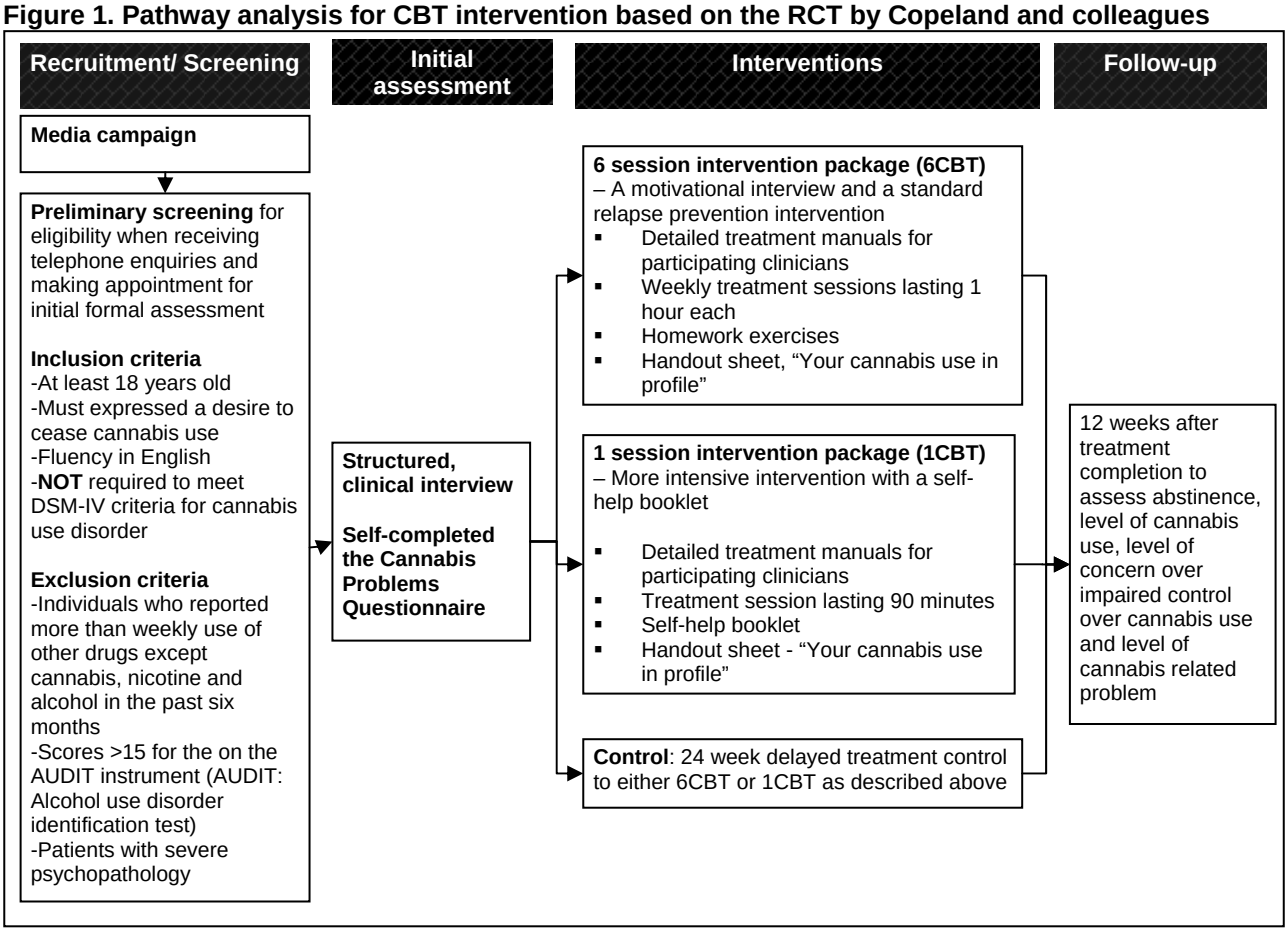
Brief cognitive-behavioural intervention for cannabis use disorders

1. Definition of Intervention

The intervention was based on the RCT conducted by Copeland and colleagues [1]. Following recruitment and assessment for eligibility, participants were allocated into three groups (Figure 1). The intervention being modelled in this evaluation is the intervention package comprising six, weekly 1-hour individual sessions of motivational interview and standard relapse prevention intervention (6CBT).

