cancer mortality rate for never smokers from the United States CPS-II study was used as a proxy for lung cancer mortality rates for never smokers in the WA State and WA Aboriginal populations due to a lack of data. This assumes that the lung cancer mortality rates for never smokers (which tends to be small (7)) will be the same for these different populations. In investigations where never smoker lung cancer mortality rates were available, mortality rates for never smokers were similar to those from the CPS-II study, and consequently most studies use never smokers from CPS-II as a proxy for never smokers in the population of interest (7, 10).

National survey data from the ABS TableBuilder (Table 2) were used to estimate the current and four-year lagged prevalence of tobacco smoking for the WA Aboriginal population. The National Aboriginal and Torres Strait Islander Health Survey 2018–2019 had limited age breakdowns (e.g. 0–14, 15+ years); therefore, the proportion of smokers in each age group from the National Aboriginal and Torres Strait Islander Social Survey 2014–2015 were used to apportion smokers to five-year age groups in 2018–2019 from age 15–74 years. This assumes that the proportion of smokers in each group in 2014–2015 will be the same for 2018–2019, which may not be the case.

Another limitation of both the national and state-based survey data is that active smoking data is not collected for those aged less than 15 years (13, 14). The proportion of tobacco smoking is likely to be small in younger age groups (e.g. data from the Australian Secondary Schools' Alcohol and Drug Survey found that in 2017, 2.2% of secondary school students aged 12–14 years were current smokers (15)), therefore, any harms associated with tobacco-smoking in under 15 year-olds are likely to be minimal and should not have a large impact on our estimates.

Our report uses current smoking to measure smoking prevalence irrespective of whether smoking occurred daily or less than daily. This approach is consistent with the methods used by the AIHW in the Australian Burden of Disease Study 2015 (6). This method contrasts to the approach used by the NDRI, who used daily smoking prevalence in their 2019 report (7). We have chosen to use all current smokers to account for social desirability bias in survey reporting and to avoid under-estimating the harms associated with tobacco smoking. Any over-estimation of hospitalisations and deaths attributable to tobacco smoking is likely to be minimised by the smaller prevalence of occasional smokers than daily smokers and likelihood that some self-reported occasional smokers should be included in the daily smoker category (3, 7).

The Global Burden of Disease Study 2017 used pack-years to measure exposure among current and former smokers (16). This method measures cumulative exposure to tobacco smoke, which is based on the intensity and duration of smoking. One pack is assumed to be approximately 20 cigarettes; therefore, one pack year would equate to smoking 20 cigarettes per day for one year (16). Pack-years were not used for this project as the number of cigarettes smoked per day were either not available or not accessible from the data sources used.

The health impacts of e-cigarettes and tobacco chewing were not considered in this analysis. This was due to the present lack of epidemiological evidence on the risks associated with e-cigarette smoking (7) and the low prevalence of tobacco chewing in Australia (6).

Summary

This report describes the methods used by the Epidemiology Directorate to update the tobacco-smoking AFs for WA using recent prevalence and relative risk estimates. These updated AFs were applied to WA hospital and deaths data to determine the numbers, rates, bed days and costs associated with tobacco-attributable hospitalisations and deaths for the State, Aboriginal people, metropolitan and country WA, and the WA health region populations. While the prevalence of smoking has decreased in WA over time, the number of tobacco-attributable hospitalisations, deaths, bed days and associated costs have all increased, likely with increases in the overall size of the WA population. Therefore, tobacco-smoking remains a significant contributor to poor health and mortality in WA.

WA's various populations do not experience the burden of tobacco-attributable hospitalisations and deaths equally. Those who live in metropolitan WA have lower rates of tobacco-attributable hospitalisations and deaths than those who live in the country. Additionally, the rates of tobacco-attributable hospitalisations and deaths are much higher among WA Aboriginal people than the WA State population. There is also variance in the rates of tobacco-attributable hospitalisations and deaths between metropolitan areas (i.e. the East, North and South Metropolitan Health Service areas) and country health regions (i.e. the Goldfields, Great Southern, Kimberley, Midwest, Pilbara, South West and Wheatbelt health regions).

