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Measuring the Loss of Consumer Choice in Mandatory Health Programs Using Discrete Choice Experiments

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Key words: Mandatory Programs, Economic Evaluation, Public Opinion, Consumer Choice

Abstract

Economic evaluation of mandatory health programs generally do not consider the utility impact of a loss of consumer choice upon implementation, despite evidence suggesting that consumers do value having the ability to choose. The primary aim of this study was to explore whether the utility impact of a loss of consumer choice from implementing mandatory health programs can be measured using discrete choice experiments (DCEs). Three case studies were used to test the methodology: fortification of bread-making flour with folate, mandatory influenza vaccination of children, and the banning of trans-fats. Attributes and levels were developed from a review of the literature. An orthogonal, fractional factorial design was used to select the profiles presented to respondents to allow estimation of main effects. Overall each DCE consisted of 64 profiles which were allocated to 4 versions of 16 profiles. Each choice task compared two profiles, one being voluntary and the other being mandatory, plus a "no policy" option, thus each respondent was presented with 8 choice tasks. For each choice task respondents were asked which health policy they most preferred and least preferred. Data was analysed using a mixed logit model with correlated coefficients (200 Halton draws). The compensating variation required for introducing a program on a mandatory basis (versus achieving the same health impacts with a voluntary program) that holds utility constant was estimated. Responses were provided by 535 participants (a response rate of 83%). For the influenza vaccination and folate fortification programs, the results suggested that some level of compensation may be required for introducing the program on a mandatory basis. Introducing a mandatory influenza vaccination program required the highest compensation ($113, 95%CI: -$61, $286) compared to folate fortification ($18, 95%CI: -$4, $40). No compensation was required for introducing the trans-fats program ($0, 95%CI: -A$6 to A$6). In addition to the type of MHP, the compensation required was also found to be dependent on a number of other factors. In

particular, the study found an association between the compensation required and stronger libertarian preferences. We conclude that DCEs can be used to measure the utility impact of a loss of consumer choice. Excluding the utility impact of a loss of consumer choice from an economic evaluation taking a societal perspective may result in a sub-optimal, or incorrect, funding decision.

Key Points for Decision Makers

- Mandatory health programs may result in a decrease in an individual's utility as they restrict personal choice and deny consumers the ability to readily substitute particular goods or services.

- There is not a single common value for the loss of consumer choice from a mandatory health program.

- Excluding the utility impact of a loss of consumer choice from an economic evaluation taking a societal perspective may result in a sub-optimal, or incorrect, funding decision.

Introduction

As health costs rise due to population ageing and the availability of more effective but costly technologies[1, 2], Governments are likely to increase their focus on preventative public health programs to contain the rising health costs. Preventative public health programs can be introduced on either a voluntary or mandatory basis (or are by their individual nature, likely to be one or the other). Voluntary programs give consumers the choice whether to adhere to a program while mandatory health programs (MHP) impose penalties for non-adherence to consumers or industry. There are often significant savings from implementing MHPs in terms of enforcement and promotion costs, and they are often the most effective method of ensuring population compliance[3].

Recently the Australian Government commissioned several economic evaluations of MHPs to ascertain whether they result in a net gain to society[4-6]. Several economic evaluations of MHPs have also been published in the literature[7].

Conventional economic evaluation of health programs assumes that the objective of health policy is to maximise the aggregate health of the population. However, a health-maximising approach is only one of many plausible approaches to public policy decision making. In addition to health outcomes, such as the potential health benefits (e.g. improved health and compliance) and increased risk of harm (e.g. adverse events), it is recommended that equity and respect for autonomy should also play a role in deliberations [8, 9].

Another approach to public policy decision making is Libertarianism, which emphasises natural rights. In particular, Locke identified two natural rights – the right to life and to the right to possessions – where, as long as individuals do not violate other people's rights, they ought to be free to do as they like[10, 11]. Thus, within Libertarianism, a health-maximising approach is not an appropriate method for determining social decision-making[12].

While some members of society may subscribe universally to either the health-maximising approach or the Libertarian approach, it is also likely there is an intermediate group who care about both the magnitude and distribution of health outcomes, and also care about how those outcomes are achieved. When taking a utilitarian approach, this is referred to as 'process utility' and has been explored in various contexts in the health economics literature[13]. In particular, with regards to personal choice, Sen argues that it is possible to attach importance (and thus value) to having opportunities that are not taken up[14].

Regardless of whether the MHP enforces or bans consumption of a good, MHPs may result in a decrease in an individual's utility as they restrict personal choice and deny consumers the ability to readily substitute particular goods or services. Conversely, some individuals may value the restriction of choice as a way of assisting self-control[15]. For example, smokers may value banning smoking in public places as it encourages them to quit smoking, or people may value banning trans-fats to assist in lowering cholesterol levels. This suggests that the utility of loss of choice may vary depending on the context.

