EVALUATE

Economics. Policy. Strategy.

The economic value of adult vaccination in Australia

GSK Australia

October 2024

Prepared by: Professor David Cullen, Alastair Furnival and Catherine McGovern, Evaluate

121 Harrington Street, The Rocks NSW 2000

T +61 (0)2 9234 3883 E alastair@evaluate.net.au, catherine@evaluate.net.au
W evaluate.net.au

Authors

Alastair Furnival and Catherine McGovern are Partners and Professor David Cullen is a Principal at Evaluate.

Evaluate

Evaluate was formed in September 2016, to bring fresh thinking to policy and economic questions, particularly those in the social sphere.

Our particular goal is to identify long-term solutions to ensuring the sustainability of Australia's admirable social compact, including universal access to healthcare and education, and the supply of aged care, housing and other social infrastructure.

Our approach is based on a traditional microeconomic toolkit, moderated by the knowledge that social services are accessed by people with a vast variety of experiences, needs and resources. Consequently, we have no bias towards either public or private supply of services, noting that the access and welfare needs of different Australians typically require a mix of both.

The Principals of Evaluate are experienced professionals, and we complement this with external expertise where appropriate.

www.evaluate.net.au

Funding

This research was requested and funded by GSK Australia. GSK acknowledges that, as with any medical intervention, vaccinations come with benefits and risks.

GSK Australia

www.au.gsk.com

Acknowledgements

The authors wish to thank and acknowledge the individuals who participated in consultations as part of the preparation of this submission. Any misinterpretations or errors are entirely those of the authors.

Table of Contents

Overview

Summary of key findings

The overall story of this study is that there will be significant economic returns from investing in preventive health by implementing the recommendations of the Australian Technical Advisory Group on Immunisation (ATAGI) for adults. Benefits will substantially exceed costs.

- **The average return on investment for vaccinating Australians: once against herpes zoster at the age of 50; annually against influenza from ages 50 to 64; and once against respiratory syncytial virus (RSV) at the age of 75 with a booster every five years exceeds three times the cost to the economy required to fund them;**

- **Funding each vaccine as outlined above would deliver returns which individually exceed the expenditure required to fund them by a factor of at least two;**

- **This is based on a net annualised cost to the economy of around $320 million for a preventive health measure, which delivers over $1.1 billion of benefits to Australians with 95% coverage.**

Further, the following statements may be made about each vaccine:

- **The herpes zoster (shingles) vaccine is cost-effective for all Australians at age 50 and with a catch-up for all Australians aged 50-64.** The shingles vaccine is marketed as *Shingrix* and is manufactured by GSK**;**

- **Annual influenza vaccination for all Australians aged 50-64 is highly cost effective; and,**

- **Vaccination against respiratory syncytial virus (RSV) is likewise cost-effective for all Australians over 75 with better value being associated with a booster at five years rather than three.** Clinical evidence and guidance related to RSV is emerging and guidelines on RSV boosters are not yet established. The RSV vaccine is marketed as *Arexvy* and is manufactured by GSK.

There are multiple other combinations which are cost-effective and can be produced as required from the model.

In contrast, the model shows that there is no general age cohort for whom the pertussis vaccine (whooping cough) is cost-effective and, as a result, this is not recommended for inclusion. There is similarly no cost-effective case for funding the diphtheria vaccine.

These statements are supported by the data in Tables One and Two which summarise the return on investment (ROI) for investment in three vaccines. These are for the first year of expenditure and based on 95% and 80% uptake of each vaccine respectively. They are highly-cost effective options for each vaccine.

Table One: Cost-benefit analysis of three vaccines with 95% takeup across target population

Scenario	Net Cost to the Economy	QALYs Gained	QALY Value	Return on Investment
Herpes Zoster: Vaccinate once at age 50	$64,885,000	3,049	$152,427,500	2.35
Influenza: Vaccinate all aged 50-64	$137,000,000	6,064	$303,200,000	2.21
RSV: Vaccinate once at 75 with a 5-yearly booster	$121,695,000	13,741	$687,040,000	5.65
Total	$323,580,000	22,853	$1,142,667,500	3.53

Table Two: Cost-benefit analysis of three vaccines with 80% takeup across target population

Scenario	Net Cost to the Economy	QALYs Gained	QALY Value	Return on Investment
Herpes Zoster: Vaccinate once at age 50	$54,640,000	2,567	$128,360,000	2.35
Influenza: Vaccinate all aged 50-64	$115,400,000	5,107	$255,350,000	2.21
RSV: Vaccinate once at 75 with a 5-yearly booster	$102,480,000	11,571	$578,560,000	5.65
Total	$272,520,000	19,245	$962,270,000	3.53

Net cost to the economy is the total cost of delivering vaccination (including future boosters) discounted by public economic benefits due to both reduced health system savings (mostly hospital expenditure) as well as increased productivity gains. This then allows a proper comparison between public cost and health benefits expressed purely in terms of increased length and quality of life.

Health benefits are measured in the standard form of Quality-Adjusted Life Years (QALYs) which are each valued at $50,000. These represent a mix of both extra life expectancy as well as improved quality of life from reduced disease and disability.

Separately, the *direct cost to Government* for each of the first five years of these programs is detailed in Table Three.

Table Three: Direct Budget Costs Years 1-5

Scenario	Annual Direct Cost with 95% Coverage	Annual Direct Cost with 80% Coverage
Herpes Zoster: Vaccinate once at age 50	$191,330,000	$161,120,000
Influenza: Vaccinate all aged 50-64	$179,400,000	$151,073,684
RSV: Vaccinate once at 75 with a five-yearly booster	$155,990,000	$131,360,000
Total	**$526,720,000**	**$443,553,684**

Each of these conclusions has been subjected to sensitivity analysis and none of them is changed by such testing. Detailed exposition of the model and associated results is outlined in this report.

Importantly, the cost-benefit analysis in this study assumes normal rates of interruption to health and productivity with correspondingly normal costs to the health system and the economy. Despite this, the recent experience of the acute COVID-19 pandemic underscores that there are much more substantial economic risks which can be addressed through timely vaccination. This is at the least an argument for greater investment in preventive health.

The solution – capturing the benefits of adult vaccination

The benefits of some vaccines are extremely high compared to their costs and this paper evaluates what it would cost to meet the full schedule of ATAGI recommendations for adult Australians. This is in turn filtered by a cost-benefit analysis which considers whether increased investment in vaccination is at least as efficient as investment in other health priorities. The conclusion of this study is that there is currently an undervaluation of available vaccines and that it would be sensible from both health and broader economic perspectives to address this. This will require reconsideration of the importance and economics of preventive health versus later treatment.

To protect adults and capture the benefits available from broader adult vaccination, Australia should:

- **Reform reimbursement systems and processes to recognise the value of vaccines and disease prevention**

  This includes:

  - Recognising the health outcomes and productivity gains that accrue over a lifetime, including via the adoption of a lower discount rate.
  - Develop new pathways to support faster access to appropriate vaccines for Australians where there is a need.

- **Prioritise adult vaccination in the National Immunisation Program (NIP), drawing on the success of the childhood vaccination experience**

  This includes:

  - **Defined immunisation rate goals, governance and review frameworks** – driving accountability and quality improvement using the Australian Immunisation Register (AIR) and established reporting frameworks.
  - **New adult immunisation schedule** – setting out clear timelines and recommendations, maximising opportunities for co-administration and alignment with life events (such as age, health screenings), including prompts for health professionals and consumers.
  - **Awareness and communications materials for the community and health professionals** – focusing on reaching our community's most vulnerable and increasing confidence in vaccinations. Materials would include easy-English, translations and targeted materials for Aboriginal and Torres Strait Islander people.
  - **Boosting the accessibility of vaccinations** – leveraging existing health networks and key partners such as community health centres, councils, pharmacies, aged care facilities, primary care, and clinical specialty groups.

Introduction

Immunising the adult population of Australia with those vaccines recommended by the Australian Technical Advisory Group on Immunisation (ATAGI) has the potential to deliver $1.1 billion in annual benefits. It will also improve the health of Australian adults and help them live healthier, more productive lives.

Australia's National Immunisation Program (NIP) has traditionally prioritised the protection of children from disease. Funding childhood vaccines coupled with a variety of other settings – including adoption of target rates for immunisation, incentives for families and general practitioners and clear reporting processes – has delivered strong results with nearly 94% of children fully vaccinated at the age of five.

One of the consequences of this prioritisation of infants and children is that there is greater health inequity as Australians age as, while wealthier Australians can privately afford a full range of available – and recommended – vaccines, those in lower socio-economic cohorts have much more limited access, which magnifies the health gap.

This report quantifies the benefits Australia could capture vaccinating its adult population as recommended by ATAGI and how this might be best achieved.

The modelling in this report reflects the 3.5% discount rate recommended in the recently released *Health Technology Assessment Policy and Methods Review – Final report.* The implementation of this Review and the *National Immunisation Strategy 2035-2030* – which is being finalised – offers the opportunity to prioritise adult vaccination and adopt the solutions outlined in this report.

Vaccination in Australia

About the National Immunisation Program

Routine immunisation of infants in Australia began in the 1950 and the first nationally funded infant program for diptheria, tetanus and polio started in 1975.[1] Since then, the National Immunisation Program (NIP) has grown to a major public health program that is recognised internationally for its success.

The NIP provides Government funded vaccinations to Australians at no cost. The Federal Government is responsible for immunisation policy and the purchase of vaccines while State and Territory Governments are responsible for the distribution and service delivery of the vaccinations.[2]

While the NIP Schedule does include a series of immunisations throughout life, its priority to date has been protecting children from disease. The NIP has delivered results with more than 91% of children fully immunised by the age of two and diseases such as measles, polio, and rubella almost or fully eliminated.[3] As noted above, this increases to nearly 94% by age five.

About Australian Technical Advisory Group on Immunisation

ATAGI performs a number of roles regarding immunisation policy, procedures and vaccine safety. For the purposes of this report, their key roles are in advising the Minister for Health and Aged Care on the administration of vaccines available in Australia, including those available through the NIP.

ATAGI members are appointed by the Minister for Health and have a variety of expertise, including research, clinical and implementation/service delivery. ATAGI members also include consumer representatives and ex-officio members.[4]

Adult vaccination in Australia

There are significant gaps between those vaccines recommended for adults by the ATAGI to the Schedule funded by NIP. Addressing gaps would deliver significant benefit. At present, vaccines recommended by ATAGI for adult Australians but not funded by the NIP include:[5]

- **Herpes zoster (shingles) vaccines:** all immunocompetent adults aged 50 years;

---

[1] Australian Government Department of Health, *National Immunisation Strategy for Australia 2019-2024*, 2019. https://www.health.gov.au/resources/publications/national-immunisation-strategy-for-australia-2019-to-2024 Accessed May 2024.
[2] Ibid.
[3] Australian Institute of Health and Welfare, *Australia's Children,* 2020. https://www.aihw.gov.au/getmedia/6af928d6-692e-4449-b915-cf2ca946982f/aihw-cws-69-print-report.pdf Accessed July 2024.
[4] Department of Health and Aged Care, "Australian Technical Advisory Group on Immunisation (ATAGI)", July 2024. https://www.health.gov.au/committees-and-groups/atagi#members Accessed October 2024.
[5] Department of Health and Aged Care, "Australian Immunisation Handbook: Vaccine preventable diseases", 2024. https://immunisationhandbook.health.gov.au/contents/vaccine-preventable-diseases Accessed October 2024; Department of Health and Aged Care, "National Immunisation Program Schedule". 2024. www.health.gov.au/topics/immunisation/when-to-get-vaccinated/nationalimmunisation-program-schedule Accessed October 2024.

- **Influenza vaccines**: every Australian aged 6 months and older;
- **Vaccines against respiratory syncytial virus (RSV)**: people aged 75 years and over; Aboriginal and Torres Strait Islander people aged 60 to 74 years; people aged 60 to 74 years with medical conditions that increase their risk of severe disease due to RSV. In addition, people aged 60 to 74 years who do not have a risk factor for severe RSV disease can consider a single dose of RSV vaccine;
- **Pertussis (whooping cough) vaccines**: all adults 50 years old and over would receive a dose of dTpa if they received their last dose more than ten years ago as would women who are breastfeeding; healthcare workers; early childhood educators and carers; travellers; adult household contacts and carers of infants; and people with a history of pertussis infection; and,
- **Diphtheria vaccines**: all adults 50 years old and over would receive a booster dose of diphtheria containing vaccine if they received their last dose more than ten years ago *and* adults aged 65 years and over would receive a booster dose of dTpa (diphtheria tetanus and pertussis) if their last dose was more than 10 years ago.

Barriers to accessing vaccination

There are many barriers to achieving appropriate vaccination rates, including access, affordability, awareness and confidence.[6] These barriers are particularly pertinent for people at high risk, such as those with pre-existing respiratory conditions, heart and/or kidney disease, diabetes and impaired immunity to name only a few. For example, less than 50% of high-risk people in their 70s are vaccinated for shingles and only 20% are immunised against pneumococcal disease.[7] Government investment in vaccination is critical to improving vaccination rates and this report focuses on investment and affordability as key issues.

Aboriginal and Torres Strait Islander peoples and those from culturally and linguistically diverse backgrounds

Research demonstrates that not speaking English at home means a high-risk adult is half as likely to be recommended a COVID vaccination while being of Aboriginal or Torres Islander background drops that likelihood to a third. The commitment of funding in the Federal Government's 2023-24 Budget specifically acknowledges the challenge of COVID vaccination uptake in culturally and linguistically diverse (CALD) communities.[8]

---

[6] H. Seale, J. Leask, M. Danchin et al. for Collaboration on Social Science and Immunisation, "A COVID-19 vaccination strategy to support uptake amongst Australians: Working paper", 2020. https://www.ncirs.org.au/sites/default/files/2020-12/WorkingPaper_AdultCOVID19%20vaccination.pdf Accessed June 2024.

[7] P. Breadon and I. Burfurd, "A fair shot How to close the vaccination gap", Grattan Institute, November 2023. https://grattan.edu.au/wp-content/uploads/2023/11/A-fair-shot-How-to-close-the-vaccination-gap-Grattan-Institute-Report.pdf Accessed June 2024.

[8] Department of Health and Aged Care, "Stakeholder pack Budget 2023-24", May 2023. https://www.health.gov.au/sites/default/files/2023-05/stakeholder-pack-budget-2023-24.pdf Accessed August 2024.

Adult vaccination rates are low among Aboriginal and Torres Strait Islander Australians with the high rates of childhood vaccination in the same population indicating that this is a challenge specifically for Aboriginal and Torres Strait Islander adults.[9] 36.5% of Aboriginal and Torres Strait Islander adults turning 71 in 2002 were vaccinated against herpes zoster compared to 41.3% of all Australian adults turning 71 years. Adult vaccination rates are also low for refugee and migrant populations with funding for vaccines being identified as a specific barrier.[10]

Experiencing disadvantage

Experiencing disadvantage is also a barrier to access with recent vaccination for the most disadvantaged in our society nearly 40% lower than for the most advantaged while our most disadvantaged people are almost 20% less likely to be vaccinated against flu.[11]

Living in rural Australia

Living in rural Australia also results in many high-risk people failing to be vaccinated (although there are also significant variation within metropolitan areas).[12]

Affordability and access

Access, including convenience of vaccination, where it occurs and the times at which it is available, is clearly a key barrier but so is affordability, with out-of-pocket costs for vaccines and vaccination services significantly impacting uptake.[13] Physical barriers can also affect access for elderly people, especially those experiencing disadvantage.[14]

---

[9] Immunisation Coalition, *Enhancing adult vaccination coverage rates in Australia,* 2021. https://www.immunisationcoalition.org.au/wp-content/uploads/2021/06/2021_06_28_Enhancing-adult-vaccination-coverage-rates-in-Aus_FINAL.pdf Accessed July 2024.