The estimates from this report can be used by government and not-for-profit organisations to understand the impacts of tobacco-smoking in the WA State, Aboriginal, metropolitan, country and health region populations. The AFs provide an indication of the hospitalisations and deaths that could be prevented in the WA population if tobacco smoking was ceased. These estimates can therefore be used to support public health advocacy, as well as planning and development of policies, programs and services designed to reduce the impacts of tobacco smoking on the health of Western Australians.

Appendix 1: Additional estimates

Tobacco-attributable hospitalisations and costs

Table 8. ASRs of tobacco-attributable hospitalisations for WA State, Aboriginal people, metropolitan and country areas, 2009–2010 to 2018–2019

Financial year	WA State ASR (LCI–UCI)	Aboriginal people ASR (LCI–UCI)	Metropolitan WA ASR (LCI–UCI)	Country WA ASR (LCI–UCI)
2009–2010	451.1 (442.2–459.9)	3,092.7 (2,892.4–3,292.9)	415.6 (406.1–425.2)	576.2 (554.6–597.9)
2010–2011	448.7 (440.0–457.3)	3,259.5 (3,051.5–3,467.5)	411.5 (402.2–420.9)	579.4 (558.0–600.8)
2011–2012	448.6 (440.1–457.1)	3,341.0 (3,133.8–3,548.1)	421.0 (411.7–430.3)	546.1 (525.7–566.5)
2012–2013	446.1 (437.7–454.5)	2,832.1 (2,663.3–3,000.9)	412.3 (403.2–421.4)	566.4 (545.9–586.9)
2013–2014	416.8 (408.8–424.8)	2,939.8 (2,772.4–3,107.2)	388.4 (379.7–397.1)	514.0 (494.9–533.2)
2014–2015	425.2 (417.2–433.2)	3,179.3 (3,002.8–3,355.7)	395.1 (386.5–403.8)	529.2 (510.0–548.3)
2015–2016	440.9 (432.9–449.0)	3,026.2 (2,860.2–3,192.2)	417.7 (408.9–426.5)	521.4 (502.5–540.4)
2016–2017	454.7 (446.7–462.8)	3,248.6 (3,083.4–3,413.8)	429.1 (420.3–437.9)	543.1 (524.0–562.3)
2017–2018	447.5 (439.6–455.3)	3,181.6 (3,020.5–3,342.6)	423.4 (414.8–432.0)	530.9 (512.3–549.6)
2018–2019	449.2 (441.4–457.0)	3,369.0 (3,208.7–3,529.3)	416.0 (407.6–424.4)	566.9 (547.8–586.0)

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR.

Table 9. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the East Metropolitan Heath Service (EMHS), 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	2,582	462.0 (444.0–479.9)	14,725	20,004,321	24,666,241
2010–2011	2,686	467.9 (450.1–485.8)	15,024	19,981,965	24,308,959
2011–2012	2,836	478.4 (460.6–496.2)	14,552	20,810,251	24,715,262
2012–2013	2,797	458.6 (441.5–475.8)	14,423	25,046,481	28,888,675
2013–2014	2,720	436.6 (420.0–453.2)	14,000	25,648,498	28,826.597
2014–2015	2,760	430.3 (414.1–446.5)	13,737	26,097,940	28,616,162
2015–2016	3,037	462.1 (445.5–478.7)	15,508	30,217,872	32,492,336
2016–2017	3,147	466.8 (450.4–483.3)	16,156	33,721,839	35,609,123
2017–2018	3,216	461.2 (445.1–477.3)	15,623	32,494,269	33,464,747
2018–2019	3,177	441.8 (426.4–457.3)	15,475	31,878,475	31,878,475