In practice decision makers may consider both the impact of the MHP on both the consequences and consumer choice. However a recent systematic review concluded that the loss of consumer choice has largely been ignored in published economic evaluations of MHPs[7]. The methods employed to measure the utility impact of a loss of consumer choice included estimating; the cost of compliance, lost productivity, price elasticities (e.g. the equivalent price change associated with the increased or decreased consumption), and contingent valuation (also known as willingness-to-pay (WTP)) studies. However significant limitations were identified with the various methods and only contingent valuation studies have the ability to capture the impact on process utility in addition to the health and cost impacts. However it is difficult to separate the utility impact of a loss of consumer choice

from the other aspects of the MHP that an individual values (e.g. health outcomes and adverse events) when using this methodology.

Discrete choice experiments (DCEs) provide an alternative methodology to estimate the utility impact of a loss in consumer choice due to MHPs. DCEs are based on Lancaster's economic theory of value where individuals derive utility from the underlying attributes of a good, and preferences (and thus utility) across goods are revealed through their consumption choices[16]. DCEs involve respondents choosing their preferred alternative from a series of hypothetical choice tasks, where each alternative is described by a bundle of attributes and each attribute is described by levels which differ across choice tasks[17].

The strength of the DCE approach is that choosing between bundles of goods is an easily comprehended task for respondents and there is evidence that it is both consistent with welfare theory[18-22] and consistent with that observed in practice[23]. DCEs also enable the measurement of the marginal willingness to pay for a change in an attribute by including cost as one of the attributes. Thus DCEs are capable of directly measuring the Hicksian compensating variation (CV): the amount of money required for introducing a program on a mandatory basis (versus achieving the same health impacts with a voluntary program) that holds utility constant. This avoids the risk of double-counting the impact of the MHP on health and adverse events which have been considered explicitly in the economic evaluation, which is a key issue with contingent valuation studies. Furthermore the estimated CV can be directly incorporated into an economic evaluation as an additional cost in the numerator.

The primary aim of this study was to explore whether the utility impact of a loss of consumer choice from implementing mandatory health programs can be measured using DCEs. The secondary aims included what is the magnitude and what are the drivers of the utility impact of a loss of consumer choice due to MHPs, particularly with regards to attitudes to liberty.

Three case studies were conducted to test the methodology: fortification of bread-making flour with folate, mandatory influenza vaccination of children, and banning trans-fats.

1 Methods

1.1 Choice of Case Studies

Overall it was hypothesised that the utility impact of a loss of consumer choice is dependent on the level of libertarianism and strength of opposition to programs being implemented on a mandatory basis, the proportion of people who voluntarily consume the good without government intervention, and how strongly people care about deviations away from their voluntary level of consumption. Possible drivers of the latter include individuals directly benefiting from or being negatively affected by the MHP, altruism towards others in the community, and the effort required to comply with the MHP.

Respondents faced one of three case studies which were chosen to explore different characteristics of MHPs and maximise the range of estimated values for the loss of consumer choice. Folate fortification was chosen because: the benefits are high in terms of neural tube defects (NTDs) avoided, albeit to a very small group of individuals[4]; voluntary consumption of folate is low[24][1]; it involves trade-offs between altruism towards children (the key beneficiaries) versus the elderly (who risk neurological problems due to vitamin B12 masking [25]); and a low level of effort is required to comply with the MHP. In contrast, mandatory influenza vaccination was chosen because: the key health benefit may be considered less severe than NTDs, albeit affecting a greater proportion of people; there exists positive externalities through reduced absenteeism due to caring for children[26] and indirect protection to the rest of the community[27]; some effort is required by parents to comply with the MHP; and a subset of parents are highly resistant to vaccination for a variety of

[1] In Australia 11% of women aged 18-49 consumed folate supplements in 2001.

reasons[28]. Finally banning trans-fats in foods was chosen because it bans rather than enforces consumption, people may welcome the restriction in choice as it may aid self-control, and consumption of trans-fats may be seen as a lifestyle choice and there is a high level of direct individual benefit and a low level of altruism towards others.

1.2 Development of attributes and levels

The introductory vignettes, attributes and levels for each profile were developed from a review of the literature, while a previous DCE informed the wording of each attribute[29]. The attributes were selected by the authors and included whether the program was voluntary or mandatory (the focus of the study), the key health outcomes and adverse events that may be experienced by the respondent or by others (the latter was included to capture altruism), and cost (required to measure the CV).

At least one level of each attribute was based on the expected impact of the MHP, with the alternative levels based on multiples of the expected level (see Tables 5-7 for details). The impact of folate fortification on NTD incidence was based on modelling commissioned by Food Standards Australia and New Zealand[4]. The number of people who develop neurological problems due to vitamin B12 deficiency masking was based on modelling in the United States[30, 31]. The efficacy of influenza vaccination was based on a published systematic review[32] and the risk of side effects was based on advice from the Australian Technical Advisory Group on Immunisation[33]. The impact of influenza vaccination on incidence in the wider population was based on modelling in the United Kingdom[34] and applied to Australian influenza incidence rates[35], assuming an equivalent impact on deaths. The efficacy of banning trans-fats was based on a systematic review[36] and Australian data on the incidence of deaths from heart disease[37].

