

The costs of haemochromatosis in Australia

2nd Biennial Australasian
Haemochromatosis
Conference

August 6th 2016

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Background

- Cost of illness studies quantify the economic burden associated with a disease;
- An essential evaluation technique in health care and health economics;
- By measuring and comparing the economic burdens of diseases to society, such studies can help health-care decision-makers to set up and prioritize health-care policies and interventions
- No previous quantification of the economic burden associated with haemochromatosis published

Cost of illness study

Research question:

- What is the economic burden of haemochromatosis in Australia?

Aim:

- To quantify all costs associated with haemochromatosis for the Australian setting, from the perspectives of the patient and society.

Methods: Categories of haemochromatosis

Category 1	Genetic mutation only (C282Y homozygotes, H63D heterozygotes and compound heterozygotes)
Category 2	Genetic mutation and elevated iron studies, either transferrin saturation or serum ferritin
Category 3	Genetic mutation, elevated iron levels and early symptoms, including arthritis, fatigue
Category 4	Genetic mutation, elevated iron levels and organ damage

Adams, P., P. Brissot, and L. Powell, *EASL International Consensus Conference on Haemochromatosis - Part II. Expert document*. Journal of Hepatology, 2000. **33**(3): p. 487-496.

Methods

Methodology

- National online survey; conducted between November 2013-February 2015
- Convenience sampling;
- Recruitment: Haemochromatosis Australia's website, newsletters, flyers to new members; flyers/posters to large hepatology, haematology and gastroenterology clinics; GPs, newspapers; case finding all Tas public hospitals 2007-2014
- Eligibility criteria: aged 18/+, living in Australia, diagnosed with haemochromatosis;

Methods

Survey components:

- Demographics;
- Living environment;
- Employment and income;
- Personal support;
- Health insurance;
- Haemochromatosis-related health (genetic mutation, liver disease, heart disease, diabetes type II, arthritis);

Methods

Resource diary:

- Completed retrospectively, monthly over 3 months
- Medications (prescribed and over-the-counter);
- Supplements/other preparations;
- GP, private specialist and other health provider visits;
- Medical procedures, tests and investigations;
- Hospital admissions/attendances;
- Specialised equipment;
- Community services;
- Transport;
- Impact on employment- presenteeism & absenteeism, transfer payments

Methods

Methodology:

Costs calculated for:

- health sector (e.g. medications, medical appointments);
 - other sector (e.g. transport to appointments), and;
 - time-loss/productivity (absenteeism, presenteeism).
-
- Costs were calculated for the patient and societal perspectives
 - Used a bottom-up, prevalence based approach



Methods

Costing methodology

- Average monthly cost/pt calculated for:
 - Medications: prescribed (PBS safety net thresholds and concession cards), non-prescribed, supplements
 - Medical appointments, investigations, procedures: MBS safety net thresholds and concession cards
 - Hospitalisations
 - Specialised equipment
 - Transport
 - Absenteeism and presenteeism
- All costs extrapolated to annual costs.
- All costs AUD 2015
- Costs incorporated into perspectives

Methods

Costing methodology:

Health sector costs:

- Medications and supplements
- Medical appointments, investigations, procedures
- Hospital admissions/presentations
- Specialised equipment

Other sector

- Transport

Time-loss/Productivity costs

- Absenteeism and presenteeism (patient)
- Absenteeism (carer)

Cost of illness study

Demographics	n=157
Mean age (range, SD)	56yrs (19-83, SD=13)
Male	41% (65)
Employment status:	
employed	54%
retired	32%
unemployed	4%
other	10%
State of residence:	
ACT	1%
NSW	24%
QLD	20%
SA	5%
TAS	29%
VIC	15%
WA	6%
NT	0
Category of haemochromatosis	
category 1	8% (12)
category 2	29% (46)
category 3	50% (78)
category 4	13% (21)

Results: estimated cost per patient per category: patient & societal perspectives