[10] A. Mahimbo, H. Seale, M. Smith, and A. Heywood, (2017) "Challenges in immunisation service delivery for refugees in Australia: A health system perspective", *Vaccine*, 35(38) 2017. https://www.sciencedirect.com/science/article/abs/pii/S0264410X17310678?via%3Dihub Accessed July 2024.

[11] P. Breadon and I. Burfurd, "A fair shot: How to close the vaccination gap", Grattan Institute, 2023. https://grattan.edu.au/wp-content/uploads/2023/11/A-fair-shot-How-to-close-the-vaccination-gap-Grattan-Institute-Report.pdf Accessed June 2024.

[12] P. Breadon and I. Burfurd, "A fair shot: How to close the vaccination gap", Grattan Institute, 2023. https://grattan.edu.au/wp-content/uploads/2023/11/A-fair-shot-How-to-close-the-vaccination-gap-Grattan-Institute-Report.pdf Accessed June 2024.

[13] H. Seale, J. Leask, M. Danchin et al. for Collaboration on Social Science and Immunisation, "A COVID-19 vaccination strategy to support uptake amongst Australians: Working paper", 2020. https://www.ncirs.org.au/sites/default/files/2020-12/WorkingPaper_AdultCOVID19%20vaccination.pdf Accessed June 2024.

[14] E. Stephenson, K. Yoo and A-S Zahar, Research Paper for NSW Council of Social Service: Barriers to vaccination for people experiencing disadvantage, Sydney Policy Reform Project, 2021. https://www.ncoss.org.au/wp-content/uploads/2022/02/20210721_PAPER_Barriers-to-vaccination-for-people-experiencing-disadvantage.pdf Accessed June 2024.

Awareness and misinformation

Awareness and understanding of which vaccines are recommended and for whom affects uptake as does access to resources that can be understood by people and which are tailored to their cultural and linguistic, including health literacy, needs.[15]

Misinformation can also lead to sceptical attitudes towards vaccination and this is more prevalent in CALD groups and those experiencing disadvantage.[16] At the same time, concerns about the safety and/or efficacy of a vaccine, lack of confidence in the benefits they deliver and worries about adverse events all act as barriers to uptake as does trust in vaccine providers.[17]

Addressing these barriers would deliver greater uptake of adult vaccination. In addition, it is likely that adopting some of the policy settings that have supported Australia's high rates of childhood immunisation could help drive uptake of adult vaccination. Appendix One outlines in detail the policies adopted in Australia with the goal of driving up the rates of childhood vaccination together with evidence of their success.

Vaccination target

A national adult immunisation target is essential to achieving and demonstrating the highest possible return on investment in vaccines.

Australia can lead the way in adult immunisation by setting a target that is ambitious and reflective of the economic and societal benefits of access to immunisations and preventing disease. The Australian Government recognised the need for an adult vaccination target to drive uptake in the 2022-2023 Budget.[18]

In this report, two proposed targets have been modelled for the percentage of adults who have had all vaccines recommended for their age:

- A 95% target – an aspirational target consistent with the Australian Government Department of Health and Aged Care childhood immunisation target. Immunisation coverage of 95% is required to achieve herd immunity against many vaccine-preventable diseases; and,

---

[15] H. Seale, J. Leask, M. Danchin et al. for Collaboration on Social Science and Immunisation, "A COVID-19 vaccination strategy to support uptake amongst Australians: Working paper", 2020. https://www.ncirs.org.au/sites/default/files/2020-12/WorkingPaper_AdultCOVID19%20vaccination.pdf Accessed June 2024.
[16] E. Stephenson, K. Yoo and A-S Zahar, Research Paper for NSW Council of Social Service: Barriers to vaccination for people experiencing disadvantage, Sydney Policy Reform Project, 2021. https://www.ncoss.org.au/wp-content/uploads/2022/02/20210721_PAPER_Barriers-to-vaccination-for-people-experiencing-disadvantage.pdf Accessed June 2024.
[17] H. Seale, J. Leask, M. Danchin et al. for Collaboration on Social Science and Immunisation, "A COVID-19 vaccination strategy to support uptake amongst Australians: Working paper", 2020. https://www.ncirs.org.au/sites/default/files/2020-12/WorkingPaper_AdultCOVID19%20vaccination.pdf Accessed June 2024.
[18] Department of Health and Aged Care, *Health Portfolio Budget Statements: Budget 2023-24,* .2023 https://www. health.gov.au/sites/default/files/2023-05/health-portfolio-budget-statements-budget-2023-24.pdf Accessed June 2024

- An 80% target - Australia's 2004 Adult Immunisation Survey indicates that, of the 2.6 million Australians in the target group for flu that year, 79.1% of them were vaccinated against flu. [19] This is the highest vaccination coverage for influenza Australia has achieved

  Canada has adopted a target rate of 80% for one dose of pneumococcal vaccine for people aged 65 years and above and for influenza vaccination of adults 65 years of age and older and adults aged 18 to 64 with chronic health conditions. [20]

The *National Immunisation Strategy 2025–2030* is an opportunity to embed a target in policy to drive accountability from Government, the health sector and the community.

Opportunity exists to improve uptake

Given the current rates of adult vaccination coverage even where vaccines are funded under the NIP, the opportunity exists to improve the rates of immunisation coverage for Australian adults.

While the Australian Childhood Immunisation Register (ACIR) was launched in 1996, it was only with the recent change of the ACIR to the Australian Immunisation Register in 2016 that adult vaccinations could be registered. However, even with this expansion to adult vaccination, mandatory reporting of adult vaccines began later when, in February 2021, it became mandatory to report adult immunisation against COVID-19 to the AIR. This was then followed, in March 2021, with mandatory reporting of influenza immunisation of adults and, subsequently, in July that year, all vaccines given under the NIP.[21] Data on adult vaccination coverage from the AIR were first reported in 2021.[22] These demonstrate low coverage rates although these have been improving in recent years.

At present, coverage rates for herpes zoster, influenza and pneumococcal vaccines are reported and, as Tables Four, Five and Six demonstrate, none reach the 95% coverage rate required to achieve herd immunity (though herd immunity is not strictly relevant for herpes zoster).[23]

---

[19] Australian Government, *Adult Immunisation Survey 2004: summary results,* 2005. https://www.aihw.gov.au/getmedia/6e2b296e-c50b-4970-ad20-91f069fa4020/avssr04.pdf?v=20230605184523&inline=true#:~:text=The%20Adult%20Vaccination%20Survey,-The%202004%20Adult&text=As%20in%20previous%20years%2C%20the,sex%2C%20age%20group%20and%20state. Accessed May 2024.

[20] Government of Canada, *Adult National Immunization Coverage Survey (aNICS): 2023 results,* 2024. https://www.canada.ca/en/public-health/services/immunization-vaccines/vaccination-coverage/adult-national-immunization-coverage-survey-2023-results.html Accessed June 2024.

[21] Department of Health and Aged Care, "Mandatory reporting of National Immunisation Program vaccines to the Australian Immunisation Register began on 1 July 2021", 8 July 2021. https://www.health.gov.au/news/mandatory-reporting-of-national-immunisation-program-vaccines-to-the-australian-immunisation-register-began-on-1-july-2021 Accessed April 2024.

[22] AIHW, "Immunisation and Vaccination", 7 July 2022.

[23] It is also worth noting that changes to data collection – in the instances of herpes zoster and pneumococcal – means that there is a lack of consistency in data reporting during the period of which adult coverage has been captured by the ACIR and reported.

Herpes zoster vaccines

A herpes zoster vaccine was added to the NIP in November 2016 for people aged 70. At the same time, a 5 year catch-up program, which was later extended, was launched with the aim of capturing those aged 71 to 79.[24]

From 1 November 2023, the recombinant zoster (shingles) vaccine was added to the NIP replacing the earlier vaccine and, at the same time, the patient cohort eligible for a funded 2-dose course of the vaccine was expanded and now includes:

- people aged 65 years and older;
- First Nations people aged 50 years and older; and,
- immunocompromised people aged 18 years and older with the following medical conditions: haemopoietic stem cell transplant; solid organ transplant; haematological malignancy; and advanced or untreated HIV.[25]

Historically rates of coverage were low with only around 40% of those becoming eligible for the funded vaccine receiving it in the same year as they become eligible as shown in Table Four.

Table Four: Herpes zoster vaccine coverage

Age group (years)	2021 Report		2022 Report	
	2020	**2021**	**2021**	**2022**
70-<71	30.9	30.6	38.7	41.3
71-<79	43.7	46.7		
Indigenous people				
70-<71	28.7	26.5	32.9	36.5
71-<79	44.9	47.3		

NB: Two figures are provided in this table for 2021 due the 2021 data points differing between the 2021 and 2022 report. In the 2022 report, vaccinations given after 71 years of age are now being included in the coverage calculations.

[24] Department of Health (Vic), "Vaccine history timeline", reviewed 10 January 2024. https://www.health.vic.gov.au/immunisation/vaccine-history-timeline Accessed April 2024.
[25] Department of Health and Aged Care, "National Immunisation Program – changes to shingles vaccination from 1 November 2023", October 8 2023. https://www.health.gov.au/news/national-immunisation-program-changes-to-shingles-vaccination-from-1-november-2023 Accessed April 2024.

Influenza vaccines[26]

In 1997, the first national influenza immunisation program begun with those over 65 years of age being eligible for funded vaccine.[27]

Over time, eligibility has expanded with the current NIP Schedule funded vaccines for adults of any age who have specified medical risk conditions or are Aboriginal or Torres Strait Islander or pregnant; and those aged 65 years and over.[28]

Table Five shows that, since 2019, influenza vaccine coverage increases with age across all adults with a peak of 73% in those people aged over 75 years in 2022.

Influenza vaccine coverage likewise increases with age for Indigenous adults. However, vaccine coverage in all Indigenous adult age groups decreased between 2020 and 2021 unlike for all Australian adults. These decreases were not insignificant either with the largest decrease – of 12.8% - seen in those aged 50 to 64 years old.[29] The smallest decrease was in those aged 75 and older – a drop of 3% as shown in Table Two. Other figures for Indigenous adults are not available within the NCIRS reports.

The 2004 Adult Vaccination Survey showed that 79.1% of the target adult population was immunised against influenza,[30] demonstrating that this level is entirely achievable.

Table Five: Influenza vaccine coverage

Age group (years)	2019	2020	2021	2022
20-<50	15.2	23.5	23.9	30.5
50-<65	24.8	35.3	38.3	46.8
65<75	54.7	61.2	62.1	67.5
≥75	61.5	62.9	68.5	73.0
Indigenous adults				
20-<50			22.0	27.4
50-<65		56.3	43.5	51.4
65<75			64.6	69.5
≥75		70.7	67.7	72.1

[26] All figures are either taken or derived from: NCIRS, *Annual Immunisation Coverage Report 2021,* 2022, https://ncirs.org.au/sites/default/files/2022-12/NCIRS%20Annual%20Immunisation%20Coverage%20Report%202021_FINAL.pdf and *Annual Immunisation Coverage Report 2022,* 2023, https://ncirs.org.au/sites/default/files/2024-01/NCIRS%20Annual%20immunisation%20coverage%20report%202022.pdf Accessed April 2024.

[27] Department of Health (Vic), "Vaccine history timeline", reviewed 10 January 2024.

[28] Department of Health and Aged Care, "National Immunisation Program Schedule", November 1 2023. https://www.health.gov.au/resources/publications/national-immunisation-program-schedule?language=en Accessed April 2024.

[29] NCIRS, *Annual Immunisation Coverage Report 2021,* 2022, https://ncirs.org.au/sites/default/files/2022-12/NCIRS%20Annual%20Immunisation%20Coverage%20Report%202021_FINAL.pdf Accessed April 2024.

[30] Australian Government, *2004 Adult Vaccination Survey – summary results,* March 2005. https://www.aihw.gov.au/getmedia/6e2b296e-c50b-4970-ad20-91f069fa4020/avssr04.pdf?v=20230605184523&inline=true Accessed April 2024.

Vaccines against pneumococcal disease

In 2005, a pneumococcal pneumonia vaccine was introduced for adults over 65 years old. Currently, the pneumococcal vaccine is funded for adults of any age with specified risk conditions; Aboriginal and Torres Strait Islander peoples aged 50 years and over; and non-Aboriginal and Torres Strait Islander adults 70 years and over.[31]

As Table Six demonstrates, uptake of the pneumococcal vaccine amongst all Australians aged 70 to 71 was significantly lower than for shingles in 2022 with coverage of 33.8% and 41.3% respectively. For Aboriginal and Torres Strait Islander people, however, rates were relatively comparable at 37.7% and 36.3% respectively.

Table Six: 13-valent pneumococcal conjugate vaccine (13vPCV) coverage

Age group (years)	2021 Report		2022 Report	
	2020	**2021**	**2021**	**2022**
70-<71	2.2	17.2	23.9	33.8
71-<79	8.1	20.1		
Indigenous people				
70-<71	2.0	18.8	25.1	37.7
71-<79	9.8	20.7		

NB: Two figures are provided in this table for 2021 due the 2021 data points differing between the 2021 and 2022 report. In the 2022 Report, vaccinations given after 71 years of age are now being included in the coverage calculations.

[31] Department of Health and Aged Care, "National Immunisation Program Schedule", November 1 2023.

Costs of preventable disease

Individual factors reflecting costs of preventable disease are tabulated against each vaccination in Appendix Two. However, some broad observations are made here.

First, the return on investment for vaccination increases as the population ages, simply because there are more years of quality life to protect. The most direct measure of the QALY – which is that it keeps people alive for longer and with better health – is increased with general improvements in life expectancy. A single QALY is conventionally valued in Australia at $50,000.

The second is that bringing forward vaccinations from typically age 65 to age 50, even when this creates later demand for boosters, means more productivity benefits can be captured for a population cohort which has not generally retired from the workforce. This is a direct and public benefit to the economy, separate from the private earnings of the individuals concerned, and these economic gains are used in Evaluate's model as discounts to the total cost of vaccination.

Finally, aside from productivity, significant savings occur elsewhere in the economy, particularly in the health system, but also in relation to disability and aged care services. Within this model, focus is on direct savings in health, most of which flow from hospital avoidance but some of which are found in primary care and other non-hospital settings.

It is a feature of the Australian healthcare system that there is excessive focus on treating those who are injured and ill at the cost of protecting the health of those who are otherwise well. Proper attention to the full benefits of preventive health will at least contribute to addressing this imbalance.

Broadscale productivity benefits

Productivity has never been more important. Treasury estimates that, as the Australian population ages over the next 40 years, the participation rate will fall from 66.6% to 63.8%.[32] This is compounded by skills shortages across key industries, exemplified by the reduction in availability of medical and allied health staff over the past five years.

Substantial vaccination across populations delivers both individual benefits which can be aggregated as well as broader protections to the economy as a whole. This has particularly been exemplified across the experience with the COVID-19 pandemic.

The analysis below includes the expected productivity losses that result from not administering specific vaccines to Australian adults and considers the losses to both individuals and the broader economy from reduced workforce participation or productivity. The methodology utilised is summarised in Appendix Two with variations detailed for each set of calculations per vaccine.