The cost attribute levels were based on the only published contingent valuation studies regarding MHPs that were identified by a published systematic review[7]. Dixon (1999) was the only study that considered compensation of those against the implementation of the program and found a mean WTP by those in favour of water fluoridation of GBP£12.63, a mean WTP to avoid for those against fluoridation of GBP£29.38, and a mean willingness-to-accept compensation for those against fluoridation of GBP£76.00[38]. In comparison, Dixon (2003) found a mean WTP for folate fortification of GBP£22.80[39]. Consequently the cost attribute levels for folate fortification ranged from paying A$60 to being compensated A$120. Due to a lack of information suggesting otherwise, a similar range was used for trans-fats. The cost attribute levels for influenza vaccination were broader (from paying A$400 to being compensated A$800) as it was hypothesized that people would care more strongly about compulsory vaccination and thus more compensation would be required to induce people to choose the MHP.

See Tables 5-7 for the final vignettes, list of attributes and levels.

1.3 Experimental design and questionnaire development

The full factorials of the three experiments yield 256, 8192, and 256 possible profiles for the folate fortification, influenza vaccination, and banning trans-fats DCEs, respectively. A subset of 32 profiles for each MHP was selected using an orthogonal, fractional factorial design[40]. Each profile contained all attributes. After applying two shift generators designed to allow estimation of main effects[41], each DCE consisted of 64 profiles which were allocated to 4 versions of 16 profiles such that all attribute levels appeared with equal frequency in each version. Recruits were sequentially assigned to each version depending on which had the fewest completions.

Each choice task compared two profiles, one being voluntary and the other being mandatory, plus a "no policy" option, thus each respondent was presented with 8 choice tasks. Whether the mandatory or voluntary option was on the left hand side was randomised, while the no policy option was always located on the right. For each choice task respondents were asked which health policy they most preferred and least preferred, thus six observations for each choice task were collected[2].

1.4 Demographic and respondent attribute questions

Respondents' demographics were collected to check whether they are similar to the general population and therefore whether the results are generalisable.

Respondents' libertarianism was also elicited by asking whether they agreed with the following statement (measured using a 5-point Likert scale) (henceforth referred to as the MHP question):

> *In general, Governments should implement mandatory health policies if they maximise the health of the population, regardless of impacts on freedom of choice.*

It was hypothesised that people who disagreed or strongly disagreed would value the loss of consumer choice more highly.

1.5 Recruitment and data collection

Overall 207, 205, and 230 participants were recruited into the case studies for folate fortification, influenza vaccination, and banning trans-fats, respectively. Respondents were recruited using an online panel provided by PureProfile PLC (Sydney, Australia). The sample

[2] Is mandatory preferred to voluntary? Is voluntary preferred to mandatory? Is mandatory preferred to no policy? Is no policy preferred to mandatory? Is voluntary preferred to no policy? Is no policy preferred to mandatory?

sizes were not powered to detect a certain level of utility impact as the study was exploratory as to whether DCEs are a feasible approach and the expected magnitude was unknown.

1.6 Data analysis

It was assumed that each respondent's utility function can be described using a random utility model (RUM)[42], where U_{ij} represents individual i's utility from consuming health program j which is composed of a systematic component (consisting of an individual's inherent characteristics Z_i and the attributes of the health program X_{ij}, including whether the program is voluntary or mandatory) and a random utility component ε_{ij}, where β and γ are vectors of coefficients:

$$U_{ij} = \beta X_{ij} + \gamma Z_i + \varepsilon_{ij}. \qquad \textit{Equation 1}$$

Consequently the probability of preferring a voluntary (program 1) versus mandatory (program 2) or no program (program 0) is due to both a systemic component and some random component:

$$\pi_{i1} = \Pr(U_{i1} > U_{ij}) \forall\ j \neq 1, \qquad \textit{Equation 2}$$

where π_{i1} represents the probability of individual i preferring health program 1. Assuming RUM holds and the error term is unbounded, it follows that everybody has a non-zero probability of preferring either a mandatory program or a voluntary one, even if this probability is miniscule for people with strong preferences (i.e. no lexicographic preferences).