	Patient perspective (AUD/person)	Societal perspective (AUD/person)
	mean cost (95%CI)	
Category 1		
Health sector costs	560 (165-989)	1384 (546-2308)
Other sector costs	47 (0-136)	47 (0-136)
Time-loss costs	n/a	0
TOTAL	607 (209-1041)	1431 (643-2262)
Category 2		
Health sector costs	765 (497-1098)	
Other sector costs	54 (32-80)	
Time-loss costs	n/a	
TOTAL	819 (544-1154)	
Category 3		
Health sector costs	1464 (1197-1796)	4126 (3336-5036)
Other sector costs	94 (62-137)	94 (62-137)
Time-loss costs	n/a	5311 (3304-7837)
TOTAL	1558 (1268-1913)	9531 (7169-12609)
Category 4		
Health sector costs	1904 (1078-2859)	
Other sector costs	162 (67-281)	
Time-loss costs	n/a	
TOTAL	2066 (1208-3028)	
Asymptomatic (categories 1 & 2)		
Health sector costs	723 (480-1017)	2445 (1719-3422)
Other sector costs	53 (30-79)	53 (30-79)
Time-loss costs	n/a	1203 (454-2269)
TOTAL	775 (528-1078)	3701 (2423-5296)
Symptomatic (categories 3 & 4)		
Health sector costs	1557 (1289-1856)	
Other sector costs	109 (76-149)	
Time-loss costs	n/a	
TOTAL	1666 (1384-1996)	

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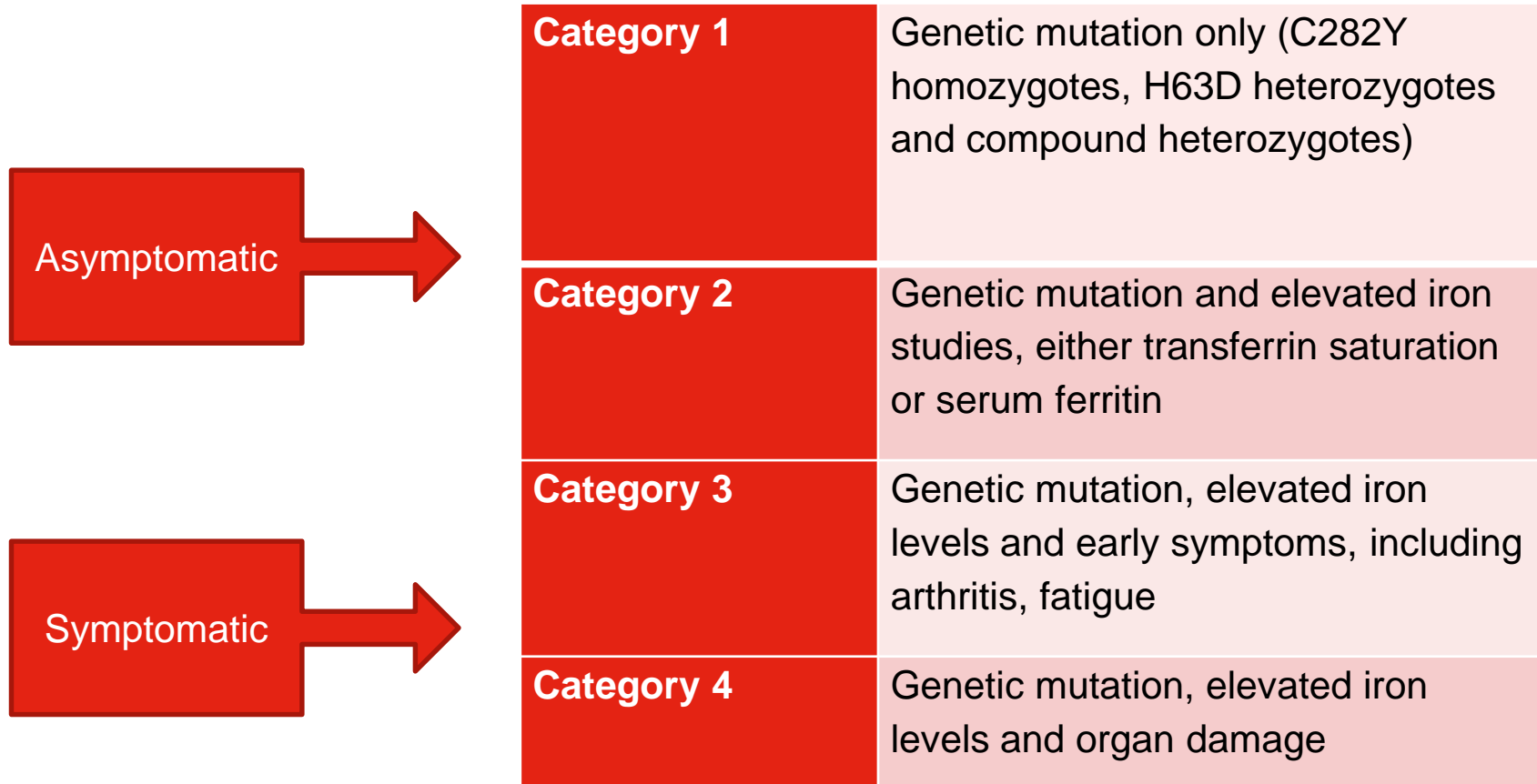
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Categories of haemochromatosis