[32] Australian Government Treasury, "2023 Intergenerational Report at a Glance", 2023. https://treasury.gov.au/sites/default/files/2023-08/p2023-435150-fs.pdf Accessed July 2024

Avoiding the opportunity cost of lost productivity is one of the principal benefits of vaccination to both:

- The broader economy (public benefits) through contribution to GDP and economic growth. This occurs not only through an increase in activity, but in a productive increase in the mean output from work; and,
- Privately, through greater income to families and also from reduced opportunity cost, for example, from reduced reliance on informal care.

However, alongside these there is also a broader productivity argument for uptake of vaccines which relates to the preparedness for more significant outbreaks than normally occur, including via mutation of the underlying cause of disease to become either more transmissible or more virulent in terms of morbidity and mortality.

This principle is recognised by statements from the US Center for Disease Control about future risks, such as "Vaccination is the most effective medical countermeasure for mitigating the potentially devastating impact of an evolving influenza pandemic."[33]

The epitome of the broadscale productivity risk in the absence of sufficient vaccination is of course the COVID-19 experience, which is sufficiently recent that its economic impacts provide strong estimates of the impact of epidemic influenza or other serious infection.

These impacts have been variously quantified in Australia as:

- Initially, a cumulative loss of around $158 billion;[34]
- An estimate that the difference between extremes of a hypothetical early suppression of the pandemic at a loss of only $229 million and unmitigated spread at a loss of $572.8 billion which based on a value of statistical life year (VSLY) measure, shows a difference of roughly 2,500 times cost.[35] This may be the strongest possible argument for vaccine funding; and,
- An estimate from the United Kingdom that total factor productivity fell 5% during 2020-21.[36]

This protection of productivity and economic output, as well as the welfare losses in terms of human life, are clearly profound and is an argument for why the full measure of productivity is included in the individual vaccine variables rather than only the direct benefits to the Treasury.

---

[33] Centres for Disease Control, "Pandemic Influenza: Vaccine and Other Medical Countermeasures", 28 April 2020. https://www.cdc.gov/flu/pandemic-resources/planning-preparedness/vaccine-medical-countermeasures.html Accessed May 2024.

[34] Australian Bureau of Statistics, "Economic gains and losses over the COVID-19 pandemic", 2022. https://www.abs.gov.au/articles/economic-gains-and-losses-over-covid-19-pandemic Accessed June 2024.

[35] Tom Kompas et al., "Health and economic costs of early and delayed suppression and the unmitigated spread of COVID-19: The case of Australia", *PLOS One*, June 4, 2021. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0252400 Accessed May 2024.

[36] Nicholas Bloom et al., "The impact of COVID-19 on productivity: Working Paper 28233", *National Bureau of Economic Research Working Paper Series*, 2020. https://cep.lse.ac.uk/pubs/download/dp1929.pdf Accessed May 2024.

Investment in prevention

While the costs of preventable diseases means that investment in prevention seems logical, specific calculations of vaccine benefits assume a typical epidemiological case (as opposed to a pandemic). Summaries of each vaccine and its costs and benefits are provided below.

Shingles

About 1 in 3 people will develop shingles in their lifetime, regardless of how healthy they may feel.[37]

Shingles is triggered by the reactivation of the chickenpox virus (varicella-zoster) in adulthood.[38] Nearly all adults 50 years and older already carry the inactive virus that causes shingles.[39] Shingles typically produces a painful, blistering rash.[40] While most people recover fully, some may experience complications including:

- Approximately 10% of people aged 50-59 experience ongoing pain that can last for months or years known as postherpetic neuralgia;[41] and,
- Up to 25% of people experience a shingles rash involving the eyes or nose, which can lead to long-term consequences, including pain, scarring and loss of vision (in rare cases).[42]

People with some diseases - such as HIV or cancer - or those receiving treatments that weaken the immune system, may be at increased risk of shingles. For people who are considered severely immunocompromised, the risk of developing shingles can be up to three times higher than the general population.[43]

---

[37] Department of Health and Aged Care, *The Australian Immunisation Handbook,* 2024. https://immunisationhandbook.health.gov.au/; Healthdirect, *Shingles,* 2024. https://www.healthdirect.gov.au/shingles#:~:text=Shingles%20is%20caused%20by%20the%20reactivation%20of%20the%22Shingles%20-%20treatments. Accessed September 2024.
Centers for Disease Control and Prevention. MMWR. 2008 June;57(RR-5):1-30.

[38] Healthdirect, Shingles, 2024. https://www.healthdirect.gov.au/shingles#:~:text=Shingles%20is%20caused%20by%20the%20reactivation%20of%20the%22Shingles%20-%20treatments Accessed September 2024.

[39] Department of Health and Aged Care, *The Australian Immunisation Handbook,* 2024. https://immunisationhandbook.health.gov.au/ Accessed September 2024.

[40] Centers for Disease Control and Prevention, Prevention of Herpes Zoster: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Early Release, 57, 2008.; Healthdirect, Shingles, 2024. https://www.healthdirect.gov.au/shingles#:~:text=Shingles%20is%20caused%20by%20the%20reactivation%20of%20the%22Shingles%20-%20treatments Accessed September 2024. Centers for Disease Control and Prevention. MMWR. 2008 June;57(RR-5):1-30.

[41] Department of Health and Aged Care, *The Australian Immunisation Handbook, 2024.* https://immunisationhandbook.health.gov.au/ Accessed September 2024.

[42] Centers for Disease Control and Prevention. MMWR. 2008 June;57(RR-5):1-30.; F.T. Scott, M.E. Leedham-Green , W.Y. Barrett-Muir et al., "A study of shingles and the development of postherpetic neuralgia in East London", *J Med Virol* (Suppl 1):S24–30, 2003; Ragozzino MW, Melton LJ 3rd, Kurland LT, Chu CP, Perry HO. "Population-based study of herpes zoster and its sequelae", *Medicine* 1982.

[43] F. Marra, K. Parhar, B. Huang and N. Vadlamudi, "Risk Factors for Herpes Zoster Infection: A Meta-Analysis", *Open Forum Infect Dis.* Jan 9;7(1), 2020. oi: 0.1093/ofid/ofaa005. PMID: 32010734; PMCID: PMC6984676.

One case of shingles in an Australian aged over 50 years old is estimated to cost the health system almost $1,000 in direct costs (findings have been adjusted from 2009).[44]

Current arrangements

At the time of writing, ATAGI recommends shingles vaccination for specific groups including:

- All immunocompetent adults aged 50 years and over; and,
- Immunocompromised people aged 18 years and over.[45]

ATAGI currently recommends a two-dose schedule, 2-6 months apart of the vaccine for people who are immunocompetent. For people who are immunocompromised, ATAGI recommends 2 doses of the recombinant zoster (shingles) vaccine at an interval of 1–2 months.

A 2-dose course of the recombinant zoster (shingles) vaccine is available for free under the National Immunisation Program for:

- People aged 65 years and over;
- First Nations people aged 50 years and over; and,
- 18 years of age and considered at increased risk of herpes zoster, due to an underlying condition and/or immunomodulatory/immunosuppressive treatments.[46]

Scenarios

We examined a single potential change to the current arrangements under the National Immunisation Program as follows:

1. A 2-course of the recombinant zoster (shingles) vaccine would be available free for all people aged 50 or over.

Results

Table Seven below sets out the estimated Incremental Cost Effectiveness Ratio (ICER)– the ICER measures the Discounted Net Cost per Discounted QALY Gained[47] – for the possible changes to the current arrangements under the National Immunisation Program.

---

[44] R. MacIntyre, A. Stein, C. Harrison, H. Britt, A.Mahimbo and A. Cunningham, "Increasing Trends of Herpes Zoster in Australia", *PloS One*, 10(4) 2015). https://doi.org/10.1371/journal.pone.0125025. Accessed September 2024.
[45] Department of Health and Aged Care, *The Australian Immunisation Handbook,* 2024. https://immunisationhandbook.health.gov.au/ Accessed September 2024.
[46] All ATAGI recommendations noted in this paper are from: Department of Health and Aged Care, *National Immunisation Program,* September 2024. https://www.health.gov.au/topics/immunisation/when-to-get-vaccinated/national-immunisation-program-schedule Accessed September 2024.
[47] The ICER is the quotient of net incremental cost divided by the number of QALYs gained, including partial QALYs. It is a figure which is then compared to the QALY threshold (in this case of $50,000). If it is lower than the threshold, then the treatment (including preventive health measures such as vaccines) is cost-effective.

Table Seven: ICER for Herpes Zoster Vaccination Scenarios, age 50

Scenario	ICER Population	ICER Females	ICER Males
Vaccinate once at 50	$21,293	$27,743	$14,247

The results demonstrate that a strategy of vaccinating once at age 50 against HZ is cost-effective at the standard $50,000 per QALY threshold.

Catch up for those aged between 50 and 64

Table Eight below sets out the ICER for vaccination during the initial period in which all people between the age 50 and 64 would be eligible for vaccinated for the first time. The ICER for this intervention is different from those in Table Seven above as it takes into account the different expected outcomes at each age.

Table Eight: ICER for Herpes Zoster Vaccination Scenarios, Cohort Aged 50-64

Scenario	ICER Population	ICER Females	ICER Males
Vaccinate once at 50 to 64	$23,779	$27,471	$19,796

Again, the catch-up program would be cost-effective for the entire population cohort at the standard $50,000 per QALY threshold.

Cost-effectiveness Against Current Arrangements

Table Nine compares the cost effectiveness of vaccination at age 50 to the current policy of vaccination at age 65.

Table Nine: ICERs for Herpes Zoster Vaccination Scenarios, Vaccinate at 50 versus vaccinate at 65

Scenario	ICER Population	ICER Females	ICER Males
Vaccinate once at 50 compared to Vaccinate once at 65	$357	$15,779	-$15,461

Vaccination at age 50 is highly cost effective compared to vaccination at age 65 at the standard $50,000 per QALY threshold. Indeed, for men it has a positive impact on the economy.

Note, the comparison undertaken is between the entire population aged 50 and the entire population aged 65. Some individuals aged between 50 and 64 are already eligible for free vaccinations from age 50, namely:

- Aboriginal and Torres Strait Islander people aged 50 years and over; and,
- People 18 years of age and considered at increased risk of herpes zoster due to specific underlying medical conditions and/or immunomodulatory/immunosuppressive treatments.

These populations are not large enough to significantly alter the ICER calculations and in any case as argued above, the cost effectiveness of the new policy (vaccination at age 50) is the key result rather than the incremental cost effectiveness of the current policy.

Costs and QALYs

Table Ten sets out the discounted net costs and discounted QALYs gained from lowering the age for vaccination for herpes zoster from 65 to 50, assuming 100 per cent take up and a catchup program in the first five years for those aged 50 to 64, noting that a new cohort of those aged 50 would enter the vaccination each year.

In brief, the change in policy would generate 64,121 additional discounted QALYs in the first five years and 10,257 additional discounted QALYs in each year thereafter. The ongoing annual cost of the program would be $201.4m, along with a catch-up cost for those aged 50-64 of $727.7 million in each of the first five years.

The discounted net economic cost takes into account productivity benefits and savings in the health system.

Table Ten: Discounted Net Costs and Discounted QALYs Gained from Lowering the Age of Vaccination

Scenario	Discounted Cost of Vaccination per Annum	Discounted Net Economic Cost per Annum	Discounted QALYs Gained per Annum
Vaccinate once at 50	$201.4m	$68.3m	3,209
Vaccinate once at 50 to 64 (five year catch up program)	$727.7m	$298.6m	12,824
Vaccinate once at 50 compared to Vaccinate once at 65	$88.6m	$0.4m	1,088

Based on a traditional QALY value of $50,000, the QALYs gained against a net economic cost of $68.3 million are worth over $160 million. This is the privately consumed benefit from improved life quality and life expectancy, which complements the savings from reduced healthcare investment and improved productivity.

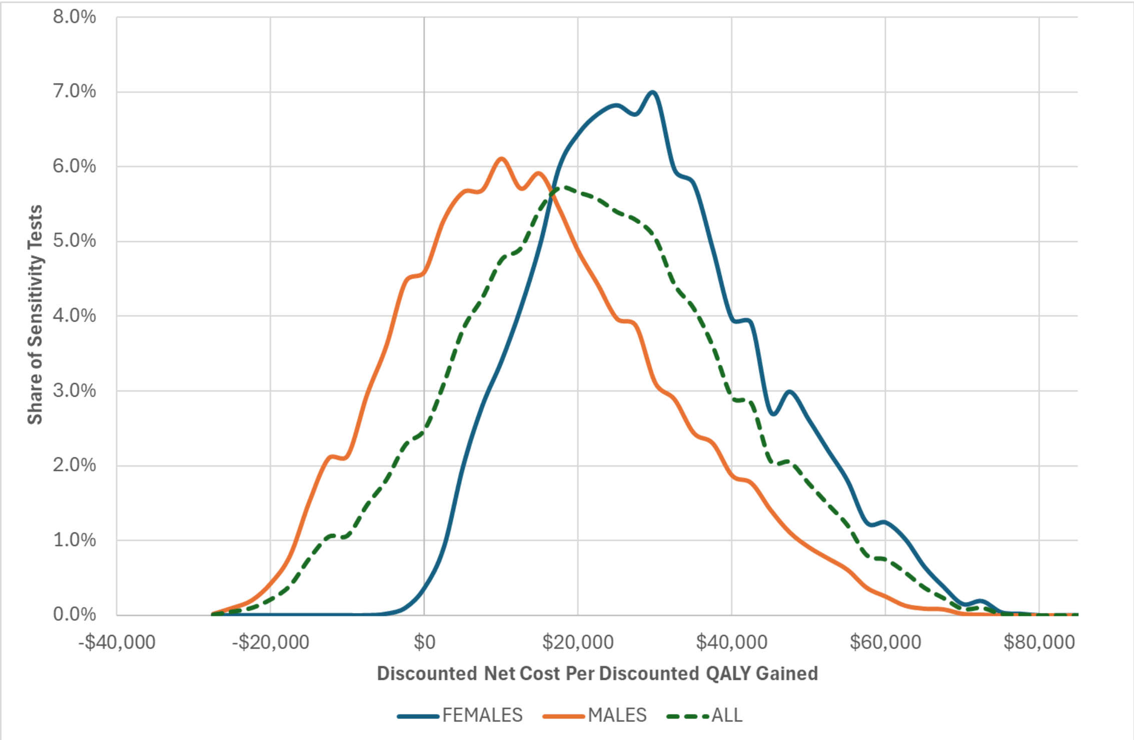
Sensitivity Analysis

A sensitivity analysis of ICERs was undertaken by allowing all the key parameters to vary randomly by up to 25%. The results of this analysis are reported in Table Eleven and Figure One. Vaccination at 50 remains cost-effective through to the 95th percentile.

Table Eleven: Sensitivity Analysis of ICERs

Scenario	Population	Females	Males
Average	$23,311	$30,846	$15,777
Standard Deviation	$17,472	$14,531	$16,907
Skew	0.126	0.418	0.362
Excess Kurtosis	-0.280	-0.281	-0.258
Minimum	-$27,014	-$3,868	-$27,014
2.5th percentile	-$10,143	$6,504	-$13,328
5th percentile	-$5,201	$8,935	-$10,143
10th percentile	$839	$12,752	-$5,202
25th percentile	$11,180	$20,150	$3,496
Median	$22,829	$29,517	$14,453
75th percentile	$34,976	$40,067	$26,855
90th percentile	$46,783	$51,360	$39,264
95th percentile	$53,443	$57,405	$46,360
97.5th percentile	$58,830	$62,380	$51,989
Maximum	$79,642	$79,642	$74,860

Figure One: Sensitivity Analysis



Influenza

Influenza ("the flu") is both a seasonal and a pandemic virus which affects people of all ages. Symptoms include sudden onset of fever, cough (usually dry), headache, muscle and joint pain, severe malaise (feeling unwell), sore throat and runny nose.