Despite what they would prefer, we know that, by definition, everyone will ultimately experience no program, a voluntary program or a mandatory program. Consequently a state of the world approach to estimating the CV is required. The CV is estimated by holding the systematic component of utility V_j constant given a change in characteristic (X_1) and cost (P) of program j[21]

$$\Delta V_j = \Delta X_{1j}\beta_1 + \Delta P_j \beta_P = 0 \quad . \qquad \textit{Equation 3}$$

Thus rearranging Equation 3 gives

$$CV = \Delta \mathrm{P_j} = -\Delta X_{1j} \frac{\beta_1}{\beta_P} \quad . \qquad \textit{Equation 4}$$

As X_1 is a dummy variable for the program being introduced on a mandatory basis, the CV is simply equal to the negative of the marginal willingness to pay (MWTP)

$$CV^M = -\frac{\beta_1}{\beta_P} \quad . \qquad \textit{Equation 5}$$

Consequently CV^M represents the utility impact of a loss of consumer choice. This is a special case, due to the participants having no ability to choose an alternative program. All else being equal, CV^M was hypothesised to be positive (i.e. compensation is required for introducing the program on a mandatory basis).

Data was analysed in STATA using several models: 1) a conditional logit model[42], which assumes common tastes for the observed attributes and the errors are independent and identically distributed; 2) a mixed (random effects) logit model[43] (200 Halton draws), which allows for taste heterogeneity but assumes that tastes in different attributes are independent; and 3) a mixed logit model with correlated coefficients (200 Halton draws) to allow for correlation in unobserved factors (captured by the error terms) over alternatives. The final models were chosen based on Akaike's information criterion (AIC), as it has been shown that the AIC is more likely to correctly pick models where errors are correlated compared to the Bayesian information criterion (BIC)[44]. In the mixed logit models, cost was assumed to have a lognormal distribution. Consequently the following formula was required to turn the natural logarithm of the cost coefficient β_{cost} into the mean coefficient for cost β_{mean_cost}, where SD_{cost} is the standard deviation surrounding β_{cost}[45]:

$$\beta_{mean\_cost} = -e^{\beta_{cost} + \frac{SD_{cost}^2}{2}} \qquad \textit{Equation 6}$$

Sub-group analysis was conducted by interacting demographic variables with the mandatory implementation attribute. This assumes there is a homogeneous shift in the mean impact of the mandatory implementation attribute but the distribution remains the same. Consequently the interaction terms were not included in the list of variables assumed to be heterogeneous when estimating the mixed logit models.

Using the MHP question can assist in determining whether it is likely that an individual has pure lexicographic preferences (a violation of the underlying random utility model) or whether the value of compensation was not sufficiently large to alter their preferences[46, 47]. Sensitivity analysis of the results was conducted by dropping individuals with potentially lexicographic preferences against MHPs (those who always preferred the voluntary program and disagreed or strongly disagreed to the MHP question). Although it is not certain that these individuals have lexicographic preferences and dropping these individuals effectively implies that their preferences 'do not count' or are 'irrational' and that the impact on their utility is equal to the population mean, which is unlikely given the circumstances.

2 Results

2.1 Demographics

Overall 175 (from 207 people recruited or a 85% response rate), 179 (from 205 people recruited or a 87% response rate), and 181 (from 230 people recruited or a 79% response rate) participants provided a response to at least one choice question regarding folate fortification, influenza vaccination, and banning trans-fats, respectively. Of these participants 158, 158, and 156 completed all choice questions and provided demographic data for folate fortification, influenza vaccination, and banning trans-fats, respectively. The respondent

characteristics are described in Table 1. The sample was largely comparable to the Australian population but was slightly younger and better educated with a lower gross weekly household income (around 19% of the respondents did not complete the question on income).

Insert Table 1 here

2.2 Non-traders

Around 30% of respondents preferred one specific program in all choice tasks (see Table 2). Overall, 9%, 12% and 11% of respondents to the folate fortification, influenza vaccination, and banning trans-fats DCEs always preferred the voluntary program, of which 62%, 67% and 50% disagreed or strongly disagreed to the MHP question. Some of these individuals may have pure lexicographic preferences against MHPs, and this was more likely in the case of influenza vaccination. Conversely a greater proportion of respondents to the banning trans-fats DCE always preferred the mandatory program to the other programs (13% of respondents to the trans-fats DCE compared to 6% and 8% of respondents to the folate fortification and influenza vaccination DCEs, respectively). This suggests that some of these individuals may value the reduction in choice, potentially for self-control reasons.

Insert Table 2 here

2.3 Baseline estimates

The mixed logit model with correlated coefficients (200 Halton draws) had the lowest AIC in all case studies and consequently was used to estimate the attribute coefficients (see Table 3). Respondents were less likely to prefer a program if it was mandatory (not statistically significant for the trans-fats DCE) or involved a higher cost to the respondent, however there was significant preference heterogeneity as indicated by the standard deviations. Respondents of the folate fortification DCE were more likely to prefer a program with a higher number of NTDs avoided and a lower incidence of neurological problems due to B12 deficiency

masking. Respondents of the influenza vaccination DCE were more likely to prefer a program with a lower risk of severe side effects. The other variables were not statistically significant, however again there was significant preference heterogeneity. Respondents of the banning trans-fats DCE were more likely to prefer a program with a higher reduction in the risk of heart disease.