All treatments were provided by registered clinical psychologists who were familiar with CBT techniques. All psychologists received information from a detailed treatment manual. Participants who received CBT intervention were assisted to develop a set of strategies to manage cannabis withdrawal and to prevent relapse. Homework exercises with accompanying handouts were assigned weekly and were reviewed at the beginning of the next session. Further details on the technical treatment content of the interventions can be obtained elsewhere [1].

Figure 1. Pathway analysis for CBT intervention based on the RCT by Copeland and colleagues



2. Health states/Risk factors affected by the intervention

The intervention aims to improve reduction and remission in cannabis use amongst cannabis users with cannabis use disorders, as defined according to the DSM-IV criteria.

3. Current practice

The incremental cost-effectiveness was calculated by comparing the intervention against 'current practice'. In the reference year of 2003 for this evaluation, there was no systematic delivery of CBT for individuals meeting the criteria for cannabis use disorders. Therefore, the comparator is considered as 'do-nothing', that is, there is no cost or benefit attributed to 'current practice'.

It is noteworthy that in the year 2007, the Commonwealth Department of Health and Ageing established the National Cannabis Prevention and Information Centre (NCPIC) in New South Wales. Many thousands of client booklets and around 100 training workshops on CBT have been delivered from NCPIC [Personal communication with Prof. Jan Copeland]. However, there is currently no published information about whether the delivery of materials and training workshops has led to systematic implementation of the intervention to individuals meeting the criteria.

4. Efficacy/effectiveness of intervention

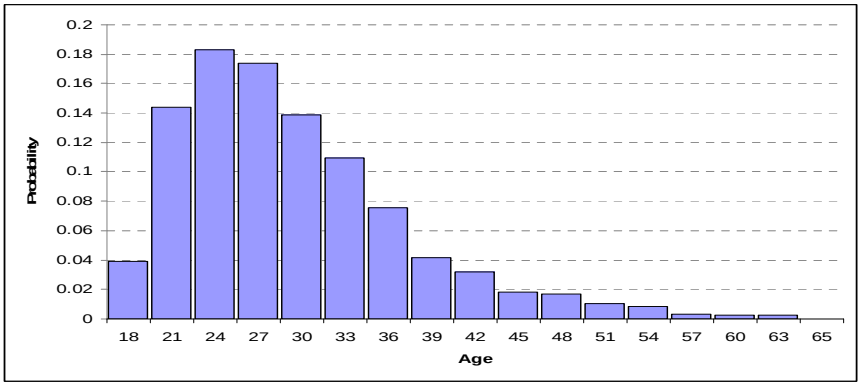
Given the reasoning that 1 session of CBT was too time-limited to be effective [2] and there is no statistical difference between 1CBT and DTC group (p=0.25), this evaluation combined 1CBT with DTC as one control group. Reanalysing using STATA statistical software (version 10.0, StataCorp), the RR of achieving complete abstinence between 6CBT and the control group was found to be 5.16 (95% CI: 1.614; 16.5, p=0.009).

5. Modelling to health outcomes

A 17-state Markov model was constructed in TreeAge Pro [3] with links to Microsoft Excel to simulate the initiation of cannabis use, progression in use, reduction and complete remission by annual cycles. Following 10-year-old Australian children in 2003 for 90 years, the model estimated annual prevalence for cannabis use at different levels of use – non-use, light use, weekly use and daily use. By applying the relative risks according to the extent of cannabis use [4-6], the age-specific prevalence of schizophrenia and HPU, and the incidence of annual RTA and fatality rate were estimated. Most of the epidemiological data for the model were obtained from the Australian Burden of Disease and Injury Study (AusBoD) 2003 [7].

In this evaluation, the model follows the experience of individuals aged between 18 to 64 years, who enter the model as daily cannabis users, until their death or reaching 100 years of age. The age of the daily cannabis users was determined by random selection according to an age probability distribution for daily users (Figure 2). This distribution was constructed based on data from the 2004 National Drug Strategy Household Survey [8]. As observed in the RCT by Copeland and colleagues [11], it was assumed that most daily cannabis users recruited to the intervention have cannabis use disorders.