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Health sector costs	765 (497-1098)	2722 (1761-3867)
Other sector costs	54 (32-80)	54 (32-80)
Time-loss costs	n/a	1517 (572-2852)
TOTAL	819 (544-1154)	4293 (2754-6110)
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Health sector costs	1904 (1078-2859)	6518 (3576-10354)
Other sector costs	162 (67-281)	162 (67-281)
Time-loss costs	n/a	5202 (1086-10576)
TOTAL	2066 (1208-3028)	11882 (5750-19707)
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Symptomatic (categories 3 & 4)		
Health sector costs	1557 (1289-1856)	4633 (3752-5672)
Other sector costs	109 (76-149)	109 (76-149)
Time-loss costs	n/a	5288 (3313-7423)
TOTAL	1666 (1384-1996)	10030 (7705-12670)

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Time-loss costs	n/a	5288 (3313-7423)
TOTAL	1666 (1384-1996)	10030 (7705-12670)

What are the costs of haemochromatosis to the Australian society?

- Need to extrapolate the /patient from the societal perspective to the Australian population

Assumptions for extrapolation of costs

Parameters	Assumption	Running count	Source of estimate
Australian popn aged 20 or older	16,652,952	16,652,952	Australian Historical Population Statistics, 2014 (ABS)
Proportion northern European ancestry	66%	10,990,948	Census of Population and Housing, Table Builder, Ancestry (ABS)
Prevalence C282Y homozygotes	0.68%	74,738	Allen et al, 2008
Estimate of % of C282Y homozygotes diagnosed	31%	23,169	(L. Gurrin, Principal Investigator, HealthIron study, personal communication, March 16 2015)
Diagnosed (n=23,169): Categories 1 and 2 Categories 3 and 4	86.1% 13.9%	19,949 3,220	Allen et al, 2008
Not diagnosed (n=51,569): Categories 1 and 2 Categories 3 and 4	86.1% 13.9%	44,400 7,168	Allen et al, 2008

What about the estimated 69% of C282Y homozygous people who are not diagnosed?