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 10. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the North Metropolitan Heath Service (NMHS), 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	2,405	375.4 (360.3–390.5)	13,079	17,250,524	21,270,684
2010–2011	2,486	377.2 (362.2–392.1)	13,487	18,493,227	22,497,843
2011–2012	2,592	379.9 (365.2–394.7)	13,616	18,715,312	22,227,211
2012–2013	2,650	379.4 (364.8–393.9)	13,872	22,333,059	25,759,006
2013–2014	2,509	350.0 (336.2–363.8)	13,968	21,687,232	24,340,328
2014–2015	2,541	347.5 (333.9–361.1)	13,333	22,472,164	24,639,434
2015–2016	2,666	357.7 (344.0–371.4)	14,344	25,703,405	27,638,070
2016–2017	2,841	371.3 (357.6–385.1)	15,050	28,663,781	30,267,984
2017–2018	2,896	366.5 (353.1–380.0)	14,878	28,070,448	28,908,804
2018–2019	3,015	369.9 (356.6–383.2)	15,848	29,900,368	29,900,368

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 11. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the South Metropolitan Heath Service (SMHS), 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	2,407	414.0 (397.4–430.7)	12,989	17,587,123	21,685,725
2010–2011	2,396	395.3 (379.4–411.2)	12,046	16,302,694	19,832,961
2011–2012	2,568	410.5 (394.5–426.5)	12,756	17,990,771	21,366,711
2012–2013	2,592	403.9 (388.2–419.5)	12,514	21,634,920	24,953,771
2013–2014	2,546	384.3 (369.3–399.3)	12,917	22,538,697	25,295,956
2014–2015	2,803	411.9 (396.6–427.3)	13,463	24,265,436	26,606,838
2015–2016	3,075	440.1 (424.4–455.7)	15,332	29,362,498	31,572,579
2016–2017	3,282	454.5 (438.8–470.2)	15,845	32,196,950	33,998,892
2017–2018	3,336	447.2 (431.9–462.5)	15,078	30,044,738	30,942,057
2018–2019	3,382	439.1 (424.2–454.1)	15,643	32,960,220	32,960,220

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 12. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the Goldfields health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	313	688.3 (607.6–769.0)	1,605	1,997,002	2,462,395
2010–2011	292	604.3 (531.2–677.3)	1,554	1,900,315	2,311,819
2011–2012	337	693.6 (615.9–771.3)	1,801	2,377,513	2,823,649
2012–2013	320	637.6 (564.8–710.3)	1,549	2,314,829	2,669,929
2013–2014	286	542.7 (477.7–607.8)	1,407	2,405,597	2,699,885
2014–2015	288	533.8 (470.2–597.4)	1,328	2,554,307	2,800,775
2015–2016	301	610.9 (539.1–682.6)	1,322	2,699,577	2,902,771
2016–2017	274	525.6 (461.1–590.1)	1,410	2,791,201	2,947,413
2017–2018	296	566.7 (500.0–633.3)	1,331	2,679,714	2,759,747
2018–2019	328	620.6 (551.4–689.9)	1,566	2,726,902	2,726,902

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 13. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the Great Southern health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	291	433.8 (383.2–484.5)	1,706	2,103,713	2,593,974
2010–2011	283	409.3 (360.9–457.8)	1,492	1,809,473	2,201,305
2011–2012	310	429.2 (380.6–477.7)	1,518	2,062,625	2,449,673
2012–2013	333	450.7 (401.5–500.0)	1,708	2,720,817	3,138,197
2013–2014	291	379.2 (334.9–423.6)	1,628	2,316,985	2,600,432
2014–2015	332	414.9 (369.2–460.5)	1,517	2,576,361	2,824,957
2015–2016	337	411.7 (366.4–456.9)	1,738	2,818,116	3,030,233
2016–2017	386	457.6 (410.5–504.8)	1,863	3,204,927	3,384,295
2017–2018	392	452.0 (405.6–498.3)	1,808	3,205,853	3,301,599
2018–2019	393	452.6 (406.1–499.1)	1,792	3,316,874	3,316,874

