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1. INTRODUCTION

Although road traffic injuries are a major global public health problem, these continue to receive inadequate attention. Alcohol influences both risk and consequence of road traffic injury, but the scale of the problem is not well understood in many countries. Rapidly increasing motorization and a significant rise in alcohol consumption in Vietnam have placed road traffic injury among the leading causes of death. A reported 34 percent to 60 percent of all vehicular crashes in Vietnam were associated with alcohol.

Considerable research has been conducted into understanding the effectiveness of interventions to reduce drunk driving in developed countries. In Vietnam, however, policymakers need information on the effectiveness of interventions in drunk driving---i.e., an assessment of both costs and consequences---but are faced with very limited data on the local situation. As an aid to priority setting, a study that examines the effectiveness using the cost-effectiveness analysis is urgently required.

This study, thus, focuses on the main research question: What are the cost-effective interventions to reduce incidences of drunk driving in Vietnam? There are two objectives:

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1. To select drunk driving interventions from the comprehensive review of literature and opinions of experts (Technical Advisory Panel or TAP);

2. To estimate the cost effectiveness of such interventions by using the Assessing Cost Effectiveness (ACE)   drunk driving model and relying on the opinion of experts.

2. LITERATURE REVIEW

2.1 The Burden of Drunk Driving

Recent analyses show that the decline in drunk driving has either plateaued or begun rising in several high-income countries (WHO 2004; Bingham et al. 2007; Sweedler et al. 2004; Stewart 2000). In most high-income countries, about 20 percent of fatalities have blood alcohol concentration (BAC) that exceed the legal limit (World Health Organization [WHO] 2004). In developing countries, where there are a high proportion of motorcycles among the registered motor vehicles (Hung *et al*. 2006; Zhang et al. 2004; Passmore et al. 2010; Davis et al. 2003) and a prevalence of drinking outside of the home (Euromonitor International 2009; WHO 2004; Rehm et al. 2009; Odero et al. 1997), alcohol-related traffic injuries could be comparatively higher. It was estimated that between 33 percent and 69 percent of fatalities in low- and middle-income countries had consumed alcohol before their accidents (Odero et al. 1997).

Most available data are from developed countries, where cars dominate their roads, while little is known about the magnitude of the drinking-and-driving problem in developing countries. The absence of scientifically designed surveillance systems on drinking and driving in many developing countries has probably underestimated the scope of the problem. Furthermore, the lack of research investment hinders the understanding of issues related to drinking and driving.

The traffic injury pattern has changed dramatically with road traffic crashes now a leading cause of death and morbidity in Vietnam (Le et al. 2003). During the two decades

of strong economic development, the country also saw a significant rise in alcohol consumption as well as a change in drinking patterns as both consumers' disposable incomes and living standards increase. Many can now afford to socialize with friends and talk business over drinks. Alcoholic drinks at a bar or restaurant have become increasingly popular among the young consumers as part of a desired "Western" social life.

Alcohol consumption in Vietnam has in fact increased 152 percent by 2008---from 1,001 million liters (12.4 liters per capita) in 2003 to 1,525 million liters (17.7 liters per capita) in 2008. Over the five-year period 2003-2008, the total value of alcohol sales rose from US$1.6 billion to US$3.1 billion (Euromonitor International 2009). As the Vietnamese economy continues to progress over the next few years---leading to higher disposable incomes as well as modern lifestyles---consumption of alcohol is projected to continue growing as well.

Whilst data on drinking and driving are very limited in Vietnam, those that are available indicate a significant problem. The National Forensic Medicine Institute found that from 2001 to 2003, 34 percent out of a sample of 500 fatal crashes were associated with a BAC in excess of national limits (Viện Pháp Y Trung 2003). An analysis of the BAC levels of patients with traffic injuries in two hospitals in Hanoi showed that 56.4 percent of samples were positive of alcohol. The proportion of BAC samples that were over the limit of 0.08g/100ml and 0.05g/100ml were 29.4 percent and 33.4 percent, respectively (Nguyen Thuong 2009). Another study on male accident victims in a hospital in Central Vietnam (Tam et al. 2008) indicated that 60 percent of those admitted in its Emergency Department due to traffic injuries had a BAC level beyond the legal limit of 0.08g/100ml. The study also showed that most of the respondents over-estimated the number of drinks they could consume and tolerate in one hour in order to drive safely and legally. Most even never planned to avoid driving after drinking alcohol.