Figure 2. Age probability distribution for daily cannabis users



The impact of CBT intervention was evaluated by applying a relative risk of 5.16 (95% CI: 1.6; 16.5) to the base-case probability of remission for daily cannabis users. This increased 'risk' in remission was applied for 1 year at the age when they enter the model. The comparator was the scenario under current practice where the relative risk of remission in daily cannabis users was assigned a value of 1. The intervention effect was applied for only 1 year, after which the probability of remission was set to return to that observed in the base case (i.e. RR=1).

The potential health gain was calculated using Disability Adjusted Life-Years (DALYs). The DALY is a composite population health measure that sums the years of life lost due to premature mortality (YLL) and the equivalent 'healthy' years lost due to disability (YLD) [7]. The DALY was selected as the common metric to evaluate health gains in the ACE-Prevention project.

Each Markov state in the model was assigned a disability weight (DW) that estimates the level of disability associated with the specified 'health' characteristics of that Markov state. The YLD was calculated in this model by accruing, cycle by cycle, the disability whenever the simulated individuals 'spent time' in a particular Markov state. The DW used in this model were based on the Dutch weighting system [9]. Where co-morbidities were present in a health state (e.g. health states with schizophrenia and HPU), a validated multiplicative method was used to adjust the DWs [10]. A list of the DWs used can be found in Appendix A. The model also tracked the YLD associated with incidence of non-fatal RTAs. Given that the level of disability of injury resulting from a RTA varies considerably, this evaluation did not estimate the YLDs by applying an average DW value as described above. Instead, age-specific 'incident YLD' due to RTA derived from the AusBoD study was applied to each incident RTA case.

The YLL component of a DALY was calculated in the model by assessing the number of death in each cycle and using the following formula:

$$\text{YLL} = \frac{1 - e^{-D*L}}{D}$$

where D is the annual discount rate (3%) and L is the health-adjusted life expectancy in the Australian population of 2003 at the age of death

Although the RCT found that 6CBT group had a more significant reduction in daily dose of cannabis consumed than the control group, this change did not correspond to a change in the Markov state in the current model i.e. individuals still remained as daily users despite using cannabis at a lesser daily dose. While this reduction may be important clinically in terms of the well-being for individual cannabis users, the corresponding reduction in health risks associated with this level of reduction is currently unknown. Therefore, this evaluation did not account for this observed effect.

6. Costs of interventions and offsets

Pathway analysis was conducted based on Figure 1 to identify the resource use associated with the intervention. All costs to the government and individuals seeking treatment were accounted for. These included: (I) the cost of recruitment and preliminary screening for participants; (II) the cost of private psychological services; (III) the cost of CBT manuals for psychologists; (IV) the patient travel cost to attend the treatment session; (V) the cost of booklets and handouts; and (VI) patient time cost to complete the homework exercises and attending the treatment sessions.

The health sector cost-offsets were estimated from the AIHW's DCIS study [11] as per the economic protocol. In addition, the cost-offsets were also calculated with or without the inclusion of the estimated cost for cannabis and heroin consumption that would have incurred to individual users if the intervention was not implemented. The consumption cost was estimated from reported prices by the Australian Crime Commission [12].

7. Key assumptions

Some of the key assumptions of the current analysis include:

(I) Individuals who achieved continuous abstinence following the intervention are able to maintained abstinence for 1 year even though the median follow-up period in the trial was 237 days (range: 102-553 days).

(II) No benefit was accounted for individuals who remain as daily users despite achieved reduction in daily cannabis consumption. This is because the corresponding reduction in health risks associated with this level of reduction is currently unknown.

(III) Psychologists are able to appropriately deliver the intervention according to the treatment manuals provided without receiving further training. This is because CBT technique is one of the core skills learnt during professional training of a clinical psychologist.

8. Uncertainty analysis

Ninety-five percent uncertainty intervals were determined by Monte Carlo simulation with 3000 iterations. Table 1 shows the distributions of uncertainty around input parameters. Based on the result of the uncertainty analysis, an 'acceptability curve' was plotted to evaluate the intervention's probability of being cost-effective against different willingness-to-pay thresholds.