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 14. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the Kimberley health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	204	816.7 (685.6–947.8)	881	1,300,943	1,604,122
2010–2011	249	1,028.7 (876.5–1,180.9)	1,171	1,697,535	2,065,127
2011–2012	262	988.7 (847.2–1,130.1)	1,196	1,791,480	2,127,649
2012–2013	241	840.2 (718.5–962.0)	1,030	1,795,468	2,070,898
2013–2014	276	1,010.1 (872.0–1,148.2)	1,163	2,120,479	2,379,887
2014–2015	277	1013.6 (873.1–1,154.1)	1,141	2,215,497	2,429,273
2015–2016	233	802.7 (682.5–922.9)	928	1,851,236	1,990,576
2016–2017	291	1,085.6 (937.6–1,233.6)	1,228	2,563,372	2,706,834
2017–2018	289	1,044.2 (902.3–1,186.1)	1,191	2,684,475	2,764,650
2018–2019	338	1,123.6 (988.4–1,258.8)	1,538	3,039,301	3,039,301

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 15. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the Midwest health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	453	705.7 (639.9–771.5)	2,661	3,570,952	4,403,146
2010–2011	427	648.7 (586.3–711.0)	2,461	2,942,777	3,580,021
2011–2012	416	610.4 (551.0–669.9)	2,167	2,768,063	3,287,486
2012–2013	424	600.7 (542.9–658.6)	2,160	3,583,801	4,133,565
2013–2014	437	609.4 (551.6–667.1)	2,453	3,701,002	4,153,762
2014–2015	469	645.7 (586.6–704.9)	2,262	4,112,565	4,509,392
2015–2016	458	620.1 (562.5–677.7)	2,248	4,135,187	4,446,437
2016–2017	503	682.5 (621.9–743.0)	2,480	4,961,106	5,238,760
2017–2018	482	639.8 (581.6–698.0)	2,385	4,865,409	5,010,720
2018–2019	518	674.9 (615.7–734.2)	2,795	5,436,853	5,436,853

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 16. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the Pilbara health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	200	718.0 (567.0–869.1)	883	1,357,465	1,673,817
2010–2011	207	951.7 (749.2–1,154.2)	1,029	1,597,748	1,943,733
2011–2012	180	656.5 (496.7–816.3)	698	1,250,312	1,484,931
2012–2013	181	537.6 (415.1–660.0)	872	1,423,519	1,641,890
2013–2014	187	555.2 (430.0–680.4)	721	1,603,237	1,799,368
2014–2015	170	471.6 (363.7–579.4)	639	1,410,324	1,546,408
2015–2016	177	585.1 (439.2–731.1)	750	1,569,893	1,688,057
2016–2017	229	799.7 (639.0–960.5)	1,049	2,076,443	2,192,654
2017–2018	229	814.7 (650.6–978.9)	793	1,793,254	1,846,812
2018–2019	242	705.7 (574.2–837.2)	892	2,137,643	2,137,643

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 17. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the South West health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	868	523.4 (488.3–558.5)	4,276	5,623,774	6,934,370
2010–2011	972	558.6 (523.1–594.1)	4,387	6,243,532	7,595,538
2011–2012	882	491.8 (459.0–524.6)	4,167	5,858,264	6,957,558
2012–2013	1,006	547.7 (513.5–581.9)	4,393	7,741,822	8,929,438
2013–2014	854	439.7 (409.9–469.6)	4,135	6,739,179	7,563,613
2014–2015	905	450.2 (420.5–480.0)	4,736	7,227,601	7,925,001
2015–2016	951	459.6 (430.0–489.3)	4,976	8,160,816	8,775,071
2016–2017	952	444.1 (415.4–472.8)	4,876	8,884,074	9,381,282
2017–2018	976	437.1 (409.1–465.0)	4,639	8,391,538	8,642,161
2018–2019	1,070	465.4 (436.9–493.8)	5,066	9,450,703	9,450,703

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Table 18. Numbers and ASRs of tobacco-attributable hospitalisations and estimated bed days, costs and inflation-adjusted costs for the Wheatbelt health region, 2009–2010 to 2018–2019