Insert Table 3 here

2.4 Compensating Variation and the Marginal Willingness to Pay

The CV (also equal to MWTP) for implementing the program on a mandatory basis was calculated for each case study (see Table 4). For the influenza vaccination and folate fortification programs the CV was positive indicating that some level of compensation would be required. While the coefficients were statistically significant the CV results were not, largely due to preference heterogeneity with regards to costs. The influenza vaccination program had the highest average CV (A$113 per person, 95%CI: -A$61 to A$286), followed by the folate fortification program (A$18 per person, 95%CI: -A$4 to A$40), while the trans-fats program had the lowest CV (A$0 per person, 95%CI: -A$6 to A$6).

Sub-group analysis found that more libertarian individuals had higher CVs, which were statistically significant for the influenza vaccination program and the trans-fats program. There was also a trend towards a higher CV for individuals who would not individually benefit from a MHP, but none were statistically significant.

Finally, the CV declined when respondents with potentially lexicographic preferences against MHPs were dropped. The influenza vaccination program still had the highest average CV (A$34 per person, 95%CI: -A$19 to A$87), followed by the folate fortification program (A$6 per person, 95%CI: A$15 to A$27), while the trans-fats program had the lowest CV (-A$1 per person, 95%CI: -A$2 to A$1).

Insert Table 4 here

3 Discussion

For the influenza vaccination and folate fortification programs, respondents were less likely to prefer a program if it was introduced on a mandatory than voluntary basis. Consequently some level of compensation may be required for introducing a program in this manner, as indicated by a positive CV. The study also found a higher CV was associated with stronger libertarian preferences. It was hypothesised that how strongly people care about deviations away from their voluntary level of consumption of the good may be determined by the level of individual benefit and the strength of altruism towards others, both of which may be dependent upon who the others are and what they are gaining or losing. For example, evidence suggests that people value gains in health more highly for people with a low quality of life or short life expectancy before treatment, if there is no other treatment available, and if the individual is young[48]. That said, the results were in the opposite direction suggesting that perhaps for these programs the self-control factor played a large role.

The existence of non-traders increased the CV estimates. The response to the MHP question indicates that the lexicographic preferences may be legitimate preferences, and thus it would be inappropriate to drop these respondents from the analysis. In contingent valuation studies these non-traders may act as “protesters” who refuse to provide information regarding their willingness to pay[38, 49], thus resulting in an underestimate. DCEs may minimise this problem if these responders simply ignore the cost variable, thus increasing the uncertainty but not necessarily biasing downwards the results [7].

Another strength of using a DCE compared to contingent valuation is that it can separate the utility impact of a loss of consumer choice from the other aspects of the MHP that an individual values. Thus the CV can be directly incorporated into economic evaluations by

treating it as an additional cost of a mandatory program, while minimising the risk of double-counting. Because the health outcomes and costs of the programs were described as “per year” it was envisioned that the CV is incurred each year.

There were a number of limitations with the approach utilised. In particular, the choice of attributes and levels may have influenced the results. For example, the attributes considered in the DCEs do not necessarily represent all possible attributes of interest, potentially causing omitted variable bias (for example, influenza hospitalisations), and the CV estimates may be driven by the range of levels associated with the cost attribute. There was significant preference heterogeneity, especially with regards to costs, which impacted on the significance of the CV results.

The sample size and number of case studies for each case study limited the analysis of the results. In particular, the sample sizes were not powered to detect a certain level of utility impact. Consequently the lack of statistical significance cannot be interpreted as there is no compensation required. Increasing the sample size for each case study would improve measurement precision, particularly in the sub-group analysis, and enable consideration of interactions in addition to main effects, as there may be some interaction between the loss of consumer choice and the size of the expected health impacts. Further research could also focus on increasing the number of case studies to explore program-specific factors, such as the importance of the type of beneficiaries or the effort required to comply with the MHP.

Overall, the CV estimates should be considered as the initial utility impact due to a loss of consumer choice. While the utility impact may be high initially, over time people may adjust their expectations and consequently the utility impact may also decline over time. More research is needed regarding the length of time people experience a utility impact after the introduction of a MHP.

When comparing different types of MHPs, it is clear that there is a range of average CVs rather than a single common value. Consequently measurement of the utility impact due to reduced consumer choice must be conducted for each MHP being evaluated. Excluding the utility impact from an economic evaluation may result in a sub-optimal, or incorrect, decision about whether the MHP results in a net gain to society. While this paper confirms that DCEs can be used to measure the utility impact of a loss of consumer choice, it does not explore whether incorporating the utility impact into past economic evaluations would result in a different implementation decision.