Most people recover from fever and other symptoms within a week without requiring medical attention. However, influenza can cause severe illness or death, especially in people at high risk. Influenza can also worsen symptoms of other chronic diseases. In severe cases influenza can lead to pneumonia and sepsis. Hospitalisation and death due to influenza occur mainly among high-risk groups.

Current evidence also indicates that influenza infection is a precipitant for ischaemic events and that vaccination and prevention of infections may have an important role in reducing the ischaemic burden. Ischaemic heart disease is a leading cause of death and was responsible for 11% of all deaths in 2019.[48]

Cardiovascular disease accounted for about 41,000 deaths as the underlying cause of death in Australia in 2018, or 26% of all deaths. Moreover, cardiovascular disease was responsible for about 1.2 million hospitalisations in 2017–2018 or 11% of all hospitalisations in Australia.[49] Hospitalisation rates of acute myocardial infarction, cardiovascular illness and all-cause death increase during influenza season and studies have found that 12.4% of people admitted with acute myocardial infarction had undiagnosed, unrecognised influenza infection, compared to 6.7% in control groups who did not have acute myocardial infarction.

Increased efficacy of influenza vaccines has been shown to be associated with reduction of cardio-respiratory illness and all-cause hospitalisation in older adults.[50] Despite this, the role of infection in ischaemic events is rarely counted in burden of disease estimates and in economic evaluations of the influenza vaccine. This study addresses this deficiency by using the estimates of the burden of respiratory and circulatory diseases attributable to influenza in adults aged 50–64 years in Australia that were reported in Moa.[51]

---

[48] Australian Bureau of Statistics, *Causes of Death*, 2020. https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/2019 Accessed September 2024.

[49] A.M. Moa et al., "Modelling the influenza disease burden in people aged 50-64 and ≥65 years in Australia", *Influenza and other respiratory viruses*, 16(1) 2022. https://onlinelibrary.wiley.com/doi/full/10.1111/irv.12902#:~:text=According%20to%20the%20Australian%20Institute,to%2026%25%20of%20all%20deaths. Accessed June 2022.

[50] For example, E.J. Chow et al.," Acute cardiovascular events associated with influenza in hospitalized adults", *Annals of Internal Medicine.* 173(8): 2020. https://pubmed.ncbi.nlm.nih.gov/32833488/ and C.R. MacIntyre et al., "Ischaemic heart disease, influenza and influenza vaccination: a prospective case control study" *Heart*, 99(24): 2013. https://heart.bmj.com/content/99/24/1843 Accessed June 2024.

[51] A.M. Moa et al., "Modelling the influenza disease burden in people aged 50-64 and ≥65 years in Australia", *Influenza and other respiratory viruses*, 16(1) 2022. https://onlinelibrary.wiley.com/doi/full/10.1111/irv.12902#:~:text=According%20to%20the%20Australian%20Institute,to%2026%25%20of%20all%20deaths. Accessed June 2022.

Current arrangements

ATAGI recommends annual influenza vaccination for everyone aged 6 months or older. Influenza vaccination is particularly recommended for:

- Children aged 6 months to <5 years;
- Adults aged ≥65 years;
- Aboriginal and Torres Strait Islander people;
- People with medical conditions that increase their risk of severe influenza;
- Homeless people;
- Pregnant women;
- Healthcare workers, carers and household contacts of people in high-risk groups residents, staff, volunteers and visitors to aged care and long-term residential facilities;
- Commercial poultry and pork industry workers;
- People who provide essential community services; and,
- People who are travelling during influenza season.

ATAGI also advises that people with the following medical conditions have a higher risk of severe influenza:

- Immunocompromising conditions, such as HIV, malignancy, functional or anatomical asplenia, and chronic steroid use;
- Receiving immuno-oncology therapy;
- Received a haematopoietic stem cell or solid organ transplant;
- Cardiac disease;
- Trisomy 21;
- Obesity;
- Chronic respiratory conditions;
- Chronic neurologic conditions;
- Chronic liver disease;
- Other chronic illnesses that need medical follow-up or hospitalisation;

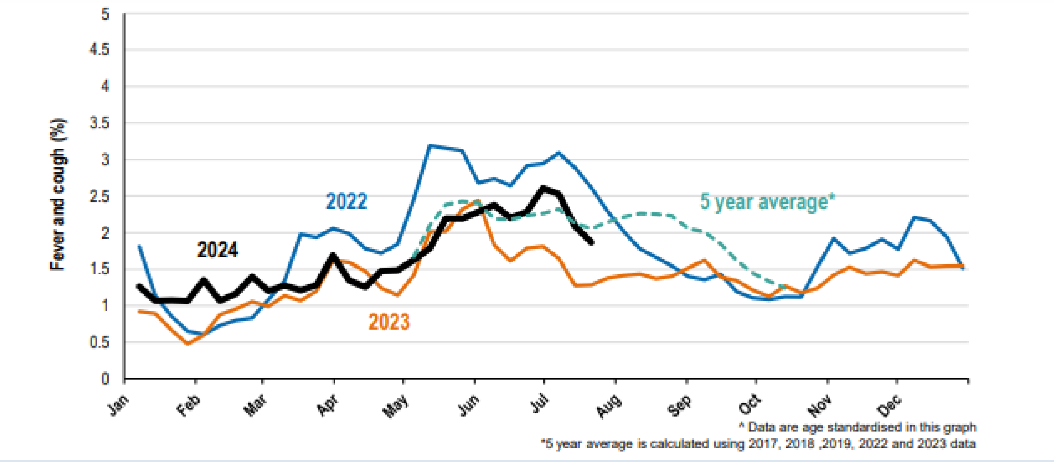
- Long-term aspirin therapy in children (aged 6 months to 10 years); and,
- Preterm infants (<37 weeks gestation).

Free influenza vaccination under the National Immunisation Program is available for eligible people most at risk of complications from influenza, including those aged 65 years or older. Either the adjuvanted influenza vaccine or the high dose influenza vaccine is recommended in preference to standard-dose egg-based or cell-based influenza vaccine for adults aged 65 years or older.

Prevalence in Australia

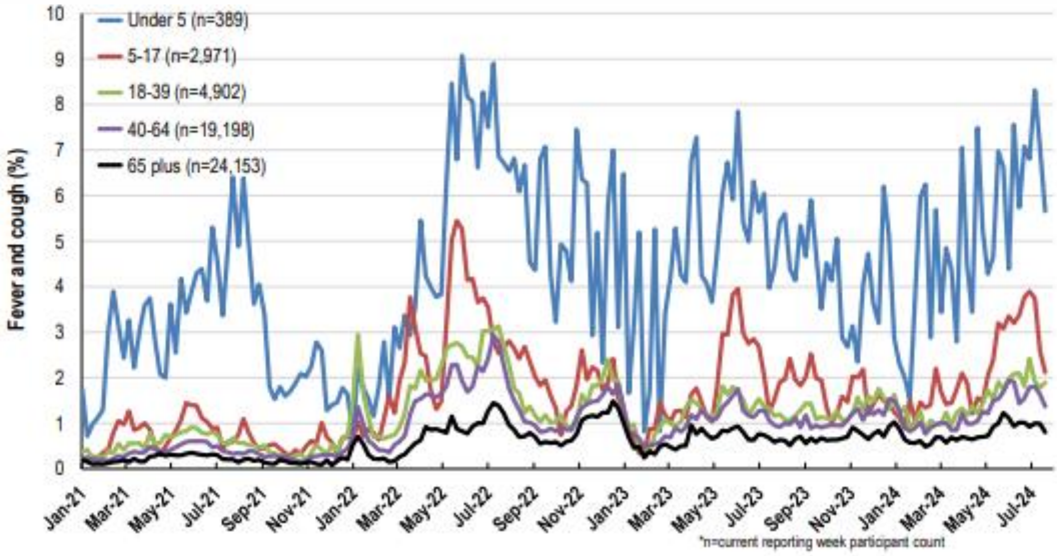
Figures Two and Three below estimate the share of the Australian population reporting influenza like symptoms each week from 2022 to 2024, based on self-reports made to the FluTracking surveillance system. Each month, on average about 1.5 per cent of people report having influenza like symptoms – with a significantly higher proportion of people aged 65 or older reporting having influenza life symptoms.

***Figure Two: Proportion of Flu-Tracking participants reporting influenza like symptoms, 2022 to 2024*[52]**



[52] FluTracking Australia, *Weekly Report: Monday 15 July-Sunday 21 July 2024,* 2024. https://info.flutracking.net/reports/australia-reports/ Accessed August 2024

Figure Three: Proportion of Flu-Tracking participants reporting influenza like symptoms, by age group[53]



The key statistic used in the models underlying the estimates this paper is the annual prevalence of influenza – that is, the share of the population that at some time during the year will have influenza. Given the short average duration of an episode of influenza, the incidence rate reported by FluTracker implies much higher annual prevalence rates, especially for older people where the incidence rate reported each week is about 4%.[54]

The prevalence rate assumed in this paper, which is derived from more comprehensive prevalence estimates undertaken by the Centers for Disease Control and Prevention in 2024 for the American population,[55] is therefore considered to be quite conservative.

Scenario

The analysis examined the following possible change to the current arrangements under the National Immunisation Program:

1. Annual vaccination against influenza would be available free for all people aged 50 or over.

Results

Table Twelve below sets out the estimated Incremental Cost Effectiveness Ratios (ICER) – the ICER measures the Discounted Net Cost per Discounted QALY Gained – for annually vaccinating all people between the ages of 50 and 64 against influenza.

---

[53] Ibid.
[54] Ibid.
[55] U.S. Centres for Disease Control and Prevention, *Flu Burden Prevented from Vaccination 2022-2023 Flu Season,* 2024. https://www.cdc.gov/flu-burden/php/data-vis-vac/2022-2023-prevented.html Accessed July 2024.

Table Twelve: ICERs for Influenza Vaccination, Cohort Aged 50-64

Scenario	ICER Population	ICER Females	ICER Males
Vaccination available for those aged 50 to 64	$22,588	$22,592	$22,585

The results show that this change in policy would be cost effective for the entire population cohort at the standard $50,000 per QALY threshold.

Costs and QALYs

Table Thirteen sets out the discounted net costs and discounted QALYs gained from lowering the age for vaccination for influenza from 65 to 50. In brief, the change in policy would generate 6,064 additional discounted QALYs each year if 95% of adults aged 55 to 64 were vaccinated. The ongoing annual cost of the program would be $179.4m, with some of that cost offset by increased productivity and lower health care cost. The net cost per annum would be $137.0 million.

Table Thirteen: Discounted Net Costs and Discounted QALYs Gained from Lowering the Age of Vaccination

Scenario	Cost of Vaccination per Annum	Discounted Net Economic Cost per Annum	Discounted QALYs Gained per Annum
Extending annual vaccination to those aged 50 to 64 (95% coverage)	$179.4m	$137.0m	6,064
Extending annual vaccination to those aged 50 to 64 (80% coverage)	$151.1m	$115.4m	5,107

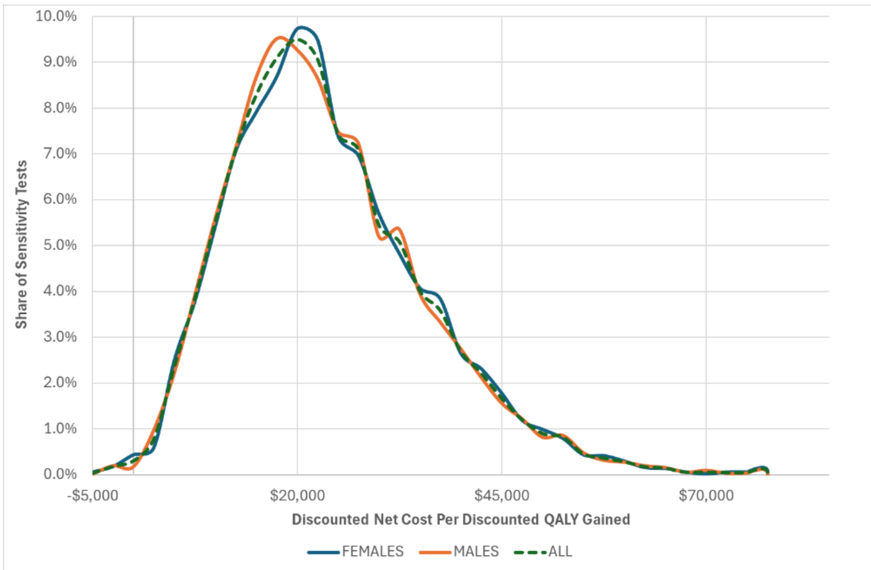
Sensitivity Analysis

A sensitivity analysis ICERs was undertaken by allowing all the key parameters to vary randomly by up to 25%. The results of this analysis are reported in Table Fourteen and Figure Four.

Table Fourteen: Sensitivity Analysis of ICERs

Scenario	Population	Females	Males
Average	$25,126	$24,872	$25,000
Standard Deviation	$11,905	$11,819	$11,863
Skew	0.74	0.77	0.76
Kurtosis	0.72	0.73	0.72
Minimum	-$2,961	-$3,814	-$3,814
2.5th percentile	$6,319	$6,455	$6,409
5th percentile	$8,655	$8,542	$8,564
10th percentile	$11,369	$11,143	$11,237
25th percentile	$16,583	$16,424	$16,508
Median	$23,395	$23,161	$23,294
75th percentile	$32,040	$31,766	$31,948
90th percentile	$41,227	$40,870	$41,022
95th percentile	$46,895	$46,786	$46,868
97.5th percentile	$52,493	$52,586	$52,576
Maximum	$78,543	$79,213	$79,213

Figure Four: Sensitivity Analysis



Once again, the sensitivity analysis shows that the expected cost-effectiveness of influenza vaccination for 50 year olds and over is within accepted QALY thresholds up to and beyond the 95th percentile.