Financial year	Number	ASR (LCI–UCI)	Bed days	Costs ($)	Adjusted costs ($)
2009–2010	464	520.3 (472.0–568.5)	2,872	3,132,774	3,862,853
2010–2011	473	514.2 (467.0–561.4)	2,876	3,359,002	4,086,377
2011–2012	445	474.3 (429.3–519.2)	2,244	3,037,069	3,606,970
2012–2013	514	524.4 (478.2–570.6)	3,233	4,220,544	4,867,986
2013–2014	518	520.0 (474.3–565.6)	3,216	4,648,887	5,217,606
2014–2015	563	542.1 (496.3–587.9)	2,800	4,971,202	5,450,879
2015–2016	530	513.7 (468.8–558.7)	3,116	4,771,065	5,130,178
2016–2017	531	513.1 (468.2–558.0)	2,798	4,829,089	5,099,355
2017–2018	538	498.2 (454.6–541.9)	2,682	5,065,617	5,216,908
2018–2019	600	542.8 (497.9–587.8)	2,669	5,579,124	5,579,124

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; Adjusted-costs are adjusted by the GFCE on hospitals and nursing homes (12).

Tobacco-attributable deaths

Table 19. Estimated rates of tobacco-attributable deaths, WA State, Aboriginal people, metropolitan and country areas, 2009–2010 to 2017–2018

Financial year	WA State ASR (LCI–UCI)	Aboriginal people ASR (LCI–UCI)	Metropolitan WA ASR (LCI–UCI)	Country WA ASR (LCI–UCI)
2009–2010	62.0 (58.7–65.3)	215.3 (147.2–283.4)	59.8 (56.1–63.4)	70.2 (62.4–78.1)
2010–2011	58.5 (55.4–61.7)	229.0 (156.0–302.1)	57.7 (54.2–61.2)	61.3 (54.1–68.5)
2011–2012	55.9 (52.9–58.9)	207.0 (144.1–269.8)	53.9 (50.5–57.2)	63.2 (56.0–70.3)
2012–2013	58.7 (55.6–61.7)	186.9 (125.2–248.6)	56.4 (53.1–59.8)	67.2 (59.9–74.4)
2013–2014	55.9 (53.0–58.8)	177.1 (121.7–232.6)	53.8 (50.6–57.1)	63.0 (56.2–69.8)
2014–2015	56.9 (54.0–59.8)	188.7 (135.5–241.9)	54.0 (50.8–57.2)	67.3 (60.4–74.3)
2015–2016	55.1 (52.3–57.9)	184.2 (131.3–237.1)	53.1 (50.0–56.2)	62.8 (56.1–69.4)
2016–2017	55.4 (52.6–58.2)	202.4 (151.3–253.5)	53.0 (49.9–56.1)	64.4 (57.7–71.0)
2017–2018	51.7 (49.1–54.4)	153.2 (113.2–193.3)	49.2 (46.3–52.1)	61.3 (54.9–67.7)

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR.

Table 20. Estimated number and rates of tobacco-attributable deaths, EMHS, NMHS and SMHS, 2009–2010 to 2017–2018

Financial year	EMHS		NMHS		SMHS	
	Number	ASR (LCI–UCI)	Number	ASR (LCI–UCI)	Number	ASR (LCI–UCI)
2009–2010	362	66.6 (59.7–73.5)	325	50.4 (44.9–55.9)	374	63.5 (57.0–69.9)
2010–2011	339	59.7 (53.3–66.1)	364	54.8 (49.2–60.5)	362	58.8 (52.7–64.8)
2011–2012	344	58.3 (52.1–64.5)	341	50.3 (44.9–55.7)	344	53.7 (48.0–59.4)
2012–2013	383	63.5 (57.1–69.9)	342	48.5 (43.3–53.7)	385	58.4 (52.6–64.3)
2013–2014	350	57.0 (51.0–63.0)	364	49.9 (44.7–55.1)	371	55.0 (49.4–60.6)
2014–2015	386	60.3 (54.2–66.4)	364	48.7 (43.6–53.7)	377	53.7 (48.2–59.1)
2015–2016	413	63.7 (57.5–69.9)	328	42.7 (38.0–47.4)	397	54.4 (49.0–59.8)
2016–2017	404	59.9 (54.0–65.8)	352	45 (40.2–49.7)	416	55.0 (49.7–60.3)
2017–2018	384	55.1 (49.5–60.6)	333	41.1 (36.7–45.6)	405	52.3 (47.1–57.4)

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR.