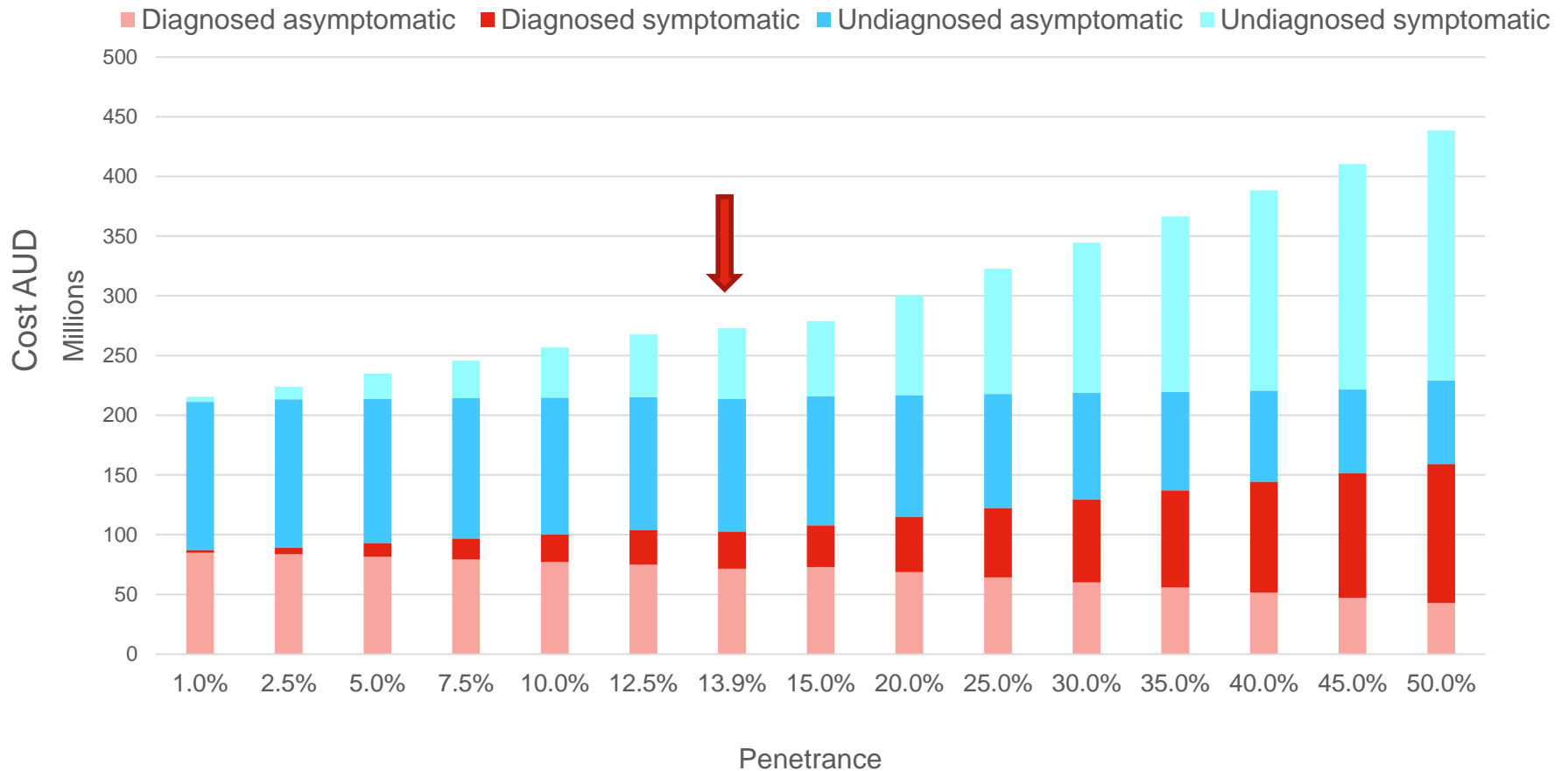
- Subtract all therapeutic venesection costs;
- All costs for category 1=0
- All other parameters: *ceteris parabis*

Study 3: Cost of illness study

Estimated costs of diagnosed haemochromatosis for the Australian population (societal perspective)

	Total cost (AUD 2015)
Asymptomatic patients (categories 1 & 2)	
Health sector costs	101,910,853
Other sector costs	3,359,748
Time-loss costs	76,874,914
TOTAL	181,145,515
Symptomatic patients (categories 3 & 4)	
Health sector costs	35,758,696
Other sector costs	1,180,782
Time-loss costs	57,389,448
TOTAL	94,328,926
TOTAL	276,474,441

Total estimated costs of haemochromatosis x penetrance rates (societal perspective)



Study 3: Cost of illness study

Limitations

- Convenience sampling;
- Assumptions

Conclusions

- First haemochromatosis COI study to be published;
- Haemochromatosis is estimated to cost AUD276 million per year from a societal perspective;
- Both health sector and time-loss costs are major drivers;
- Costs could be decreased by reducing penetrance through early diagnosis and treatment (i.e. reduce penetrance rate).