Respiratory Syncytial Virus

Respiratory syncytial virus (RSV) is a common, highly contagious seasonal virus[56] that affects the lungs and breathing passages and causes repeated infections throughout life.[57]

RSV and influenza infection carry similar risk of hospitalisation and mortality in older adults.[58] RSV spreads through a person touching their face after having touched a contaminated surface, coughs or sneezes from infected people, direct contact with someone who has RSV.[59]

In Australia, RSV infections tend to occur most commonly in autumn and winter[60] but can occur all year round.[61]

Among adults, people who have higher risk of severe RSV disease including those aged over 60 years and those who are immunocompromised[62] and live with underlying medical conditions such as:

- Chronic lung disease; [63]
- Chronic heart disease; [64]
- Diabetes;[65] and,

56 K. Bloom-Feshbach, W.J. Alonso, V. Charu, J. Tamerius, L. Simonsen, M.A. Miller, and C. Viboud, "Latitudinal variations in seasonal activity of influenza and respiratory syncytial virus (RSV): a global comparative review", *PloS One*, 8(2), 2013. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0054445 Accessed September 2024.
57 P.J.M. Openshaw, C.Chiu, F.J. Culley and C. Johansson, "Protective and Harmful Immunity to RSV Infection", *Annual Review of Immunology*, 35(1) 2017. https://pubmed.ncbi.nlm.nih.gov/28226227/ Accessed September 2024.
58 S. Maggi, N. Veronese, M. Burgio, G. Cammarata, M.E. Ciuppa, S. Ciriminna, F. Di Gennaro, L. Smith, M. Trott, L.J. Dominguez, G.M. Giammanco, S. De Grazia, C. Costantino, F. Vitale and M. Barbagallo, "Rate of Hospitalizations and Mortality of Respiratory Syncytial Virus Infection Compared to Influenza in Older People: A Systematic Review and Meta-Analysis", *Vaccines*, 10(12) 2022. https://doi.org/10.3390/vaccines10122092. Accessed September 2024.
59 J. Kaler, A. Hussain, K.Patel, T. Hernandez and S. Ray, "Respiratory Syncytial Virus: A Comprehensive Review of Transmission, Pathophysiology, and Manifestation". *Cureus*, 15(3) 2023). https://doi.org/10.7759/cureus.36342. Accessed September 2024.
60 F. Kodama, D.A. Nace and R.L.P. Jump, "Respiratory Syncytial Virus and Other Noninfluenza Respiratory Viruses in Older Adults", *Infectious Disease Clinics of North America*, 31(4) 2017). https://doi.org/10.1016/j.idc.2017.07.006. Accessed September 2024.
61 F. Di Giallonardo et al., "Evolution of Human Respiratory Syncytial Virus (RSV) over Multiple Seasons in New South Wales, Australia", *Viruses* 10(9) 2018. Accessed September 2024.
62 Centers for Disease Control and Prevention (CDC), *RSV in Older Adults and Adults with Chronic Medical Conditions,* 2020. https://www.cdc.gov/rsv/high-risk/olderadults.html Accessed September 2024.
63 Centers for Disease Control and Prevention (CDC), *RSV in Older Adults and Adults with Chronic Medical Conditions,* 2020. https://www.cdc.gov/rsv/high-risk/olderadults.html Accessed September 2024.
64 S.A. Kujawski, M. Whitaker, M.D. Ritchey, A.L. Reingold, S.J. Chai, E.J. Anderson, K.P. Openo, M.Monroe, P. Ryan, E. Bye, K. Como-Sabetti, G.R. Barney, A. Muse, N.M. Bennett, C.B. Felsen, A. Thomas, C. Crawford, H.K. Talbot, W. Schaffner and S.I. Gerber, "Rates of respiratory syncytial virus (RSV)-associated hospitalization among adults with congestive heart failure—United States, 2015–2017", *PloS One*, 17(3) 2022. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0264890; K.S. Ivey, K.M. Edwards, and H.K.Talbot, Respiratory Syncytial Virus and Associations With Cardiovascular Disease in Adults. Journal of the American College of Cardiology, 71(14) 2018). https://doi.org/10.1016/j.jacc.2018.02.013. Accessed September 2024.
65 S.A. Kujawski, M. Whitaker, M.D. Ritchey, A.L. Reingold, S.J. Chai, E.J. Anderson, K.P. Openo, M.Monroe, P. Ryan, E. Bye, K. Como-Sabetti, G.R. Barney, A. Muse, N.M. Bennett, C.B. Felsen, A. Thomas, C. Crawford, H.K. Talbot, W. Schaffner and S.I. Gerber, "Rates of respiratory syncytial virus (RSV)-associated hospitalization among adults with congestive heart failure—United States, 2015–2017", *PloS One*, 17(3) 2022. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0264890; K.S. Ivey, K.M. Edwards, and H.K.Talbot, Respiratory Syncytial Virus and Associations With Cardiovascular Disease in Adults. Journal of the American College of Cardiology, 71(14) 2018). https://doi.org/10.1016/j.jacc.2018.02.013. Accessed September 2024.

- Chronic kidney disease.[66]

Symptoms of RSV in older adults may include nasal congestion, cough, shortness of breath and wheezing, fever, sore throat, runny nose, body aches and tiredness and headache.[67]

One case of RSV is estimated cost to the health system between $1,000 and $8,000 in direct costs. The cost rises as a person ages.[68]

Current Arrangements

ATAGI recommends RSV vaccination for adults in the following cases:

- All people aged 75 years or older;
- Aboriginal and Torres Strait Islander people aged 60 years or older;
- People with medical risk factors for severe RSV disease who are aged 60 years or older; and,
- Pregnant women to protect their newborn infant.

The medical risk factors for severe RSV disease for adults include:

- Cardiac disease;
- Chronic respiratory conditions;
- Immunocompromising conditions;
- Chronic metabolic disorders, including diabetes;
- Chronic kidney disease (stage 4 or 5);

---

[66] S.A. Kujawski, M. Whitaker, M.D. Ritchey, A.L. Reingold, S.J. Chai, E.J. Anderson, K.P. Openo, M.Monroe, P. Ryan, E. Bye, K. Como-Sabetti, G.R. Barney, A. Muse, N.M. Bennett, C.B. Felsen, A. Thomas, C. Crawford, H.K. Talbot, W. Schaffner and S.I. Gerber, "Rates of respiratory syncytial virus (RSV)-associated hospitalization among adults with congestive heart failure—United States, 2015–2017", *PloS One*, 17(3) 2022. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0264890; K.S. Ivey, K.M. Edwards, and H.K.Talbot, Respiratory Syncytial Virus and Associations With Cardiovascular Disease in Adults. Journal of the American College of Cardiology, 71(14) 2018). https://doi.org/10.1016/j.jacc.2018.02.013. Accessed September 2024.
[67] J. Kaler, A. Hussain, K.Patel, T.Hernandez and S. Ray, "Respiratory Syncytial Virus: A Comprehensive Review of Transmission, Pathophysiology, and Manifestation". *Cureus*, 15(3) 2023. https://doi.org/10.7759/cureus.36342; H.F. Tseng, L.S. Sy, B. Ackerson, Z. Solano, J. Slezak, Y. Luo, C.A.Fischetti and V. Shinde, "Severe Morbidity and Short- and Mid- to Long-term Mortality in Older Adults Hospitalized with Respiratory Syncytial Virus Infection", *The Journal of Infectious Diseases*, 222(8) 2020. https://doi.org/10.1093/infdis/jiaa361; K. Korsten, N. Adriaenssens, S. Coenen, C. Butler, B. Ravanfar, H. Rutter, J. Allen, A.Falsey, J.-Y. Pirçon, O. Gruselle, V. Pavot, C. Vernhes, S. Balla-Jhagjhoorsingh, D. Öner, G. Ispas, J. Aerssens, V. Shinde, T. Verheij, L.Bont and J. Wildenbeest, "Burden of respiratory syncytial virus infection in community-dwelling older adults in Europe (RESCEU): an international prospective cohort study", *European Respiratory Journal*, 57(4) 2021. https://doi.org/10.1183/13993003.02688-2020.
[68] S. Masnoon, T. Ian, T. Alysia, T. Marcus, H. Yufan, S. Aruni and M. Daniel, "Annual Economic Burden of Respiratory Syncytial Virus Among Older Adults in Australia", [Conference presentation], CDIC 2024 Brisbane Convention and Exhibition Centre, Australia, 11-13 June 2024.

- Chronic neurological conditions; and,
- Obesity.

ATAGI further suggests that non-Indigenous adults aged 60–74 years who do not have a medical risk factor for severe RSV disease may also consider vaccination. There are benefits of vaccination in this age group, but the benefits may be less than for those aged 75 years or older, because of a comparatively lower risk of severe RSV disease.[69]

Vaccination against RSV is not funded under the NIP.[70]

Scenarios

Clinical evidence and guidance related to RSV is emerging and guidelines on RSV boosters are yet to be established.

In this analysis, we examined six potential scenarios:

1. Vaccination against RSV for all people aged 75 with either a) no booster, or b) a booster every three years, or c) a booster every five years; and,
2. Vaccination against RSV for all people aged 75 or older with either a) no booster, or b) a booster every three years, or c) a booster every five years.

Results

Table Fifteen below sets out the estimated Incremental Cost Effectiveness Ratios (ICER) – the ICER measures the Discounted Net Cost per Discounted QALY Gained – for two possible changes to the current arrangements under the National Immunisation Program.

Table Fifteen: ICERs for Vaccination Scenarios

Scenario	One off vaccination	One off vaccination and 3-year booster	One off vaccination and 5-year booster
Vaccinate once at 75	$7,106	$9,559	$8,857
Vaccinate everyone who is aged 75 or older	$9,613	$11,440	$11,040

69 Department of Health and Aged Care, "Australian Immunisation Handbook". https://immunisationhandbook.health.gov.au/contents/vaccine-preventable-diseases/respiratory-syncytial-virus-rsv Accessed August 2024.

70 National Centre for Immunisation Research and Surveillance, "Respiratory syncytial virus (RSV): Frequently asked questions (FAQs)", September 2024. https://ncirs.org.au/ncirs-fact-sheets-faqs-and-other-resources/respiratory-syncytial-virus-rsv-frequently-asked#:~:text=No%20RSV%20prevention%20products%20are,antibody%20(mAB)%20in%20Australia. Accessed September 2024.

These results demonstrate that vaccination against RSV is cost effective in each of these scenarios at the standard $50,000 per QALY threshold, with the most cost effective approach the one which vaccinates at age 75 without a booster.

Costs and QALYs

Table Sixteen sets out the discounted net costs and discounted QALYs gained from vaccinating older adults against RSV.

In brief, vaccination of all adults at age 75 would generate 7,593 additional discounted QALYs in each year. The average annual cost of the program would be $66.8 million. The average net impact on the economy would be $54.0 million per annum given the additional productivity of the additional QALYs.

Table Sixteen: Discounted Net Costs and Discounted QALYs Gained from Vaccinating Older Adults (100% coverage)

Scenario	Discounted Cost of Vaccination	Discounted Cost to the Economy	Discounted QALYs Gained
Vaccinate once at age 75	$66.8m	$54.0m	7,593
Vaccinate at age 75 with three yearly boosters	$250.6m	$196.6m	20,569
Vaccinate at age 75 with five yearly boosters	$164.2m	$128.1m	14,464
Vaccinate once for those aged 75 or older	$559.8m	$438.7m	45,638
Vaccinate those aged 75 or older with three yearly boosters	$1,622.4m	$1,238.4m	108,254
Vaccinate those aged 75 or older with five yearly boosters	$1,096.3m	$839.4m	76,029

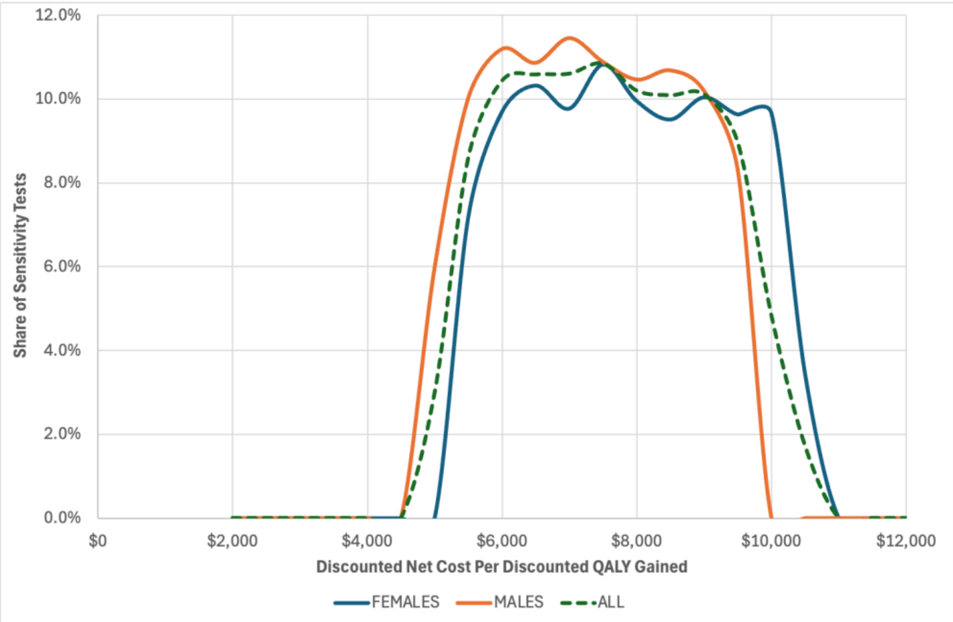
Sensitivity Analysis

A sensitivity analysis ICERs was undertaken by allowing all the key parameters to vary randomly by up to 25%. The results of this analysis are reported in Table Seventeen and Figure Six for the case of a person who is vaccinated at 75.

Table Seventeen: Sensitivity Analysis of ICERs (Vaccination at 75)

Measure	Population	Females	Males
Average			
Standard Deviation	$8,139	$7,548	$7,843
Skew	$1,447	$1,333	$1,422
Kurtosis	0.023	0.023	0.070
Minimum	(1.176)	(1.177)	(1.067)
2.5th percentile	$5,750	$5,347	$5,460
5th percentile	$5,870	$5,460	$5,672
10th percentile	$6,153	$5,721	$5,918
25th percentile	$6,904	$6,410	$6,637
Median	$8,110	$7,520	$7,811
75th percentile	$9,379	$8,691	$9,030
90th percentile	$10,172	$9,418	$9,767
95th percentile	$10,425	$9,652	$10,172
97.5th percentile	$10,545	$9,762	$10,425
Maximum	$10,693	$9,892	$10,693

Figure Six: Sensitivity Analysis



Even at the maximum, only around 25% of the QALY threshold is reached.

Pertussis and Diphtheria

Pertussis, or whooping cough, is a bacterial respiratory infection caused by *Bordetella pertussis*. It is typically characterised by paroxysms of coughing that may interfere with normal breathing with a whooping sound during inhalation. The cough may last for 1-2 months or longer. Other significant symptoms can include sleep disturbance, urinary incontinence, fainting and rib fracture (rarely). Pertussis can also cause inner ear infections, long-lasting bronchitis, pneumonia, fits, brain damage and death. Pertussis is a highly infectious illness. In Australia, it is one of the least well-controlled vaccine-preventable diseases. Robust childhood and maternal immunization programs prevent pertussis-related hospitalisations and mortality in infants and children, but breakthrough disease can occur at any age, because naturally acquired and vaccine-induced immunity against pertussis is not lifelong.[71]

Current arrangements

Pertussis vaccine is available in Australia in combination with diphtheria and tetanus, with or without other antigens such as inactivated poliomyelitis (IPV), hepatitis B (hepB) and Haemophilus influenzae type b (Hib).

For adults, the Australian Technical Advisory Group on Immunisation recommends pertussis-containing vaccines for:

- Adults at ages 50 years and 65 years;
- Adults aged 65 years or older if they have not had one in the past 10 years;
- Pregnant women during each pregnancy, preferably between 20 and 32 weeks gestation; and,
- Healthcare workers, early childhood educators and carers, and people in close contact with infants every ten years.

Pertussis-containing vaccinations for adults are not funded under the National Immunisation Program.

A booster dose of a tetanus-containing vaccine is also recommended, though not funded under the NIP, for:

- Adults who are aged 50 years or older and who have not received a tetanus-containing vaccine in the previous 10 years (but have previously completed a primary course) and,
- Adults with tetanus-prone wounds if more than 5 years has elapsed since a previous dose.

[71] R. Pearce, J. Chen, K.L. Chin, A. Guignard, L.A. Latorre, C.R. MacIntyre, B. Schoeninger and S. Shantakumar, "Population-Based Study of Pertussis Incidence and Risk Factors among Persons >50 Years of Age", *Emerging Infectious Diseases,* 2024. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10756356/ Accessed June 2024.

Scenarios

We examined the following possible change to the current arrangements under the NIP, which would align the NIP approach with ATAGI's recommendation for adults:

1. Vaccination against pertussis would be available free for all people at age 50 and at age 65 and at ten yearly intervals thereafter.