It is worth noting that whether the loss of consumer choice should be considered depends on the perspective of the economic evaluation. A review of economic evaluation guidelines by similar organisations found that of a total of 26 guidelines reviewed, a societal perspective is preferred when evaluating health programs in six countries and another five[3] countries preferred both a health system and societal perspective[50, 51]. On the other hand, if a public health system perspective is taken then it would not be appropriate to consider loss of consumer choice. This latter perspective is taken by the National Institute of Health and Clinical Excellence (NICE) in England and Wales, justified on the basis of maximising the health of the population subject to a fixed budget[52].

However, for many MHPs, a health system perspective would be too restrictive to capture all benefits and costs. This is most likely if an MHP uses resources outside of that typically provided by a public health system, such as capital required for water fluoridation or enforcement resources. Consequently a health system perspective may lead to inefficient allocation of resources. Furthermore many MHPs are evaluated by non-health Government departments. The involvement of these resources and Government departments suggests that

[3] Note that the latest Pharmaceutical Benefits Advisory Committee guidelines for Australia suggest that PBAC prefers a health system perspective over a societal perspective.

a whole-of-government or a societal perspective would the most appropriate. Guidelines for conducting economic evaluations by non-health Government departments suggest taking a societal perspective[53, 54]. When a societal perspective is appropriate, the loss of consumer choice should be considered in the analysis.

4 Conclusions

DCEs are capable of directly measuring the utility impact of a loss of consumer choice from introducing a MHP, while holding health impacts constant. Measuring the utility impact of a loss of consumer choice in this way avoids the risk of double-counting and can be directly incorporated into economic evaluations. For the influenza vaccination and folate fortification programs the CV was positive indicating that some level of compensation may be required for introducing the program on a mandatory rather than voluntary basis. In addition to the type of MHP, the value of the CV also depended on a number of other factors. In particular, the study found a higher CV was associated with stronger libertarian preferences. Further research into the importance of the loss of consumer choice to the final implementation decision is warranted.

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Table 1: Characteristics of respondents

	Folate	Influenza	Trans-fats	Australia
Male, n (%)	73 (47%)	79 (50%)	70 (45%)	50%
Age, n (%)				
18-21 years	10 (6%)	6 (4%)	8 (5%)	6%
22-29 years	31 (20%)	40 (25%)	30 (19%)	12%
30-39 years	40 (25%)	37 (23%)	37 (24%)	14%
40-49 years	37 (23%)	27 (17%)	31 (20%)	14%
50-59 years	21 (13%)	26 (16%)	28 (18%)	13%
60+ years	19 (12%)	22 (14%)	22 (14%)	19%
Average age (years)	39.9	40.3	41.3	43.4
Education, n (%)				
Did not complete secondary school	24 (15%)	28 (18%)	32 (21%)	31%
Completed secondary school	17 (11%)	27 (17%)	31 (20%)	20%
Trade qualification	40 (25%)	38 (24%)	40 (26%)	26%
Bachelors degree	50 (32%)	37 (23%)	28 (18%)	16%
Postgraduate qualification	27 (17%)	28 (18%)	24 (15%)	6%
Marital Status, n (%)				
Single	46 (29%)	35 (22%)	38 (25%)	19%
Divorced or separated or widowed	19 (12%)	20 (13%)	14 (9%)	15%
Married	92 (59%)	103 (65%)	103 (66%)	66%
Any children 6 months - 16 years in household, n (%)	51 (32%)	60 (38%)	49 (32%)	32%
Average number of children 6 months - 16 years in household (n)	0.53	0.72	0.61	0.59
Employed, n (%)	104 (66%)	106 (67%)	99 (64%)	68%
Average gross weekly household income ($)	1,318	1,307	1,228	1,562
Response to MHP question, strongly disagree or disagree	52 (33%)	52 (33%)	41 (26%)	
Attempting to conceive	11 (7%)			
Total completed survey and provided demographic data	**158**	**158**	**156**	
Total answered at least one choice question	**175**	**179**	**181**	

* Fully vaccinated for vaccines due before 72 months. Sources: [4, 35, 55-59]

Table 2: Trading and non-trading respondents (% of respondents)

	Folate	Influenza	Trans-fats
Always chose voluntary as most preferred program	15 (9%)	22 (12%)	20 (11%)
% MHP question – negative response*#	62%	67%	50%
Always chose mandatory as most preferred program	7 (4%)	9 (5%)	19 (10%)
% MHP question – negative response*#	0%	0%	0%
Always chose no policy as most preferred program	10 (6%)	11 (6%)	4 (2%)
Did not always prefer a particular program	143 (82%)	137 (77%)	138 (76%)

* Percentage that strongly disagreed or disagreed to the statement "Governments should implement mandatory health policies if they maximise the health of the population, regardless of the impact on freedom of choice" # Respondents who did not answer all questions were not asked the MHP question.