Acknowledgements

Menzies Institute for Medical Research

Supervisory team:

- Prof Andrew Palmer
- Dr Amanda Neil
- A/Prof Kristy Sanderson
- Dr Kwang Chien Yee

Menzies Health Economics Groups

- Lei Si
- Julie Campbell
- April Jankiewicz
- Nhat Quang Tran
- Adriana Nevarez Flores
- Dr Hasnat Ahmad

School of Pharmacy

- Dr Felicity Veal

Information Technology Services

- Ben Duan

External support

- A/Prof Lyle Gurrin (School of Population and Global Health, University of Melbourne)
- Prof Martin Delatycki, Murdoch Children's Research Institute

Funding and support:

- University of Tasmania, APS scholarship
- Haemochromatosis Australia, Ben Marris
- Broadreach Holdings

All the lovely people who have shared the highs and lows, provided guidance, support and humour and wonderful morning teas.

And of course.....the 'pack'

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Key model parameters

Parameter	Base case		Range for SA		Distribution	Source
Uptake of screening:						
<i>Status quo</i>	0.05	0.025-0.075~	Triangular	Estimate ^d		
<i>Of these:</i>						
Cascade screening	0.50	-	Triangular	[57, 58]		
Incidental screening	0.50	-	Triangular	[57, 58]		
Genotype	0.469	0.23-0.70~	Triangular	[57, 58]		
Neonatal heelprick	1.00	-	Triangular	[33, 59, 73]		
Adult state iron studies	0.50	0.025-0.075~	Triangular	Estimate ^d		
Utilities	Male	Female	Male	Female		
Category 1	0.88	0.71	0.70-1.00	0.57-0.85	Beta	[53]
Category 2	0.85	0.77	0.68-1.00	0.62-0.92	Beta	[53]
Category 3	0.59	0.60	0.47-0.71	0.48-0.72	Beta	[53]
Category 4	0.59	0.41	0.47-0.71	0.33-0.49	Beta	[53]
Annual discount rate						
Costs	0.05		-			
Effectiveness	0.05	0.00-0.07	-	[26]		