2.2 Effectiveness of Interventions To Reduce Drunk Driving

In many economically developed countries over the past few decades, the improved laws, enhanced enforcement, and higher public awareness campaigns by concerned citizens have led to a dramatic decline in drinking and driving (Sweedler et al. 2004).

BAC law: Establishing a legal limit in BAC and even lowering it is effective in reducing drunk driving casualties [Tam et al. 2008]. In a recent review, Fell et al. (2006) summarize the evidence regarding the effectiveness of reducing the illegal BAC limit to 0.05g/100ml. According to their review, lowering the BAC limit from 0.10g/100ml to 0.08g/100ml effectively brought about a 5 percent to 16 percent reductions in alcohol-related crashes, fatalities, or injuries. The authors further argue that lowering the BAC limit from 0.08g/100ml to 0.05g/100ml would make sense as laboratory studies indicate that impairment in critical driving functions begins at low BACs and that most subjects are significantly impaired at 0.05g/100ml. In Australia, for example, by lowering the legal BAC from 0.08g/100ml to 0.05g/100ml, authorities succeeded to reduce the number of crashes between 1975 and 1986 (Homel 1994).

Raising the legal drinking age: The most effective means of enforcement are those directed on sellers, who have a vested interest in retaining the right to sell alcohol. Minimum legal drinking age (MLDA) laws specify an age below which the purchase or public consumption of alcoholic beverages is illegal. Locations with such laws experienced a reduction in drunk driving casualties and other alcohol-related harms. For example, the MLDA in the United States, which was studied by Voas et al. (2006) based on data on drivers younger than age 21 years and involved in accidents from 1982 to 1997, proved to be effective in reducing the proportion of fatal crashes involving drunk drivers. A more recent review (Shults et al. 2001) of studies in the United States, Canada, and Australia shows that amendments in the MLDA result in changes of roughly 10 percent to 16 percent in alcohol-related crash outcomes for the targeted age groups, decreasing when the MLDA is raised and increasing when it is lowered. These effects were consistent in follow-up tests ranging from seven to 108 months.

Mass media campaigns against drunk driving: Alcohol consumption has been a part of human culture and social customs in many communities since the beginning of recorded history. Thus, the laws on drinking and driving are expected to be enforced because of their power on public behavior.

Creating a social norm or normative belief for control of drinking and driving is essential. Studies in developed countries have shown that at a general level, communities

tend to hold negative views regarding drunk driving and consider it a serious social problem (Homel et al. 1998; Loxley et al. 1990). It has been recommended that public policy interventions designed to deter or prevent drunk driving depend, in part, on modifying beliefs in the risks, social acceptability and immorality of driving under the influence of alcohol (Greenberg et al. 2004). Research findings indicate that public awareness of and tolerance for the problem of drinking and driving have changed dramatically (Deshapriya and Iwase 1998).

Random breath testing (RBT): Intensive random breath testing---whereby police enforcers randomly stop drivers to check the concentration of alcohol in their blood---and sobriety checkpoints---where all vehicles are stopped and drivers suspected of drunk driving are breath tested---are found to reduce alcohol-related injuries and fatalities (Fell and Voas 2006). A review done by Peek-Asa (1999) on 14 separate studies shows that random screening appeared to be widely effective in both US and Australian populations. The variation in the drop in alcohol-related fatalities is wide, ranging from 8 percent to 71 percent (Peek-Asa 1999). Also, a recent meta-analysis on 40 studies worldwide (Erke et al. 2009) indicates that alcohol-related crashes are reduced by 17 percent at a minimum because of the sobriety checkpoints, while crashes without alcohol involvement are reduced by about 10 percent to 15 percent.