Table 1. Distributions of uncertainty around input parameters

Parameter	Distribution	Median (Uncertainty Range)	Sources
% Dependent cannabis users aged 18 – 64 years in the general population	Normal	0.022, s.e =0.002	Swift and colleagues [13]
N^{o} Paid advertisements in local newspaper	Triangular*	16 (8,24)	Estimated
% Respond to recruitment campaign	Uniform[§]	0.036 (0.036, 0.18)	Calculated based on estimated total daily cannabis users in NSW
% Eligible persons following preliminary screening	Triangular	0.474 ± 0.2	Trial based point estimate [1]
% Attended first appointment	Triangular	0.467± 0.2	Trial based point estimate [1]
% Eligible for the intervention	Triangular	0.962 ± 0.2	Trial based point estimate [1]
N^{o} CBT session attended patient for 6CBT arm	Discreet	0 session: 9.0% 1 session: 7.6% 2 sessions: 9.0% 3 sessions: 7.7% 4 sessions: 7.7% 5 sessions: 9.0% 6 sessions: 50%	Copeland and colleagues [1]
Paid advertisement rate	Triangular	$1250 ± 20%	Estimated based on total budget for advertisement in the trial
Receptionists salary	Triangular	$34,971 ± 20%	[Ref] Estimated
Treatment manuals	Triangular	$50 ($40, $60)	Estimated
Cost of Initial psychological assessment (hour)	Triangular	$63.05 ± 20%	[14] and Protocol
Cost of psychological service - 60 minute session	Triangular	$90.10 ± 20%	[14] and Protocol

*In a triangular distribution, the greatest probability of being chosen is the value representing the top of the triangle (i.e. the most likely value), while the probability of other values being chosen tapers off towards the extremes of the base of the triangle between the minimum and maximum values; [§]Uniform distribution is used equal probability between two values

9. Results

Based on the estimated recruitment rates, it is anticipated that about 1,970 cannabis users who used cannabis daily will access the CBT service through private psychologists in one year. When compared against a 'do nothing' alternative, the intervention averted 71 DALYs at a total costs of $1.04 million (Table 6). The median health sector cost offsets (CO1) was found to be $0.43M. This estimate increases substantially when consumption costs (CO2) were incorporated ($8.00M).

Despite having a low impact in terms of the number of DALY averted, the intervention is found to be cost-effective because of its relatively low costs. The incremental cost-effectiveness ratio

(ICER) was found to be $15,400. When CO1 was incorporated, the ICER reduced to $8,800 per DALY averted. The intervention is a dominant intervention to a 'do nothing' alternative when CO2 was incorporated.

Table 2 Cost-effectiveness results for the Gatehouse intervention in Australia

	Median	95% uncertainty range
Number of participants recruited	1,970	670; 4,260
Total DALY averted	**71**	**4; 194**
Total Intervention cost	**$1.04M**	**$0.3M; $2.63M**
Total cost-offsets (without consumption cost) (CO1*)	$0.43M	$0.09M; $1.51M
Total cost-offsets (with consumption cost) (CO2§)	$8.00M	$2.82M; $18.2M
Cost/DALY averted (no CO)	**$15,400**	**$3,300; $63,700**
Cost/DALY averted (with CO1)	$8,800	Dominant; $45,916
Cost/DALY averted (with CO2)	Dominant	Dominant

*CO1 includes medical cost estimates for cases of schizophrenia, road traffic accident and heroin and poly-drug use;
§CO2 includes CO1 and consumption costs of cannabis and heroin

The result of uncertainty analysis is illustrated in Figure 3. The probability of being cost-effective was determined by assessing the uncertainty estimates against various "willingness-to-pay" thresholds (Figure 4). When assessed against a threshold of $50,000 per DALY averted, approximately 94% of the estimates fall below the threshold. When CO1 and CO2 were incorporated, about 96% and 98% falls below the $50,000 per DALY averted threshold.