One-way sensitivity analyses: male adults

Parameters	Mean costs (AUD)				Mean effectiveness (QALYs)				ICER * (AUD)		
	Status quo	Genetic screening (blood)	Genetic screening (buccal)	Transferrin saturation	Status quo	Genetic screening (blood)	Genetic screening (buccal)	Transferrin saturation	Genetic screening (blood)	Genetic screening (buccal)	Transferrin saturation
BASE-CASE									DOMINANT	12,019	19,681
Discount rate: 0%	518	437	493	476	42.249	42.267	42.267	42.265	2,906	18,738	6,702
Discount rate: 7%	101	119	174	123	11.903	11.906	11.906	11.905	39	10,380	DOMINANT
Prevalence: -20%	127	138	193	149	15.453	15.457	15.457	15.457	2,906	18,738	6,702
Prevalence: +20%	186	186	242	182	15.451	15.457	15.457	15.455	39	10,380	DOMINANT
Probability of starting in category 1: -20%	159	160	215	168	15.451	15.456	15.456	15.455	109	12,034	1,985
Probability of starting in category 1: +20%	128	142	198	149	15.454	15.458	15.458	15.457	4,208	20,544	7,226
Transition from category 1 to 2: -20%	134	143	199	150	15.453	15.457	15.457	15.456	2,589	17,261	4,912
Transition from category 1 to 2: +20%	152	158	213	165	15.452	15.456	15.456	15.456	1,353	14,545	3,661
Costs: category 2(no treatment): -20*	133	144	200	150	15.453	15.457	15.457	15.456	2,736	16,522	4,971
Costs: category 2(no treatment): +20*	155	158	214	166	15.453	15.457	15.457	15.456	941	14,727	3,331
Costs: category 3(no treatment): -20*	130	142	198	148	15.453	15.457	15.457	15.456	3,060	16,846	5,270
Costs: category 3(no treatment): +20*	157	160	215	168	15.453	15.457	15.457	15.456	617	14,403	3,032
Discount rate: 0%	271	190	190	220	42.249	42.267	42.267	42.265	DOMINANT	DOMINANT	DOMINANT
Discount rate: 7%	32	21	21	23	11.903	11.906	11.906	11.905	T	T	T
Prevalence: -20%	46	31	31	35	15.453	15.457	15.457	15.456	DOMINANT	DOMINANT	DOMINANT
Prevalence: +20%	69	46	46	48	15.451	15.457	15.457	15.455	DOMINANT	DOMINANT	DOMINANT
Probability of starting in category 1: -20%	59	39	39	42	15.451	15.456	15.456	15.455	DOMINANT	DOMINANT	DOMINANT
Probability of starting in category 1: +20%	46	39	39	35	15.454	15.456	15.456	15.457	DOMINANT	DOMINANT	DOMINANT
Transition from category 2 to 3: -20%	46	31	31	34	15.454	15.457	15.457	15.457	DOMINANT	DOMINANT	DOMINANT
Transition from category 2 to 3: +20%	58	38	38	43	15.452	15.456	15.456	15.455	DOMINANT	DOMINANT	DOMINANT
Transfer costs: category 3: -20	46	31	31	34	15.453	15.457	15.457	15.456	DOMINANT	DOMINANT	DOMINANT
Transfer costs: category 3: +20	59	39	39	43	15.453	15.457	15.457	15.456	DOMINANT	DOMINANT	DOMINANT
Discount rate: 0%	789	627	683	695	42.249	42.267	42.267	42.265	DOMINANT	DOMINANT	DOMINANT
Discount rate: 7%	133	140	195	146	11.903	11.906	11.906	11.905	2,643	23,898	5,825
Baseline age: 20 years	212	197	252	209	16.051	16.056	16.056	16.055	DOMINANT	9,297	DOMINANT
Baseline age: 40 years	196	186	242	197	14.528	14.532	14.532	14.531	DOMINANT	11,211	118
Prevalence: -20%	174	168	224	184	15.453	15.457	15.457	15.457	DOMINANT	14,262	3,223
Prevalence: +20%	255	232	288	230	15.451	15.457	15.457	15.455	DOMINANT	6,071	DOMINANT
Screening uptake: - 50%	205	188	232	196	15.452	15.454	15.454	15.454	DOMINANT	-321,063	16,081
Screening uptake: +50%	210	184	251	197	15.453	15.459	15.459	15.458	DOMINANT	-321,063	16,081
Probability of starting in category 1: -20%	219	198	254	210	15.451	15.456	15.456	15.455	DOMINANT	7,597	DOMINANT
Probability of starting in category 1: +20%	174	174	229	184	15.454	15.458	15.458	15.457	500	16,163	3,334
Transition from category 1 to 2: -20%	182	175	231	185	15.453	15.457	15.457	15.456	DOMINANT	12,848	918
Transition from category 1 to 2: +20%	208	195	251	206	15.452	15.456	15.456	15.456	DOMINANT	10,130	DOMINANT
Transition from category 2 to 3: -20%	187	179	235	189	15.454	15.457	15.457	15.457	DOMINANT	12,971	750