Table 3: Attribute coefficients

	Folate		Influenza		Trans fats	
Observations	7856		7876		7904	
Log likelihood	-2138		-1965		-2007	
AIC	4316		4018		4054	
BIC	4456		4325		4194	
Attribute	**Coeff. (t-stat)**	**SD (t-stat)**	**Coeff. (t-stat)**	**SD (t –stat)**	**Coeff. (t-stat)**	**SD (t –stat)**
Treat (mandatory or voluntary versus no program)	0.390 (2.740)	1.583 (8.97)	-0.030 (-0.07)	3.749 (6.79)	-0.652 (-3.60)	2.128 (10.64)
Mandatory program	-0.896 (-5.12)	2.310 (12.14)	-1.362 (-4.41)	3.682 (14.50)	0.018 (0.07)	3.324 (14.10)
NTDs avoided	0.023 (6.06)	0.038 (8.23)				
Incidence of B12 deficiency who develop symptoms	-0.022 (-6.58)	0.036 (10.94)				
Vaccine efficacy			0.402 (0.59)	3.963 (5.68)		
Deaths of children avoided			0.031 (1.60)	0.049 (1.04)		
Deaths of elderly avoided			0.011 (1.84)	0.050 (9.62)		
Probability of mild side effects			0.113 (0.18)	5.968 (10.42)		
Probability of severe side effects			-0.439 (-3.25)	1.431 (11.07)		
Reduced risk of heart disease					2.397 (5.32)	4.196 (7.89)
Number of deaths from heart disease avoided					0.003 (5.79)	0.005 (9.17)
Financial impact on individual (natural logs)	-7.688 (-13.33)	3.061 (8.35)	-8.733 (-15.24)	2.938 (7.08)	-6.035 (-17.57)	2.654 (9.56)

Method: Main effects, mixed logit with correlated coefficients (200 Halton draws).

* Compared to 45 out of every 100 children don't get influenza.

SD = standard deviation.

Table 4: Compensating variation (CV), A$

	Folate	Influenza	Trans fats
CV due to the implantation of the program on a mandatory basis (CV^M), holding health impacts constant	**18 (-4, 40)**	**113 (-61, 286)**	**0 (-6, 6)**
CV due to of the improvement in health attributes as a result of the MHP (CV^A)	-6 (-14, 2)	-61 (-179, 56)	-13 (-23, -2)
Overall CV due to implementing the MHP	12 (-3, 28)	51 (-22, 124)	-13 (-25, -1)
CV due to the implantation of the program on a mandatory basis (CV^M), holding health impacts constant, after dropping respondents with potentially lexicographic preferences against MHPs	6 (-15, 27)	34 (-19, 87)	-1 (-2, 1)
Sub-group analysis: mean difference in CV^M between groups			
Libertarianism			
MHP question**: strongly disagree or disagree versus strongly agree, agree, or neither agree nor disagree	0 (-2, 3)	1925 (1216, 2634)	19 (2, 37)
Individual benefit			
Not pregnant versus pregnant	-5 (-27, 17)		
No children versus children		-2 (-15, 10)	

Method: main effects, mixed logit with correlated coefficients (200 Halton draws).

95% confidence intervals in brackets.

** In general, Governments should implement mandatory health policies if they maximise the health of the population.

6 Supplementary Data

Table 5: Folate fortification

Every year over 100 babies in Australia are born with neural tube defects such as anencephaly, encephalocele and spina bifida. The majority of babies born with anencephaly die within a few days of birth. Encephalocele and spina bifida reduce life expectancy and can cause a range of disabilities, such as difficulties walking or paralysis, incontinence, and learning difficulties. Neural tube defects also cause miscarriages and some pregnancies may be terminated.

If you and your partner are trying to conceive, increased intake of folic acid by women prior to conception and for the first few weeks of pregnancy can reduce the risk of neural tube defects by 72%[60]. However, not all women take supplements due to awareness, affordability, choice or unplanned pregnancies.

The total number of babies being born with neural tube defects can be reduced by adding folic acid to flour for bread making (known as folate fortification)[4]. The number of miscarriages and terminations would also fall. However there is a concern that folate fortification may mask vitamin B12 deficiency in the elderly, which can lead to some people losing some sensation in the arms and legs. Many doctors feel that this is avoidable through awareness and tests[25].

The taste and appearance of food will not change as a result of fortification.

The cost of folate fortification will increase the cost of bread, however the Government may subsidise fortified bread to encourage consumption.

Attributes	**Levels**
The new folate fortification policy will be	Mandatory: all bread will contain folic acid which will be declared on the food label Voluntary: some bread will contain folic acid which will be declared on the food label
The number of babies born with neural tube defects per year will	No impact compared to current situation Fall by 12 people Fall by 24 people* Fall by 48 people
The number of people with B12 deficiency and who develop symptoms per year will	No impact compared to current situation Increase by 15 people Increase by 30 people* Increase by 60 people
The impact of the policy on your expenditure on bread per year will be	$60 more $30 more $15 more No impact $15 less $30 less $60 less $120 less

* Expected impact of MHP [4, 31]

Table 6: Influenza vaccination

Influenza (commonly known as the flu) is an infectious disease with symptoms such as fever, cough, headache, muscle aches, fatigue, sore throat, and a stuffy or runny nose, and it is often confused with other viruses, such as the common cold. However people can become severely ill with the flu, particularly the elderly and people with high risk medical conditions[35]. On average there are around 3,000 hospitalisations and 50 flu-related deaths per year. Most hospitalisations occur in children aged 0-4 years while most deaths occur in adults aged 60 years and over [35].