Figure 3. Cost-effectiveness of uncertainty analysis

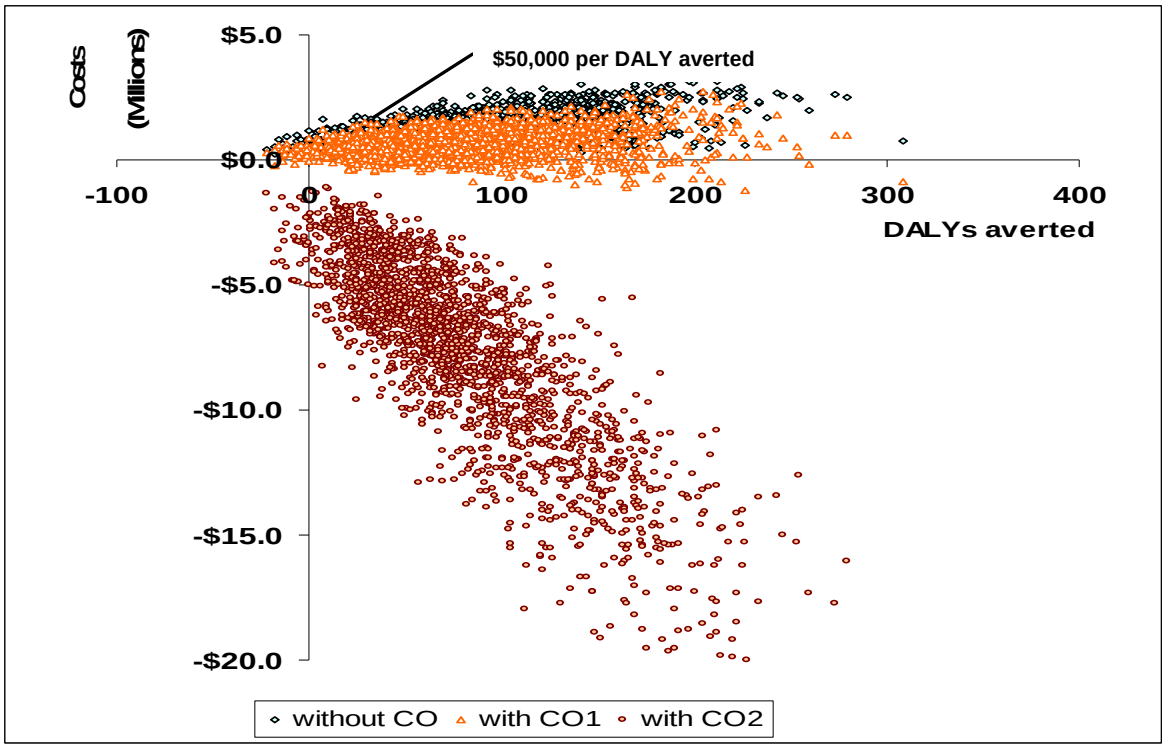
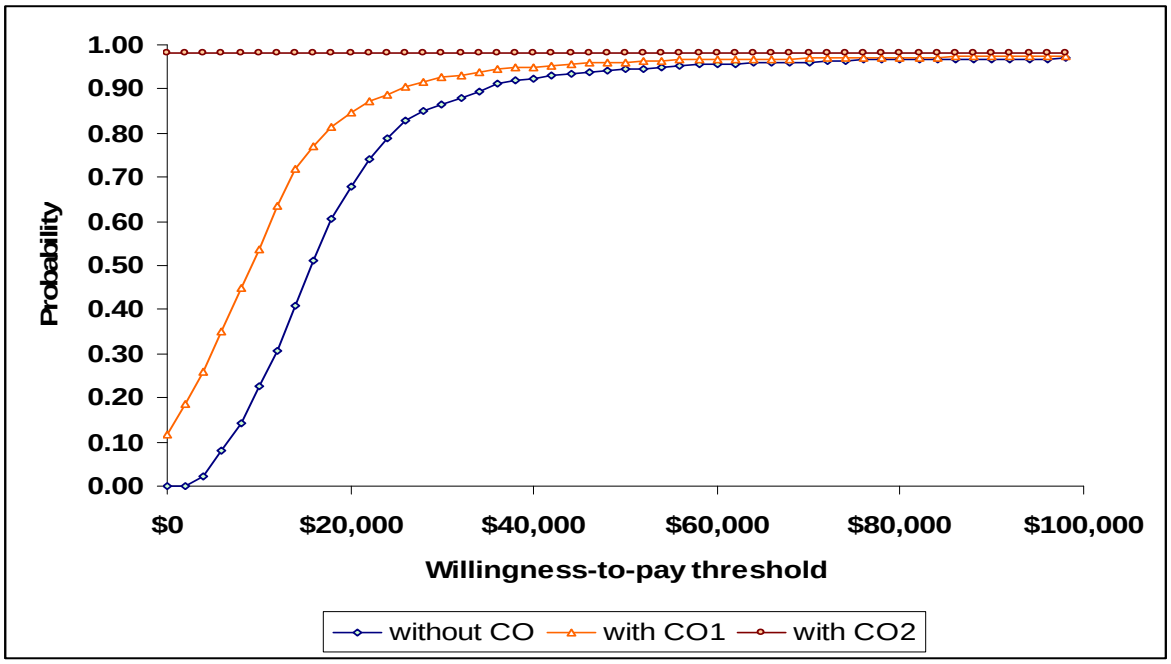