Table 21. Estimated number and rates of tobacco-attributable deaths, Goldfields, Great Southern and Kimberley, 2009–2010 to 2017–2018

Financial year	Goldfields		Great Southern		Kimberley	
	Number	ASR (LCI–UCI)	Number	ASR (LCI–UCI)	Number	ASR (LCI–UCI)
2009–2010	38	105.0 (70.3–139.7)	43	61.4 (42.8–79.9)	13	N/A
2010–2011	23	57.3 (32.6–82.1)	35	48 (31.9–64.2)	15	N/A
2011–2012	36	83.6 (54.8–112.3)	34	45.6 (30.3–60.9)	17	N/A
2012–2013	35	77.0 (50.7–103.3)	44	57.2 (40.2–74.1)	16	N/A
2013–2014	25	60.2 (36.2–84.1)	49	60.1 (43.2–77.0)	24	125.2 (67.3–183.1)
2014–2015	40	90.3 (61.5–119.2)	52	59.9 (43.5–76.3)	24	118.0 (62.6–173.3)
2015–2016	31	73.2 (46.6–99.9)	48	54.2 (38.8–69.6)	21	109.4 (54.1–164.8)
2016–2017	40	95.9 (64.9–126.9)	54	59.6 (43.6–75.6)	22	105.3 (50.1–160.6)
2017–2018	32	71.5 (45.8–97.2)	55	58.3 (42.8–73.9)	14	N/A

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; ASR derived from a low count is not reliable, therefore it is not calculated when the number is <20.

Table 22. Estimated number and rates of tobacco-attributable deaths, Midwest and Pilbara, 2009–2010 to 2017–2018

Financial year	Midwest		Pilbara	
	Number	ASR (LCI–UCI)	Number	ASR (LCI–UCI)
2009–2010	58	94.7 (69.9–119.5)	13	N/A
2010–2011	50	82.5 (59.5–105.6)	10	N/A
2011–2012	51	76.5 (55.2–97.9)	10	N/A
2012–2013	50	72.3 (52.1–92.6)	13	N/A
2013–2014	59	82.4 (61.1–103.6)	16	N/A
2014–2015	47	64.1 (45.6–82.7)	12	N/A
2015–2016	59	81.6 (60.6–102.7)	9	N/A
2016–2017	53	71.3 (51.8–90.9)	13	N/A
2017–2018	63	82.7 (62.0–103.4)	9	N/A

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR; ASR derived from a low count is not reliable, therefore it is not calculated when the number is <20.

Table 23. Estimated number and rates of tobacco-attributable deaths, South West and Wheatbelt, 2009–2010 to 2017–2018

Financial year	South West		Wheatbelt	
	Number	ASR (LCI–UCI)	Number	ASR (LCI–UCI)
2009–2010	95	58.6 (46.8–70.5)	54	63.0 (46.0–79.9)
2010–2011	93	54.9 (43.7–66.2)	58	63.6 (47.1–80.1)
2011–2012	111	62.1 (50.4–73.7)	52	55.8 (40.4–71.2)
2012–2013	107	59.3 (48.0–70.7)	74	76.2 (58.7–93.7)
2013–2014	98	50.5 (40.4–60.6)	64	63.3 (47.7–79.0)
2014–2015	132	64.6 (53.5–75.7)	64	60.4 (45.4–75.3)
2015–2016	110	51.2 (41.5–60.8)	73	68.6 (52.6–84.6)
2016–2017	116	52.1 (42.6–61.7)	72	67.4 (51.6–83.2)
2017–2018	124	54.7 (44.9–64.4)	64	57.9 (43.5–72.3)

All rates are per 100,000 population; ASR = Age-standardised rate; ASR LCI = 95% lower confidence limit for ASR; ASR UCI = 95% upper confidence limit for ASR.

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