One-way sensitivity analyses: female adults

Parameters	Mean costs (AUD)				Mean effectiveness (QALYs)				ICER * (AUD)		
	Status quo	Genetic screening (blood)	Genetic screening (buccal)	Transferrin saturation	Status quo	Genetic screening (blood)	Genetic screening (buccal)	Transferrin saturation	Genetic screening (blood)	Genetic screening (buccal)	Transferrin saturation
Adult females											
Discount rate: 0%	269	251	306	252	33.125	33.126	33.126	33.130	DOMINANT	22,178	DOMINANT
Discount rate: 7%	65	94	150	87	11.286	11.286	11.286	11.287	DOMINATED	DOMINATED	18,102
Prevalence: -20%	80	104	160	101	14.281	14.282	14.282	14.283	294,388	DOMINATED	19,364
Prevalence: +20%	115	136	192	121	14.277	14.277	14.277	14.280	DOMINATED	DOMINATED	1,973
Costs: category 2(no treatment): -20%	77	105	161	98	14.280	14.280	14.280	14.282	989,998	DOMINATED	12,185
Costs: category 2(no treatment): +20%	102	121	177	116	14.280	14.280	14.280	14.282	678,382	DOMINATED	8,440
Probability of starting in category 1: -20%	108	123	179	117	14.280	14.280	14.280	14.282	200,095	DOMINATED	5,519
Probability of starting in category 1: +20%	85	111	166	104	14.280	14.280	14.280	14.282	1,698,343	DOMINATED	11,632
Transition from category 1 to 2-: -20%	80	107	162	100	14.281	14.281	14.281	14.282	9,494,935	DOMINATED	11,711
Transition from category 1 to 2-: +20%	97	119	174	113	14.280	14.280	14.280	14.281	387,984	DOMINATED	9,154
Adult females											
Discount rate: 0%	56	41	41	50	33.125	33.126	33.126	33.130	DOMINANT	DOMINANT	DOMINANT
Discount rate: 7%	7	5	5	6	11.286	11.286	11.286	11.287	25,464	2	DOMINANT
Prevalence: -20%	11	7	7	9	14.281	14.282	14.282	14.283	DOMINANT	DOMINANT	DOMINANT
Prevalence: +20%	16	11	11	12	14.277	14.277	14.277	14.280	43,139	5	DOMINANT
Probability of starting in category 1: -20%	16	10	10	11	14.280	14.280	14.280	14.282	DOMINANT	DOMINANT	DOMINANT
Probability of starting in category 1: +20%	11	8	8	9	14.280	14.280	14.280	14.282	DOMINANT	DOMINANT	DOMINANT
Transition from category 2 to 3-: -20%	10	7	7	8	14.281	14.281	14.281	14.282	17,375	3	DOMINANT
Transition from category 2 to 3-: +20%	14	10	10	11	14.280	14.280	14.280	14.281	DOMINANT	DOMINANT	DOMINANT
Transfer costs: category 3-: -20	11	7	7	8	14.280	14.280	14.280	14.282	DOMINANT	DOMINANT	DOMINANT
Transfer costs: category 3-: +20	14	10	10	11	14.280	14.280	14.280	14.282	DOMINANT	DOMINANT	DOMINANT
Adult females											
Discount rate: 0%	325	292	347	302	33.125	33.126	33.126	33.130	DOMINANT	13,586	DOMINANT
Discount rate: 7%	72	99	155	93	11.286	11.286	11.286	11.287	DOMINATED	DOMINATED	16,664
Baseline age: 35 years	116	132	187	127	15.243	15.243	15.243	15.245	92,147	425,284	5,835
Baseline age: 55 years	83	109	165	102	12.865	12.865	12.865	12.866	DOMINATED	DOMINATED	13,223
Prevalence: -20%	90	112	167	110	14.281	14.282	14.282	14.283	254,279	914,005	17,428
Prevalence: +20%	131	147	203	133	14.277	14.277	14.277	14.280	DOMINATED	DOMINATED	543
Probability of starting in category 1: -20%	123	134	189	129	14.280	14.280	14.280	14.282	133,395	836,678	3,082
Probability of starting in category 1: +20%	96	119	174	113	14.280	14.280	14.280	14.282	1,472,853	5,114,939	10,170
Transition from category 2 to 3-: -20%	98	119	175	114	14.281	14.281	14.281	14.282	DOMINATED	DOMINATED	9,949
Transition from category 2 to 3-: +20%	105	124	179	119	14.280	14.280	14.280	14.281	86,377	340,008	7,603