Figure 4. Acceptability curve for CBT intervention



10. Discussion

This evaluation found that providing 6 sessions of CBT by psychologists to recruited individuals with cannabis use disorders offers, at a population level, a small benefit in terms of DALYs averted. Nevertheless, at relatively low costs, the intervention was found to be cost-effective with more than 94% of the uncertainty estimates falling below a $50,000 per DALY averted willingness-to-pay threshold.

One reason for the relatively low impact of this intervention is because of the small estimated number of participants recruited. In this evaluation, the number of participants was estimated using the same recruitment rates as those observed in the trial i.e. recruiting via paid advertisements and self-referral. Using the same recruitment rates in this evaluation is reasonable because these rates take into account the effectiveness of the recruitment method, as well as individuals' motivational factors when self-referring and attending the treatment service. Given the low budget for advertisements ($2,500) in the trial, it may be speculated that increasing the expenditure in advertising may increase the awareness of treatment availability, and subsequently improves the overall impacts of this intervention. However, a low participation rate may still remain due to the lack of motivation in eligible individuals in seeking treatment.

It is important to note that the recruited trial participants were a group of severely dependent cannabis users for whom a brief CBT treatment is not usually considered as appropriate [1]. It is therefore probable that alternative treatment targets of a younger and less dependent group of cannabis users may offer higher impact from a population perspective.

A limitation of this evaluation is the lack of consideration for those who remain as daily users despite using cannabis at lesser daily dose. Analysis in the original trial indicated a statistically significant effect in daily cannabis consumption and a lower likelihood of self-reported cannabis-related problems in those who received the 6CBT intervention [1]. The evaluation excluded this consideration because it is not known how this reduction may impact on the overall 'disability' of individuals. Indeed, although the trial observed that the intervention group had a significant reduction in scores using the *Severity of Dependence Scale*, the mean score at follow-up for all groups remained above the threshold for dependence [1]. Nevertheless, it is important to recognise that any reduction in use may be an important benefit to *individual users* from both health and economic perspectives.

Another important issue for consideration when implementing this intervention is related to service delivery. It has been noted in the field of alcohol and tobacco secondary prevention that the use of brief interventions has "largely failed" (p. 11) despite a substantial body of research evidence demonstrating their efficacy [15]. Roche and Freeman argued in this article that the key influencing factors hindering the success of brief interventions were the unwillingness of professionals in up-taking the intervention and the ineffectiveness of service delivery model through general practice [15]. Although the CBT intervention in this evaluation involves psychologists rather than the highly demanded medical service through general practice, ensuring the availability and effective access to treatment service to all clients remains pertinent for the realisation of effectiveness and cost-effectiveness.

In summary, offering effective treatments for individuals with cannabis use disorders is an important policy option. Although the findings indicate that 6 sessions of CBT intervention has a low level of population impact in terms of DALYs averted, this economic evaluation provides evidence for its cost-effectiveness. Benefits to individuals such as reduction in daily cannabis consumption should be considered by clinicians on an individual basis. The CBT intervention may have a greater impact at the population level if effectiveness can be demonstrated amongst younger and less dependent individuals with cannabis use disorders.