Results

Table Eighteen below sets out the estimated ICERs for the possible change to the current arrangements under the National Immunisation Program, if the discount rate is assumed to be 3.5 per cent.

Table Eighteen: ICERs for Pertussis Vaccination Scenario

Scenario	ICER Population	ICER Females	ICER Males
Vaccinate at 50 and at 65 and a booster every 10 years thereafter	$323,979	$301,537	$348,128

The results demonstrate that vaccination against Pertussis at any age is not currently cost effective at the standard $50,000 per QALY threshold.

Note, however, that this analysis does not take account of:

- The protective benefits conferred by dTpa vaccines against Diphtheria and Tetanus; and,
- The flow on benefits to children conferred by the vaccination of adults.

Given the failure against the critical ICER evaluation, no projected costs or benefits are provided for the various scenarios. Diphtheria, like pertussis, is combined with the tetanus booster and will consequently deliver a similar cost-benefit analysis, although likely worse than pertussis given the extremely low rate of diphtheria in the adult 50-65 population.

Accordingly, these vaccines are not recommended for inclusion on the NIP in this paper.

Summary of costs and benefits

A vast number of combinations could be made across the three vaccines with positive ICERs to give an overall cost/benefit comparison. Specific options and combinations can be produced as required.

However, for summary purposes, the total net economic cost plus the QALYs gained have been costed based on the vaccination option which showed the lowest ICER and therefore represents the most economically efficient expenditure. This is based on a highly cost-effective ICER based on all Australians in that category: for example, we have not selected only women where the ICER for females was lower of that for males.

Table Nineteen and Twenty outline the cost-benefit analysis of the three cost-effective vaccines based on 95% and 80% uptake of each vaccine.

Table Nineteen: Cost-benefit analysis of three vaccines with 95% takeup across target population

Scenario	Net Cost to the Economy	QALYs Gained	QALY Value	Return on Investment
Herpes Zoster: Vaccinate once at age 50	$64,885,000	3,049	$152,427,500	2.35
Influenza: Vaccinate all aged 50-64	$137,000,000	6,064	$303,200,000	2.21
RSV: Vaccinate once at 75 with a 5-yearly booster	$121,695,000	13,741	$687,040,000	5.65
Total	$323,580,000	22,853	$1,142,667,500	3.53

Table Twenty: Cost-benefit analysis of three vaccines with 80% takeup across target population

Scenario	Net Cost to the Economy	QALYs Gained	QALY Value	Return on Investment
Herpes Zoster: Vaccinate once at age 50	$54,640,000	2,567	$128,360,000	2.35
Influenza: Vaccinate all aged 50-64	$115,400,000	5,107	$255,350,000	2.21
RSV: Vaccinate once at 75 with a 5-yearly booster	$102,480,000	11,571	$578,560,000	5.65
Total	$272,520,000	19,245	$962,270,000	3.53

These tables allow it to be stated, for example, with strong confidence that:

- The average return on investment across the three vaccine initiatives proposed exceeds three times the expenditure required to fund them; and,
- All vaccines have returns which are at least double the net cost to the economy required to fund them.

Net economic costs take into account both the savings to the health system as well as the productivity gains which flow from vaccination. This net cost also accounts for the discounted cost of all future boosters for RSV, as well as associated future QALYs.

Separately, the *direct cost to Government* for each of the first five years of these programs is detailed in Table Twenty One.

Table Twenty One: Direct Budget Costs Years 1-5

Scenario	Annual Direct Cost with 95% Coverage	Annual Direct Cost with 80% Coverage
Herpes Zoster: Vaccinate once at age 50	$191,330,000	$161,120,000
Influenza: Vaccinate all aged 50-64	$179,400,000	$151,073,684
RSV: Vaccinate once at 75 with a five-yearly booster	$155,990,000	$131,360,000
Total	**$526,720,000**	**$443,553,684**

Other benefits of vaccinating Australian adults

The role of vaccines in tackling antimicrobial resistance

Antimicrobial resistance (AMR) is a global health emergency, recognised by the World Health Organization (WHO) as one of the top ten public health threats facing humanity.[72]

AMR occurs when bacteria, viruses, fungi and parasites become resistant to medicines. Patients with resistant infections are more likely to experience ineffective treatment, hospitalisation, recurrent infection, delayed recovery, or death.[73]

AMR is a global problem which is already having a severe but often silent impact in Australia with 5,200 deaths associated with AMR every year[74] and $72 million in hospitalisation costs in 2020.[75] This is increasing and, by 2050, AMR could lead to 10,000 Australian deaths per year and $283 billion cost to Australia's economy.[76]

Vaccines are an important tool to help healthcare systems manage AMR. The most direct way in which vaccines can manage AMR is by limiting the spread of resistant pathogens.[77] Vaccines also have the benefit of reducing antibiotic use. Since symptoms like fever or respiratory infections look similar whether caused by bacteria or viruses, doctors often use antibiotics without knowing the exact cause. Several viral infections, such as influenza and RSV, can also lead to secondary bacterial infections that need antibiotic treatment.[78]

The WHO's *Global action plan on antimicrobial resistance* has recognised the role of vaccines in tackling AMR, stating that "[Member States recognise] the importance of immunization as one of the most cost-effective public health interventions, and that vaccines play an important role in reducing antimicrobial resistance."[79]

While the impact of vaccination is undeniable, it is challenging to quantify the impact of vaccines in restricting the pace and reducing the burden of AMR as there are too many variables. However, for example, one trial of pneumococcal conjugate vaccine (PCV) in China – which has a high rate of antibiotic

---

[72] World Health Organization, "Antimicrobial Resistance". https://www.who.int/health-topics/antimicrobial-resistance Accessed June 2024.

[73] Australian Commission on Safety and Quality in Health Care, "Antimicrobial stewardship". https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship Accessed August 2024

[74] Australian AMR Network, "Fighting Superbugs: Ensuring Australia is Ready to Combat the Rise of Drug Resistant Infections". https://www.mtpconnect.org.au/reports/fightingsuperbugsreport

[75] T.M. Wozniak, A. Dyda, G. Merlo and L. Hall, "Disease burden, associated mortality and economic impact of antimicrobial resistant infections in Australia", *The Lancet – Regional Health Western Pacific,* Vol. 27, October 2022. https://www.thelancet.com/journals/lanwpc/article/PIIS2666-6065(22)00136-5/fulltext Accessed August 2024.

[76] Australian AMR Network, "Fighting Superbugs: Ensuring Australia is Ready to Combat the Rise of Drug Resistant Infections". https://www.mtpconnect.org.au/reports/fightingsuperbugsreport Accessed August 2024.

[77] World Health Organization, "Leveraging Vaccines to Reduce Antibiotic Use and Prevent Antimicrobial Resistance". https://www.who.int/publications/m/item/leveraging-vaccines-to-reduce-antibiotic-use-and-prevent-antimicrobial-resistance

[78] Ibid.

[79] WHO, Sixty-Eighth World Health Assembly, Agenda Item 15.1, "the importance of immunization as one of the most cost-effective public health interventions, and that vaccines play an important role in reducing antimicrobial resistance", 26 May 2015, p.2. https://apps.who.int/gb/ebwha/pdf_files/WHA68/A68_R7-en.pdf Accessed June 2024.

use and low existing PCV use – showed baseline reduction in AMR against penicillin of 6.6%, amoxicillin of 10.9% and third-generation cephalosporins of 9.8% with nominal direct and indirect savings of USD371 million.[80]

As the health and economic impacts of AMR continues to escalate in Australia and around the world, vaccines provide a significant tool to limit its spread. While it is difficult to accurately quantify the AMR reduction from a cost-effectiveness perspective, it should be acknowledged as an increment to the estimates provided in this study.

Intergenerational Benefits

The value proposition of vaccination is also relevant to two propositions around demographic change over time as follows:

1. Ageing populations experience worse average health status and greater impact from disease; and,
2. The associated increased treatment costs are likely to occur at a time when there is a lower participation rate due to a higher percentage of the population being elderly, which implies a greater average burden per working Australian.

These observations are in themselves strong arguments for preventive health investment – including greater vaccination – as the intergenerational burden of not funding vaccines is clearly inequitable. Funding preventive care in earlier years would be more financially efficient.

Relevant projections in Australia are:

- An increase in the old-age dependency ratio (persons over 65 per 100 persons aged 15-64) from 26.6% to 38.2% in the four decades between 2023 and 2063,[81] an increased reliance of 43.6%;
- Real GDP per person will grow over the same period from $83,874 to $131,815,[82] an increase of 57.2%; while,
- Real public spending on health will increase from $4,000 to $8,677[83] or 117%.

Australia with current demographic, health investment and technology settings is a paradigmatic argument for increased investment in preventive health, given that increased dollar expenditure substantially exceeds the rate of GDP growth (and thus mean incomes) and the relative number of taxpayers to dependents shrinks over the same period.

[80] Ember (Yiwei) Lu, "Health and economic impact of the pneumococcal conjugate vaccine in hindering antimicrobial resistance in China", *Proceedings of the National Academy of Sciences*, 2021. https://www.pnas.org/doi/10.1073/pnas.2004933118 Accessed June 2024.
[81] Treasury, "2023 Intergenerational Report", 2023, Appendix A1.
[82] Treasury, 2023.
[83] Treasury, 2023.

At the same time, as noted in GSK's *Risk to Resilience* report, Australia's spending on preventative health as a percentage of total health spend is lower than many equivalent countries. Australia spends 1.8% of total health spend on preventative health, compared to 2.9% in the United States, 3.7% in the United Kingdom and 5.9% in Canada.[84]

Ambulance ramping

The issue broadly described as 'ambulance ramping' is twofold, describing both:

- Increasing attendance at emergency departments (ED) across the country – 8.8 million in 2022 - which has multiple drivers, including reduced access to primary care; and,
- Associated increases in ambulance callouts, which are responsible for around one in four ED attendances, and which grew by roughly a third over the past decade.[85]

Both of these are obviously driven by raw demand for medical interaction, which is suppressed by the rate of vaccination. While there is no clear estimate for this in Australia, it has been understood for some time that the population of ED attendees are undervaccinated compared to the broader community.[86] This makes intuitive sense, and is addressed in the model in terms of avoided hospitalisation costs.

More recently, studies of flu vaccine shortages have shown a correlation between a 20% reduction in supply and a 12% increase in cases and rates of hospitalisation.[87] This has the potential to particularly clog the ED as an entry point to hospital.

The best direct estimates of the benefits of vaccination in terms of the ED are that vaccination of a cohort of otherwise low-risk (immunocompetent) individuals during cocirculation of flu and COVID reduce demand for acute beds by 35-54% and intensive care by 16-25% (along with reduction in other healthcare demand, as well as rates of mortality).[88]

There is a similar benefit observed in the United Kingdom regarding the opportunity cost of avoidable hospital admission. The relevant estimate is that the value of hospital beds freed up by vaccination against seasonal illnesses is 1.1-2 times higher.[89]

---

[84] GSK, *Risk to Resilience: A roadmap to vaccine access for older Australians,* 2023. https://au.gsk.com/media/6823/2003219_gsk-vaccineaccessreport-web-version.pdf Accessed May 2024.
[85] Australian Medical Association, "2023 Ambulance Ramping Report Card", 2023. https://www.ama.com.au/articles/2023-ambulance-ramping-report-card Accessed June 2024
[86] Lance E Rodewald et al, "Is an Emergency Department Visit a Marker for Undervaccination and Missed Vaccination Opportunities Among Children Who Have Access to Primary Care?", *Paediatrics*, 1993.
[87] Femy Amin et al, "Impact of Flu Vaccine Shortage on the National Health Service (NHS) in England and Wales", *ISPOR*, December 2023
[88] Van Hung Nguyen et al, "Estimating the impact of influenza vaccination of low-risk 50–64-year-olds on acute and ICU hospital bed usage in an influenza season under endemic COVID-19 in the UK", *Human Vaccines and Immunotherapeutics*, 2023. https://pubmed.ncbi.nlm.nih.gov/36912725/ Accessed June 2024.
[89] Margherita Neri et al, "Vaccine-Preventable Hospitalisations from Seasonal Respiratory Diseases: What Is Their True Value?", *Vaccines,* 2023. https://www.mdpi.com/2076-393X/11/5/945 Accessed August 2024

Further study of the benefits of increased vaccination in reducing emergency demand in Australia would be beneficial and is recommended.

Conclusion

The Australian Government has an opportunity to invest in adult vaccination, delivering better health outcomes and significant economic benefits. This report shows funding a redesigned NIP is an investment, not a cost, that will deliver returns now and into the future.

Australia’s population is ageing and, with that, come fiscal challenges and opportunities. Health is a powerful economic force. It is a key driver of productivity, participation and demand on Government services.

By embedding the value of keeping people well and preventing disease in broader Government policy, the Australian Government can best equip itself to navigate the years ahead.

It’s time the Government re-balanced its funding of health. Vaccines are a proven intervention that will prevent and reduce the impact of disease helping people live longer and to age well.

This report demonstrates investment in adult vaccination will deliver high returns.

Appendix One: Vaccination in Australia

Australia has long valued vaccination. As a fledging nation, vaccination was so valued that, in 1916, laboratories were established with the specific intent to provide Australia with vaccines, the first mass vaccination program occurred in 1924 and the first school-based vaccination programs began in 1932.[90]

By 1996 however Australia's record of vaccination was causing significant concern. That year, 4,000 Australian children had whooping cough (pertussis); 2,500 suffered from rubella; and 500 had measles. The rate of immunisation for diphtheria, tetanus and pertussis was only around 70% in children aged 18 months old, too low to prevent epidemics occurring and this was the highest rate of any childhood vaccination.[91]

Over time, Australia's rates of vaccination improved markedly. In 2011, it was reported that 91.8% of children were fully immunised at 12 months of age and 92.6% were at 24 months.[92] By 2021, these figures had improved even further – 94.6% of children aged 1 year old were fully vaccinated; 92.6% of 2 year olds; and 95.0% of 5 year olds.[93]

Policy settings for childhood vaccination

The turn-around in Australia's childhood vaccination rates largely began with the introduction of the *Immunise Australia: Seven Point Plan* in 1997. Designed specifically to lift childhood vaccination rates, strategies introduced included vaccine requirements before children could start school as well as a comprehensive raft of financial incentives targeted at parents and general practitioners (GPs).[94] The payment of numerous government benefits, including child-care cash rebate and child-care assistance, became linked to providing proof of vaccination while GPs were empowered to request information about the immunisation status of children and supported to vaccinate them.

In addition, data from the Australian Childhood Immunisation Register (ACIR) introduced in 1996 began to be published annually and the target of 90% of children being vaccinated was established.[95] Children's vaccination status has been measured at ages 1, 2 and 5 since then and "fully immunised" is defined as a

---

[90] National Centre for Immunisation Research and Surveillance (NCIRS), "Significant events in immunisation policy and practice in Australia", last updated July 2021. https://www.ncirs.org.au/sites/default/files/2018-11/Immunisation-policy-and-practice-Australia-July-2018.pdf Accessed April 2024.

[91] The Hon. Michael Wooldridge MP, Minister for Health, "Ministerial Statements – Immunise Australia: Seven Point Plan", 25 February 1997. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22chamber%2Fhansardr%2F1997-02-25%2F0025%22 Accessed April 2024.

[92] Noted in L.K. Chin et al., "Australian immunisation registers: established foundations and opportunities for improvement, *Eurosurveillance*, April 19 2012. https://pubmed.ncbi.nlm.nih.gov/22551464/ Accessed April 2024.