If you have children, vaccinating them against the flu will reduce their risk of becoming ill, thus reducing their risk of hospitalisation and death. It will also reduce the risk of the flu to adults, the elderly, and in other children who are unable to be vaccinated. Working parents will also need to take less time off from work to care for children[27].

The vaccine is not always 100% effective against the flu, however if children get influenza, it will usually be a milder case than if they were not vaccinated.

Common mild side effects include: swelling, redness and pain at the injection site. Fever, drowsiness and general muscle ache occur less frequently.

Severe side effects such as allergic reactions and Guillain-Barré syndrome are rare. Children allergic to eggs should not be given the vaccine[33].

Currently only children with underlying medical conditions, such as severe asthma, are recommended to receive flu vaccination[33]. The new voluntary policy will recommend flu vaccination for all healthy children aged 6 months to 16 years and will be listed on the National Immunisation Schedule. If the policy is mandatory proof of vaccination will be required for enrolment at school (excluding those allergic to eggs). Annual vaccination is required to provide continuing protection.

The Government will subsidise the cost of vaccination, however the government will also save some money through reduced heath care costs. The total impact on the Government will be passed on to tax payers through the tax system.

Attributes	Levels
The new policy on flu vaccination will be	Voluntary: flu vaccination is recommended for all children Mandatory: flu vaccination is recommended for all children and proof of vaccination will be required for enrolment at school
The vaccine will guarantee that	45 out of every 100 children don't get the flu 54 out of every 100 children don't get the flu 65 out of every 100 children don't get the flu * 78 out of every 100 children don't get the flu
The new vaccination policy will mean that of children aged 0 to 5 years	No impact compared to current situation 2 will not die from flu per year* 4 will not die from flu per year 8 will not die from flu per year
The new vaccination policy will mean that of adults aged over 60 years	No impact compared to current situation 10 will not die from flu per year 20 will not die from flu per year 40 will not die from flu per year*
The vaccine causes mild side effects for	1 out of every 20 children 1 out of every 10 children* 1 out of every 5 children 1 out of every 2.5 children
The vaccine causes severe side effects for	1 out of every 1,000,000 children* 1 out of every 100,000 children
The amount of tax paid per year by you will be	$400 more $200 more $100 more No impact $100 less $200 less $400 less $800 less

* Expected impact of MHP [32-35]

Table 7: Banning trans-fats

Introduction

Trans fatty acids (also known as trans-fats) are formed when liquid vegetable oils are partially hydrogenated or 'hardened' for use as spreads such as margarine, cooking fats for deep-frying and shortening for baking. Trans-fats are also found naturally in meat and milk.

Trans-fats behave similarly to saturated fats and cause similar health issues. Both trans-fats and saturated fats increase the level of bad cholesterol, but trans-fats also decrease the level of good cholesterol. Overall, consuming too much trans-fats can increase the chance of heart disease.

On average Australians consume relatively low amounts of trans fatty acids compared with people in other countries and average consumption is lower than the World Health Organization's (WHO) recommendations. However around 7% of people, including children, consume more trans-fats than the recommended rate. Foods high in trans fat include: pastries, sausages, luncheon meats and creamy pasta dishes[61].

Currently the amount of total fat and the amount of saturated fat must be declared on all food labels, not the amount of trans-fats. If a ban of trans-fats was voluntary manufacturers would need to change their labelling to include the amount of trans-fats. On the other hand, if a mandatory ban of trans-fats was implemented, manufacturers would need to change their ingredients to trans-fats alternatives.

Banning trans-fats will result in manufacturers changing the type of fats used in their products and will result in higher prices for some foods, however the Government may subsidise manufacturers to help cover costs and encourage consumption of foods low in trans-fats.

Attributes	**Levels**
New policy on trans-fats will be	Voluntary: some foods will contain high levels of trans-fats but it must be declared on the food label Mandatory: foods high in trans-fats are banned
If you currently eat foods high in trans-fats your chance of developing heart disease will	No change Fall by 10% Fall by 20%* Fall by 40%
The number of people who die from heart disease per year will	No impact compared to current situation Decrease by 100 people Decrease by 200 people Decrease by 400 people*
Your food expenditure (groceries and take away foods) per year will be	$120 more $60 more $30 more $15 more No impact $15 less $30 less $60 less

* Expected impact of MHP [36, 37]