11. References

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12. Appendices

Appendix A – Disability weights for health-states in the cannabis model

Cannabis use level	Non-users				Light users				Weekly users				Daily users				
Comorbidity / Age	Nil^	SZP*	HPU§	SZP + HPU	nil	SZP	HPU	SZP + HPU	nil	SZP	SZP + HPU	SZP + HPU	nil	SZP	HPU	SZP + HPU	Dead
10	0.025	0.423	0.263	0.597	0.025	0.448	0.288	0.597	0.045	0.459	0.303	0.605	0.045	0.459	0.303	0.605	1.000
15	0.032	0.420	0.261	0.600	0.032	0.452	0.293	0.600	0.057	0.466	0.312	0.610	0.057	0.466	0.312	0.610	1.000
20	0.040	0.416	0.259	0.603	0.040	0.456	0.299	0.603	0.065	0.471	0.318	0.614	0.065	0.471	0.318	0.614	1.000
25	0.049	0.413	0.257	0.607	0.049	0.461	0.306	0.607	0.068	0.473	0.320	0.615	0.068	0.473	0.320	0.615	1.000
30	0.053	0.411	0.256	0.609	0.053	0.464	0.309	0.609	0.073	0.475	0.323	0.617	0.073	0.475	0.323	0.617	1.000
35	0.057	0.409	0.255	0.610	0.057	0.466	0.312	0.610	0.070	0.473	0.321	0.615	0.070	0.473	0.321	0.615	1.000
40	0.061	0.407	0.254	0.612	0.061	0.468	0.314	0.612	0.073	0.475	0.323	0.617	0.073	0.475	0.323	0.617	1.000
45	0.074	0.402	0.250	0.617	0.074	0.476	0.324	0.617	0.082	0.480	0.330	0.621	0.082	0.480	0.330	0.621	1.000
50	0.083	0.398	0.248	0.621	0.083	0.481	0.331	0.621	0.091	0.486	0.337	0.624	0.091	0.486	0.337	0.624	1.000
55	0.098	0.391	0.243	0.627	0.098	0.489	0.342	0.627	0.098	0.489	0.342	0.627	0.098	0.489	0.342	0.627	1.000
60	0.117	0.383	0.238	0.635	0.117	0.500	0.356	0.635	0.117	0.500	0.356	0.635	0.117	0.500	0.356	0.635	1.000
65	0.143	0.372	0.231	0.646	0.143	0.515	0.374	0.646	0.143	0.515	0.374	0.646	0.143	0.515	0.374	0.646	1.000
70	0.178	0.356	0.222	0.660	0.178	0.535	0.400	0.660	0.178	0.535	0.400	0.660	0.178	0.535	0.400	0.660	1.000
75	0.231	0.334	0.208	0.682	0.231	0.564	0.438	0.682	0.231	0.564	0.438	0.682	0.231	0.564	0.438	0.682	1.000
80	0.285	0.310	0.193	0.704	0.285	0.595	0.478	0.704	0.285	0.595	0.478	0.704	0.285	0.595	0.478	0.704	1.000
85	0.349	0.282	0.176	0.731	0.349	0.632	0.525	0.731	0.349	0.632	0.525	0.731	0.349	0.632	0.525	0.731	1.000
90	0.393	0.264	0.164	0.749	0.393	0.656	0.557	0.749	0.393	0.656	0.557	0.749	0.393	0.656	0.557	0.749	1.000
95	0.415	0.254	0.158	0.758	0.415	0.669	0.573	0.758	0.415	0.669	0.573	0.758	0.415	0.669	0.573	0.758	1.000
100	0.409	0.257	0.160	0.756	0.409	0.665	0.568	0.756	0.409	0.665	0.568	0.756	0.409	0.665	0.568	0.756	1.000

^ Background disability; *SZP: Schizophrenia; §HPU: Heroin and poly-drug use

Appendix B – Cost-offset estimate (in AUD 2003) for health-states in the cannabis model