[93] Australian Institute of Health and Welfare (AIHW), "Immunisation and Vaccination", 7 July 2022. https://www.aihw.gov.au/reports/australias-health/immunisation-and-vaccination Accessed April 2024.

[94] A. Pearce et al., "Barriers to childhood immunisation: Findings from the Longitudinal Study of Australian Children", *Vaccine,* June 26 2015. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4503793/#:~:text=The%20'Immunisation%20Australia%3A%20Seven%20Point,practitioners%20%5B1%E2%80%933%5D. Accessed April 2024.

[95] The Hon. Michael Wooldridge MP, Minister for Health, "Ministerial Statements – Immunise Australia: Seven Point Plan", 25 February 1997. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22chamber%2Fhansardr%2F1997-02-25%2F0025%22 Accessed April 2024.

child having received all the vaccinations listed on the National Immunisation Program Schedule (NIP) as appropriate for their age.

These interventions and introduction of a vaccination target drove changed behaviour and Australia saw childhood vaccination rates improve.

More recently, additional policy settings were adopted by the Australian Government as well as a new target for childhood vaccination. In 2016, needing a higher level of immunisation coverage protect the community against measles, Australia's "aspirational childhood coverage target" was set at 95% to achieve herd immunity against all vaccine-preventable diseases[96] and the goal was to achieve this by 2020.[97]

In addition, in 2016, the Government announced that it would remove some of the exemptions that had previously existed in relation to the immunisation requirements for eligibility for government benefit payments. This was due to the concern about the risk non-vaccinated children posed to community health and specifically related to the removal of the exemption for conscientious objectors to vaccination.[98] In addition, the age of children covered by the measure was extended and, from 1 January 2016, children of all ages need to be up-to-date with their immunisations or they lose their eligibility for the FTB-A end-of-year supplement, Child Care Benefit and Child Care Rebate payments, unless they have a medical exemption.

The targets adopted together with the policy settings implemented have led to improved vaccine uptake in Australia. While the most recent figures show that 93.16% of 1 year olds are fully immunised, 91.24% of 2 year olds and 93.93% of 5 year olds, these figures have at variously times reached levels of 94.85%, 92.6% and 95.09% respectively.[99] This compared to 74.42% for 5 year olds when the data was first collected in 2005 and the previously mentioned highest vaccination rate of around 70% for the diphtheria, tetanus and pertussis was only around 70% in children aged 18 months old in 1996.[100]

---

[96] AIHW, "Australia's Children", last updated 25 July 2022. https://www.aihw.gov.au/reports/children-youth/australias-children/contents/health/immunisation Accessed April 2024.

[97] Department of Health, *National Immunisation Strategy for Australia 2019–2024*, 2018. https://www.health.gov.au/sites/default/files/national-immunisation-strategy-for-australia-2019-2024_0.pdf Accessed April 2024.

[98] M. Klapdor and A. Grove, "'No Jab No Pay' and other immunisation measures", Budget Review 2015-16 Index, Parliamentary Library, May 2015. https://www.aph.gov.au/About_Parliament/Parliamentary_departments/Parliamentary_Library/pubs/rp/BudgetReview201516/Vaccination Accessed April 2024.

[99] Department of Health and Aged Care, "Historical coverage data tables for all Australian children", last updated 21 April 2023. https://www.health.gov.au/topics/immunisation/immunisation-data/childhood-immunisation-coverage/historical-coverage-data-tables-for-all-children Accessed April 2024.

[100] The Hon. Michael Wooldridge MP, Minister for Health, "Ministerial Statements – Immunise Australia: Seven Point Plan", 25 February 1997. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22chamber%2Fhansardr%2F1997-02-25%2F0025%22 Accessed April 2024.

Appendix Two: Methodology Summary

This study is fundamentally a cost-benefit analysis of a series of proposals that increase public subsidy to partially fill the gaps between ATAGI recommendations and the current Australian NIP. The study focuses on the cohort of adults aged 50 years and over recognising that, as Australians age, their baseline health deteriorates, their vulnerability to infection increases and both the severity and burden of their disease also increase.

Consequently, the core approach is an age-specific decision analytic model which compares the expected lifetime costs between the vaccinated and unvaccinated cohorts. This is in turn built upon a contemporary population model for age and sex and simultaneously draws upon the most recent Global Burden of Disease study[101] and other literature to determine impact of infections.

A multicohort static Markov model with a cycle length of 1 year is used to follow the adult population aged 50 years and over for their remaining lifetime. Age-stratified vaccine efficacy and waning rates are based on the latest clinical trial data. An annual discount rate of 5% is applied equally to costs and savings.

Finally, sensitivity analysis is applied via a Monte Carlo simulation to establish a level of confidence around the principal conclusions of the cost-benefit analysis.

Different assumptions are made for different vaccines in line with ATAGI recommendations – for example, frequency of recommended booster vaccines varies by disease[102] – but core factors which are used for each prospective disease-vaccine pair are:

- Population – age and sex;
- Incidence of disease;
- Severity by age;
- Excess mortality;
- Disability weights;
- Disease costs differentiated by severity and age/sex:
    - Health care costs including hospitalised and non-admitted care;
    - Productivity losses;
- Vaccine coverage rates at 95% and 80%;

[101] University of Washington, Institute for Health Metrics and Evaluation (IHME), "Global Burden of Disease 2021", 2024. https://www.healthdata.org/research-analysis/gbd Accessed June 2024.
[102] These variations are noted in the factor tables below for each individual vaccine

- Initial effectiveness of the vaccine;
- The waning effectiveness rate of the vaccine;
- The full cost of administering vaccine;
- Direct health care costs incurred as a result of the disease after age 50;
- Indirect costs incurred as a result of the disease after age 50, which are estimated based on the average annual income from employment and the employment rate for the age-sex cohort. Lost time is estimated by considering the disease-specific disability weight as a share of the average baseline utility rate for the age-sex cohort; and,
- Quality Adjusted Life Years lived after 50, which are based on the average baseline utility rates for the age-sex cohorts and the additional disability weight for the disease.

Lifetime (after age 50) costs and benefits are calculated using a 3.5% annual discount rate. While Evaluate believes this is more appropriate than the higher rate commonly used by the Australian Government Department of Health, for completeness, calculations at 5% are also provided at Appendix Three.

The principal perspective of this analysis is that of the payer, i.e., the Australian Government, which is why health costs and productivity are focal inclusions. However, acknowledging that selection of healthcare investments traditionally rely on patient outcomes, cost consequence and cost-utility analysis (cost per QALY saved) are core measures of efficacy.

In relation to this approach, it is noted that, for the target cohort of adults aged 50 and over, baseline health states are not at the mean, so an appropriate decrement is applied to QALYs depending upon age.[103] This has the effect of increasing productivity gains from vaccination for older Australians, which are already at a higher mean rate as reflected in the age-income distribution.

[103] For discussion, see: K Claxton et al, "Methods for the estimation of the National Institute for Health and Care Excellence cost-effectiveness threshold", 2015, Ch.4. https://www.ncbi.nlm.nih.gov/books/NBK274319/ Accessed June 2024.

Factors and Sources: Shingles

Scenario	Age	Value	Source
Epidemiology			
Incidence	50-59	0.63%	MacIntyre (2015)
Incidence	60-69	1.37%	MacIntyre (2015)
Incidence	70-79	1.53%	MacIntyre (2015)
Incidence	80+	1.99%	MacIntyre (2015)
Conditional Probability (PHN or other complications)	50-59	24.57%	MacIntyre (2015) and Myers (2019)
Conditional Probability (PHN or other complications)	60-69	23.90%	MacIntyre (2015) and Myers (2019)
Conditional Probability (PHN or other complications)	70-79	33.32%	MacIntyre (2015) and Myers (2019)
Conditional Probability (PHN or other complications)	80+	38.93%	MacIntyre (2015) and Myers (2019)
Share of cases accessing General Practitioner	All	100%	
Share of Complicated Cases Hospitalised	50-59	11.2%	Stein (2009)
Share of Complicated Cases Hospitalised	60-69	23.8%	Stein (2009)
Share of Complicated Cases Hospitalised	70-79	26.9%	Stein (2009)
Share of Complicated Cases Hospitalised	80+	31.7%	Stein (2009)
Share of Complicated Cases Using Emergency Department	50-59	15.9%	Stein (2009)
Share of Complicated Cases Using Emergency Department	60-69	16.6%	Stein (2009)
Share of Complicated Cases Using Emergency Department	70-79	10.8%	Stein (2009)
Share of Complicated Cases Using Emergency Department	80+	9.8%	Stein (2009)
Vaccine Efficacy (Year 1)	50-69	98.9%	PBAC (2023)
Vaccine Efficacy (Year 1)	70+	95.4%	PBAC (2023)
Vaccine Waning Rate (Annual)	50-69	1.5%	PBAC (2023)
Vaccine Waning Rate (Annual)	70+	2.3%	PBAC (2023)
Mortality and Morbidity			
Population Mortality rate (by age and gender)	Varies	Varies	ABS (2023a)
Excess Mortality due to HZ	All	0.00006	GBDCDN (2024)
Average Baseline Utility (by age and gender)	Varies	Varies	AIHW (2024)
Excess Disability Weight for HZ	All	0.058	GBDCN (2024)
Cost of Vaccination			
Cost of Vaccine (2 doses)	All	$560	
Administration of Vaccine (2 doses)	All	$40	Based on payment under the National Immunisation Program for vaccination by a pharmacist. (PPA 2024)
Cost of Adverse Events	All	Varies	Curran (2019) adjusted for Australian prices
Indirect Cost of Vaccination (Productivity)	All	Varies	Based on 2 hours lost productivity
Direct Care Costs			
Treatment Cost (Uncomplicated cases)	All	$80	Based on average cost of GP Visit + antiviral
Treatment cost (Emergency Department)	All	$445	Stein (2009) updated for 2024 prices
Treatment cost (Hospital)	All	$7,075	Stein (2009) updated for 2024 prices
Indirect Costs			

Average Income from Employment (by age and gender)	All	Varies	ABS (2023b) – indexed. By WPI ABS (2024b)
Participation Rate (by age and gender)	All	Varies	ABS (2024a)
Discount Rates (per annum)			
Costs and Benefits	All	3.5%	

References for Shingles

Australian Bureau of Statistics (ABS). (2023a). *Life Expectancy, 2020-2022.*

Australian Bureau of Statistics (ABS). (2023b). *Personal Income in Australia, 2020-21.*

Australian Bureau of Statistics (ABS). (2024a). *Labour Force, Australia, Detailed, April 2024*.

Australian Bureau of Statistics (ABS). (2024b). *Wage Price Index, Australia, March 2024*.

Australian Institute of Health and Welfare (AIHW). (2024). *Australian Burden of Disease Study 2023, National estimates for Australia: Supplementary tables.*

Australian Technical Advisory Group on Immunisation (ATAGI). Australian Immunisation Handbook. Canberra: Australian Government Department of Health and Aged Care.

Chen J, Abrahamson PE, Ke Y, Ong CR, Parikh R & Shantakumar S. (2024). A systematic literature review of the epidemiology and burden of herpes zoster in selected locales in Asia Pacific. *Human vaccines & immunotherapeutics,* 20(1), 2344983.

Curran D, Patterson B, Varghese L, Van Oorschot D, Buck P, Carrico J, Hicks K, Lee B, & Yawn B. (2018). Cost-effectiveness of an Adjuvanted Recombinant Zoster Vaccine in older adults in the United States. *Vaccine*, 36(33), 5037–5045.

GBD 2021 Causes of Death Collaborators (GBDCDN). (2024). Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*, 403(10440), 2100–2132.

Global Burden of Disease Collaborative Network (GBDCN). (2024). *Global Burden of Disease Study 2021, Disability Weights*. Seattle, United States of America: Institute for Health Metrics and Evaluation.

MacIntyre R, Stein A, Harrison C, Britt H, Mahimbo A, Cunningham A & Thompson R. Increasing trends of herpes zoster in Australia. PloS One,10(4):e0125025.

Meyers JL, Candrilli SD, Rausch DA, Yan S, Patterson BJ & Levin MJ. (2019). Costs of herpes zoster complications in older adults: A cohort study of US claims database. Vaccine, 37(9), 1235–1244.

Pharmaceutical Benefits Advisory Committee (PBAC). (2023). *Public Summary Document, March 2023 PBAC Meeting.*

Pharmacy Program Administrator (PPA). (2024). *Program Rules: National Immunisation Program in Pharmacy (NIPVIP) Program.* Canberra: Australian Government Department of Health and Aged Care.

Stein AN, Britt H, Harrison C, Conway EL, Cunningham A & Macintyre CR. (2009). Herpes zoster burden of illness and health care resource utilisation in the Australian population aged 50 years and older. Vaccine, 27(4), 520–529.

Factors and Sources: Influenza

Scenario	Age	Value	Source
Epidemiology			
Incidence	50-64	9.9%	CDC (2024)
Conditional Probability (Medical Attention)	50-64	0.4300	CDC (2024)
Conditional Probability (Hospitalisation)	50-64	0.1131%	Moa (2023)
Vaccine Effectiveness (Annual)	All	65%	Department of Health (2023)
Mortality and Morbidity			
Population Mortality rate (by age and gender)	Varies	Varies	ABS (2023a)
Excess Mortality due to Influenza	50-64	0.0026%	Moa (2023)
Average Baseline Utility (by age and gender)	Varies	Varies	AIHW (2024)
Excess Disability Weight for Influenza	All	0.05	GBDCN (2024)
Cost of Vaccination			
Cost of Vaccine	All	$20	Based on average cost of vaccine
Administration of Vaccine	All	$20	Based on payment under the National Immunisation Program for vaccination by a pharmacist. (PPA 2024)
Indirect Cost of Vaccination (Productivity)	All	Varies	Based on 1 hours lost productivity
Direct Care Costs			
Treatment cost (Medical Attention)	All	$60	Based on average cost of GP visit
Treatment cost (Hospital)	All	$8,732	Newall (2008) updated for 2024 prices
Indirect Costs			
Average Income from Employment (by age and gender)	All	Varies	ABS (2023b) – indexed. By WPI ABS (2024b)
Participation Rate (by age and gender)	All	Varies	ABS (2024a)
Discount Rates (per annum)			
Benefit	All	3.5%	

References for Influenza

Australian Bureau of Statistics (ABS). (2023a). *Life Expectancy, 2020-2022.*

Australian Bureau of Statistics (ABS). (2023b). *Personal Income in Australia, 2020-21.*

Australian Bureau of Statistics (ABS). (2024a). *Labour Force, Australia, Detailed, April 2024*.

Australian Bureau of Statistics (ABS). (2024b). *Wage Price Index, Australia, March 2024*.

Australian Department of Health and Aged Care (Department of Health). (2023). *Australian Influenza Surveillance Report – 2023: End of Season Summary.*

Australian Institute of Health and Welfare (AIHW). (2024). *Australian Burden of Disease Study 2023, National estimates for Australia: Supplementary tables.*

Australian Technical Advisory Group on Immunisation (ATAGI). *Australian Immunisation Handbook*. Canberra: Australian Government Department of Health and Aged Care.

Chow EJ, Rolfes MA, O'Halloran A, et al. (2020). Acute cardiovascular events associated with influenza in hospitalized adults. *Ann Intern Med. 173(8): 605–13.*

FluTracking Australia. (2024). *Weekly Report: Monday 15 July 2024- Sunday 21 July 2024.*

Global Burden of Disease 2021 Causes of Death Collaborators (GBDCDN). (2024). Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*, 403(10440), 2100–2132.