Cannabis use level	Non-users				Light users				Weekly users				Daily users			
Comorbidity / Age	Nil	SZP*	HPU§	SZP + HPU	nil	SZP	HPU	SZP + HPU	nil	SZP	SZP + HPU	SZP + HPU	nil	SZP	HPU	SZP + HPU
10	-	17,917	1,172	19,089	37	17,954	1,209	19,126	1,467	19,384	2,639	20,556	5,135	23,052	6,307	24,224
15	-	22,647	2,352	24,999	37	22,683	2,389	25,035	1,467	24,114	3,819	26,466	5,135	27,782	7,487	30,134
20	-	22,647	20,547	43,194	37	22,683	20,584	43,230	1,467	24,114	22,014	44,661	5,135	27,782	25,682	48,329
25	-	14,276	19,660	33,936	37	14,313	19,696	33,972	1,467	15,743	21,127	35,403	5,135	19,411	24,795	39,071
30	-	14,276	21,176	35,452	37	14,313	21,213	35,489	1,467	15,743	22,643	36,919	5,135	19,411	26,311	40,587
35	-	9,928	20,804	30,731	37	9,964	20,840	30,768	1,467	11,395	22,271	32,198	5,135	15,063	25,939	35,866
40	-	9,928	14,384	24,311	37	9,964	14,420	24,348	1,467	11,395	15,851	25,778	5,135	15,063	19,519	29,446
45	-	7,944	13,936	21,880	37	7,980	13,973	21,917	1,467	9,411	15,404	23,347	5,135	13,079	19,071	27,015
50	-	7,944	13,936	21,880	37	7,980	13,973	21,917	1,467	9,411	15,404	23,347	5,135	13,079	19,071	27,015
55	-	6,409	13,807	20,216	37	6,446	13,843	20,253	1,467	7,876	15,274	21,683	5,135	11,544	18,942	25,351
60	-	6,409	13,807	20,216	37	6,446	13,843	20,253	1,467	7,876	15,274	21,683	5,135	11,544	18,942	25,351
65	-	10,124	13,765	23,889	37	10,160	13,802	23,926	1,467	11,591	15,233	25,356	5,135	15,259	18,900	29,024
70	-	10,124	13,765	23,889	37	10,160	13,802	23,926	1,467	11,591	15,233	25,356	5,135	15,259	18,900	29,024
75	-	12,008	14,376	26,385	37	12,045	14,413	26,421	1,467	13,476	15,843	27,852	5,135	17,143	19,511	31,520
80	-	12,008	14,376	26,385	37	12,045	14,413	26,421	1,467	13,476	15,843	27,852	5,135	17,143	19,511	31,520
85	-	19,956	15,209	35,165	37	19,992	15,246	35,201	1,467	21,423	16,676	36,632	5,135	25,091	20,344	40,300
90	-	19,956	15,209	35,165	37	19,992	15,246	35,201	1,467	21,423	16,676	36,632	5,135	25,091	20,344	40,300
95	-	19,956	15,209	35,165	37	19,992	15,246	35,201	1,467	21,423	16,676	36,632	5,135	25,091	20,344	40,300
100	-	19,956	15,209	35,165	37	19,992	15,246	35,201	1,467	21,423	16,676	36,632	5,135	25,091	20,344	40,300

*SZP: Schizophrenia; §HPU: Heroin and poly-drug use

Appendix C – Second stage filter criteria – (DRAFT ONLY)

Cost per DALY averted	Strength of evidence	Equity	Acceptability	Feasibility	Sustainability	Relevance to indigenous population	'Other effects' (not captured in modelling)
No cost offsets: $15,400 **+ cost offsets CO1*:** $8,800 **+ cost offsets CO2§:** Dominant	"Limited evidence of effectiveness" – The effect is unlikely to be due to chance but the effectiveness was estimated from only one good quality level II study. However, there were several studies with similar but different treatment modalities that have demonstrated the efficacy [2, 16].	Potential to increase inequities if access to intervention is limited by the availability of psychologists in regional and rural areas	Consistent with the national drug strategy – Acceptable to the Government. CBT is a commonly used psychological intervention – Acceptable to the users	Availability of psychologists in regional and rural areas may be a potential issue	Likely to be sustainable once established and implemented	Relevance – high rate of cannabis use in indigenous population. **However**, there is lower availability of services in regional and rural areas	**Positive:** Reduction in cannabis consumption in those who those who remains as daily users May potentially benefit social outcomes such as employment and crime **Negative:**
Decision point: Cost-effective	Appropriate evaluation alongside program implementation	May be an issue if access to the intervention is not evenly distributed	Not likely to be an issue	Workforce may be an issue	Sustainable if implemented	May be an issues in reaching intervention targets in indigenous population	Potentially having positive benefits at individual and social level

Policy Considerations: The implementation of a CBT intervention based on the model proposed by Copeland and colleagues is very likely to be cost-effective even though the overall impact of the intervention is low from a population perspective. However, the effectiveness was estimated from only one good quality level II study. The availability of psychological service in regional and rural area may be an issue in term of feasibility and equity. The intervention may not reach intervention targets in indigenous population.

*CO1 includes medical estimates for cases of schizophrenia, road traffic accident and heroin and poly-drug use;
§CO2 includes CO1 and consumption costs of cannabis and heroin