Global Burden of Disease Collaborative Network (GBDCN). (2024). *Global Burden of Disease Study 2021, Disability Weights*. Seattle, United States of America: Institute for Health Metrics and Evaluation.

MacIntyre CR, Heywood AE, Kovoor P, et al. (2013). Ischaemic heart disease, influenza and influenza vaccination: a prospective case control study. *Heart*, 99(24):1843-8.

Moa AM, Menzies RI, Yin JK, & MacIntyre CR. (2022). Modelling the influenza disease burden in people aged 50-64 and ≥65 years in Australia. *Influenza and other respiratory viruses*, 16(1), 132–41.

Pharmacy Program Administrator (PPA). (2024). *Program Rules: National Immunisation Program in Phamacy (NIPVIP) Program.* Canberra: Australian Government Department of Health and Aged Care.

U.S. Centres for Disease Control and Prevention (CDC). (2024). *Estimated Influenza Illnesses, Medical Visits, Hospitalizations, and Deaths Prevented by Vaccination in the United States – 2022-2023 Influenza Season*.

World Health Organisation (WHO). (2023). *Fact Sheet: Influenza*.

Factors and Sources: RSV

Parameter	Age	Value	Source
Epidemiology			
Incidence	All	5.0%	Falsey (2005)
Conditional Probability (Non Medical Attention Needed)	50-64	58.8%	Li (2023) Modelled from over 65 trends
	65-74	57.5%	Li (2023)
	75-84	55.0%	Li (2023)
	85+	52.0%	Li (2023)

Conditional Probability (Medical Attendance)	50-64	38.7%	Li (2023) Modelled from over 65 trends
	65-74	37.9%	Li (2023)
	75-84	36.2%	Li (2023)
	85+	34.2%	Li (2023)
Conditional Probability (Hospitalisation)	50-64	2.4%	Li (2023) Modelled from over 65 trends
	65-74	4.6%	Li (2023)
	75-84	8.8%	Li (2023)
	85+	13.8%	Li (2023)
Vaccine Effectiveness against medical attendance (Year 1)	All	65.5%	Ortega-Sanchez (2024)
Vaccine Effectiveness against medical attendance (Year 2)	All	28%	Ortega-Sanchez (2024)
Vaccine Effectiveness against medical attendance (Year 3)	All	0%	Ortega-Sanchez (2024)
Vaccine Effectiveness against Hospitalisation (Year 1)	All	78%	Ortega-Sanchez (2024)
Vaccine Effectiveness against Hospitalisation (Year 2)	All	60%	Ortega-Sanchez (2024)
Vaccine Effectiveness against Hospitalisation (Year 3)	All	0%	Ortega-Sanchez (2024)
Mortality and Morbidity			
Population Mortality rate (by age and gender)	Varies	Varies	ABS (2023a)
Case Fatality Rate (Post Hospitalisation)	All	5.3%	Li (2023)
Average Baseline Utility (by age and gender)	Varies	Varies	AIHW (2024)
Excess Disability Weight (Medical Attendance)	All	0.01	Two days sick leave
Excess Disability Weight (Hospitalisation)	All	0.05	Ten days sick leave
Cost of Vaccination			
Cost of Vaccine	All	$295.15	Assumption
Administration of Vaccine	All	$18.15	Average Cost of Pharmacy provided vaccination
Adverse Events	All	$2.80	Curran (2019) adjusted for Australian prices
Indirect Cost of Vaccination (Productivity)	All	Varies	Based on 1 hours lost productivity
Direct Care Costs			
Treatment Cost (Medical Attention)	All	$60	Average cost of GP visit
Treatment Cost (Hospitalisation)	All	$10,043	IHACPA (2024) AR-DRG E62A
Indirect Costs			

Average Income from Employment (by age and gender)	All	Varies	ABS (2023b) – indexed. By WPI ABS (2024b)
Participation Rate (by age and gender)	All	Varies	ABS (2024a)
Discount Rates (per annum)			
Costs and Benefits	All	3.5%	

References for RSV

Australian Bureau of Statistics (ABS). (2023a). *Life Expectancy, 2020-2022.*

Australian Bureau of Statistics (ABS). (2023b). *Personal Income in Australia, 2020-21.*

Australian Bureau of Statistics (ABS). (2024a). *Labour Force, Australia, Detailed, April 2024*.

Australian Bureau of Statistics (ABS). (2024b). *Wage Price Index, Australia, March 2024*.

Australian Institute of Health and Welfare (AIHW). (2024). *Australian Burden of Disease Study 2023, National estimates for Australia: Supplementary tables.*

Australian Technical Advisory Group on Immunisation (ATAGI). *Australian Immunisation Handbook*. Canberra: Australian Government Department of Health and Aged Care.

Australian Department of Health and Aged Care. (2024). *National Immunisation Program schedule.*

Curran D, Patterson B, Varghese L, Van Oorschot D, Buck P, Carrico J, Hicks K, Lee B, & Yawn B. (2018). Cost-effectiveness of an Adjuvanted Recombinant Zoster Vaccine in older adults in the United States. *Vaccine*, 36(33), 5037–5045.

Falsey AR, Hennessey PA, Formica MA, Cox C, Walsh EE. (2005). Respiratory syncytial virus infection in elderly and high-risk adults. *N Engl J Med*. 352(17):1749-59.

GBD 2021 Causes of Death Collaborators (GBDCDN). (2024). Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*, 403(10440), 2100–2132.

Global Burden of Disease Collaborative Network (GBDCN). (2024). *Global Burden of Disease Study 2021, Disability Weights*. Seattle, United States of America: Institute for Health Metrics and Evaluation.

Independent Health and Aged Care Pricing Authority. (2024). *National Efficient Price Determination 2024–25.*

Ison MG, Papi A, Athan E, Feldman RG, Langley JM, Lee D-G, Leroux-Roels I, Martinon-Torres F, F Schwarz T, van Zyl-Smit RN, Verheust C, Dezutter N, Gruselle O, Fissette L, David M-P, Kostanyan L, Hulstrøm V, Olivier A, Van der Wielen M, Descamps D, for the AReSVi-006 Study Group. (2024). Efficacy and Safety of Respiratory Syncytial Virus (RSV) Prefusion F Protein Vaccine (RSVPreF3 OA) in Older Adults Over 2 RSV Seasons. *Clinical Infectious Diseases*, 78(6):1732–1744.

Li Y, Kulkarni D, Begier E, Wahi-Singh P, Wahi-Singh B, Gessner B, Nair H. (2023). Adjusting for Case Under-Ascertainment in Estimating RSV Hospitalisation Burden of Older Adults in High-Income Countries: a Systematic Review and Modelling Study. *Infect Dis Ther.* 12(4):1137-1149.

Ortega-Sanchez, IR. (2024). *Economics of Respiratory Syncytial Virus (RSV) Vaccination in All U.S. Adults≥75 years-old, and Adults aged 60-74 and 50-59 years at Increased Risk*. National Centre for Immunisation and Respiratory Diseases, ACIP Meeting, 26 June 2024.

Factors and Sources: Pertussis

Scenario	Age	Value	Source
Epidemiology			
Incidence	50-64	0.0826%	Pearce (2024)
Incidence	65-74	0.0702%	Pearce (2024)
Incidence	75-84	0.0461%	Pearce (2024)
Incidence	85+	0.0463%	Pearce (2024)
Conditional Probability (Hospitalisation)	50-64	2.2%	Marshall (2022)
Conditional Probability (Hospitalisation)	65-79	5.6%	Marshall (2022)
Conditional Probability (Hospitalisation)	80+	16.5%	Marshall (2022)
Vaccine Effectiveness (Initial)	All	85%	Booy (2010)
Vaccine Wanning Rate (per annum)	All	7.5%	Booy (2010)
Mortality and Morbidity			
Population Mortality rate (by age and gender)	Varies	Varies	ABS (2023a)
Average Baseline Utility (by age and gender)	Varies	Varies	AIHW (2024)
Excess Disability Weight for Pertussis (Moderate)	All	0.051	Kitanao (2021)
Excess Disability Weight for Pertussis (Severe)	All	0.133	Kitanao (2021)
Direct Cost of Vaccination			
Cost of Vaccine	All	$20	Based on average cost of vaccine
Administration of Vaccine	All	$20	Based on payment under the National Immunisation Program for vaccination by a pharmacist. (PPA 2024)
Average Cost of Adverse Event following vaccination	50-64	$1.34	
Average Cost of Adverse Event following vaccination	65+	$7.96	
Indirect Cost of Vaccination			
Indirect Cost of Vaccination (Productivity)	All	Varies	Based on 1 hours lost productivity
Direct Care Costs			
Treatment cost (Medical Attention)	All	$186	Based on average cost of GP visit, pathology test and course of antibiotic
Treatment cost (Hospital)	All	$5,193	Average of prices for DRGs E70A and E70B
Indirect Costs			
Average Income from Employment (by age and gender)	All	Varies	ABS (2023b) – indexed. By WPI ABS (2024b)
Participation Rate (by age and gender)	All	Varies	ABS (2024a)
Discount Rates (per annum)			

Benefit	All	3.5%	Assumption
Cost	All	3.5%	Assumption

References for Pertussis and Diphtheria

Australian Bureau of Statistics (ABS). (2023a). *Life Expectancy, 2020-2022.*

Australian Bureau of Statistics (ABS). (2023b). *Personal Income in Australia, 2020-21.*

Australian Bureau of Statistics (ABS). (2024a). *Labour Force, Australia, Detailed, April 2024*.

Australian Bureau of Statistics (ABS). (2024b). *Wage Price Index, Australia, March 2024*.

Australian Institute of Health and Welfare (AIHW). (2024). *Australian Burden of Disease Study 2023, National estimates for Australia: Supplementary tables.*

Australian Technical Advisory Group on Immunisation (ATAGI). (2024). *Australian Immunisation Handbook*. Canberra: Australian Government Department of Health and Aged Care.

Booy R, Van der Meeren O, Ng SP, Celzo F, Ramakrishnan G, Jacquet JM. (2010). A decennial booster dose of reduced antigen content diphtheria, tetanus, acellular pertussis vaccine (Boostrix™) is immunogenic and well tolerated in adults. *Vaccine*, 29(1):45-50.

Centers for Disease Control and Prevention (CDC). (2021). *Epidemiology and Prevention of Vaccine-Preventable Diseases.* Hall E, Wodi AP, Hamborsky J, et al., eds. 14th ed. Washington, D.C. Public Health Foundation.

Global Burden of Disease 2021 Causes of Death Collaborators (GBDCDN). (2024). Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*, 403(10440), 2100–2132.

Global Burden of Disease Collaborative Network (GBDCN). (2024). *Global Burden of Disease Study 2021, Disability Weights*. Seattle, United States of America: Institute for Health Metrics and Evaluation.

Kitano T. (2021). The estimated burden of 15 vaccine-preventable diseases from 2008 to 2020 in Japan: A transition by the COVID-19 pandemic. *Journal of Infection and Chemotherapy*, 27(10):1482-1488.

Marshall KS, Quinn HE, Pillsbury AJ, Maguire JE, Lucas RM, Dey A, Beard FH, Macartney KK, & McIntyre PB. (2022). Australian vaccine preventable disease epidemiological review series: Pertussis, 2013-2018. *Communicable diseases intelligence*, 46.3.

National Centre for Immunisation Research and Surveillance (NCIRS). (2023). *Pertussis vaccines for Australians Fact Sheet.*

Pearce R, Chen J, Chin KL, Guignard A, Latorre LA, MacIntyre CR, Schoeninger B, & Shantakumar S. (2024). Population-Based Study of Pertussis Incidence and Risk Factors among Persons >50 Years of Age, Australia.

Pharmacy Program Administrator (PPA). (2024). *Program Rules: National Immunisation Program in Pharmacy (NIPVIP) Program.* Canberra: Australian Government Department of Health and Aged Care.

Appendix Three: Higher Discount Rate

As noted above, and for completeness, this Appendix provides further calculations on three vaccines which are found to be cost-effective. The only variation to the model is that ICERS and costs are calculated here with a 5% rather than a 3.5% discount rate.

Herpes Zoster

Table One of this Appendix sets out the estimated ICERs for the three possible changes to the current arrangements under the National Immunisation Program, if the discount rate is assumed to be 5%

Appendix Three Table One: ICER for Herpes Zoster Vaccination Scenario, age 50 (5% Discount Rate)

Scenario	ICER Population	ICER Females	ICER Males
Vaccinate once at 50	$34,550	$41,317	$27,235

Table Two below sets out the ICERs for vaccination during the initial period in which all people between the age 50 and 64 would be eligible for vaccinated for the first time, if the discount rate is assumed to be 5 %

Appendix Three Table Two: ICER for Herpes Zoster Vaccination Scenario, Cohort Aged 50-64 (5% Discount Rate)

Scenario	ICER Population	ICER Females	ICER Males
Vaccinate once at 50 to 64	$33,328	$37,180	$29,213

Table Three sets out the discounted net costs and discounted QALYs gained from lowering the age for vaccination for HZ from 65 to 50, assuming 100 per cent take up and a catchup program in the first five years for those aged 50 to 64 (noting that a new cohort of those aged 50 would enter the vaccination each year), if the discount rate is assumed to be 5%.

Appendix Three Table Three: Discounted Net Costs and Discounted QALYs Gained from Lowering the Age of Vaccination

Scenario	Discounted Cost of Vaccination per Annum	Discounted Net Economic Cost per Annum	Discounted QALYs Gained per Annum
Vaccinate once at 50	$201.4m	$89.7m	2,595
Vaccinate once at 50 to 64 (five year catch up program)	$727.7m	$359.58m	10,720
Vaccinate once at 50 compared to Vaccinate once at 65	$110.5m	$30.6m	1,098

Influenza

Table Four sets out the estimated Incremental Cost Effectiveness Ratios (ICER) – the ICER measures the Discounted Net Cost per Discounted QALY Gained – for annually vaccinating all people between the ages of 50 and 64 against influenza if a 5% discount rate is assumed.

Appendix Three Table Four: ICERs for Influenza Vaccination, Cohort Aged 50-64

Scenario	ICER Population	ICER Females	ICER Males
Vaccination available for those aged 50 to 64	$22,649	$22,652	$22,646

The results show that this change in policy would be cost effective for the entire population cohort at the standard $50,000 per QALY threshold.

Table Five sets out the discounted net costs and discounted QALYs gained from lowering the age for vaccination for influenza from 65 to 50 if a 5% discount rate is assumed.

Appendix Three Table Five: Discounted Net Costs and Discounted QALYs Gained from Lowering the Age of Vaccination

Scenario	Cost of Vaccination per Annum	Discounted Net Economic Cost per Annum	Discounted QALYs Gained per Annum
Extending annual vaccination to those aged 50 to 64 (95% coverage)	$179.4m	$137.0m	6,048
Extending annual vaccination to those aged 50 to 64 (80% coverage)	$151.1m	$115.4m	5,093

Respiratory Syncytial Virus

Table Six below sets out the estimated ICERs for the modelled scenarios, with a 5% discount rate.

Appendix Three Table Six: ICERs for Vaccination Scenarios (5% Discount Rate)

Scenario	One off vaccination	One off vaccination and 3-year booster	One off vaccination and 5-year booster
Vaccinate once at 75	$7.824	$10,188	$9,473
Vaccinate everyone who is aged 75 or older	$10,409	$12,138	$11,739

Mainly due to the later age of vaccination, these are not materially different from ICERs calculated at 3.5%.

Finally, as pertussis and diphtheria vaccinations are not cost-effective at 3.5% discount, no calculations are warranted at 5%.