Taxation: Drinkers respond to changes in the price of alcohol as they do to changes in the price of other consumer products. When other factors such as income and the price of other goods are held constant, a rise in alcohol prices leads to less alcohol consumption and less alcohol-related harm (and vice versa) in both high- and low-income countries (Anderson et al. 2009). Demand for alcohol is fairly inelastic to price. That is, an increase in price results in a drop in consumption that is smaller than the price hike. Thus, increasing alcohol taxes not only reduces alcohol consumption and related harm but also increases government revenues, given that alcohol taxes are generally well below their maximum revenue-generating potential while their revenue collection is usually well below the social costs of alcohol.

Cases from developed countries prove that drunk driving legislations and law enforcement are the main countermeasures to reduce drunk driving and alcohol-related

traffic crashes. On the other hand, in many low- and middle-income countries, the existing legislation is met with a "sleeping level" of implementation (Davis et al. 2003). The enforcement is often weak, not visible, not uniformly implemented; imposes low penalties; and is muddled with political inadequacies and economic barriers. The lack of technology, dedicated teams, and information systems compounds the problem further.

In Vietnam, drunk driving has been prohibited since 2001 but enforcement is often constrained by lack of both police personnel and of a capacity to detect drivers' intoxication (WHO 2009; Anh 2007).

The new road traffic legislation that took effect on 1 July 2009 reduced the legally acceptable level of blood- and breath-alcohol content so as to be in line with the international best practice. For motorcyclists, the BAC of 0.08g/100ml blood was reduced to 0.05g/100ml blood or 0.25mg/1L of expired air. For car drivers, the legal BAC was reduced to zero (National Assembly of the Socialist Republic of Vietnam 2008). Also, the Health Insurance Law in Vietnam requires all road traffic-injured hospital patients to be investigated for violation of road safety laws. This technically includes testing for alcohol. However, this is rarely implemented and routinely monitored (WHO 2009; Anh 2007).

The Vietnamese government recently made some positive reforms, especially in restricting alcohol consumption in public places. However, there remain gaps in the current regulations on alcohol. That is, there are no laws yet banning alcohol brands as sponsors of sports and youth events, and the BAC for car drivers differs from that for motorcycle drivers (i.e., the BAC limit for car driver is zero tolerance while that for motorbike drivers is 0.05g/100ml).

Also, laws on advertising and RBT are not fully enforced. Finally, Vietnam does not yet have a minimum drinking age nor restricts who can sell or distribute alcoholic drinks.

As part of its commitment when it joined the World Trade Organization (WTO), the Vietnamese government made several changes to its tax rates in favor of imported brands. The tax levied on imported beer was reduced to 65 percent and will further decrease to 35 percent in the next five years. For wine and spirits, the tax rate will go down from 65 percent to 45 percent to 50 percent in the next five to six years. Such will make alcohol

more affordable. Ergo, given that there is also a rising number of consumers within the legal drinking age (which accounts for more than 65 percent of the total population in 2008), the tax reform will all the more boost the total alcohol consumption growth (Euromonitor International 2009). Thus, there is a strong call for a more strategic and comprehensive approach to the alcohol policy in general, and drunk driving in particular.

3. METHODOLOGY

3.1   Selecting Interventions To Evaluate

3.1.1   Listing Interventions in Vietnam and Other Countries

A comprehensive review of the literature was undertaken to assist the selection of interventions. This paper identified several quality reviews done by reputable sources, including the World Health Organization (WHO). From these reviews, the following broad categories of interventions for drinking and driving were identified:

- Policy, legislative and enforcement interventions to control the problem of drinking and driving.

    - Taxation: general or specific---e.g., beverage/alcohol content;

    - Licensing controls: hours, outlet type/density, drinking age, public monopoly, community control, server training;

    - Advertising controls: level/content, voluntary versus legislative, local promotions, warning labels;

- Drunk driving legislation: age specific, blood alcohol concentration level, automatic suspension, ignition locks, RBT;

- Education, communication, training and public awareness interventions:

    - School based: facts based/social skills, interactivity, parent/community involvement;

    - Mass media: social marketing and health promotion message in various forms/intensity/focus;

- Screening and brief interventions.

3.1.2 Seeking Opinions of Experts (Technical Advisory Panel)

A technical advisory panel composed of experts helped identify the interventions modeled in the study. The Technical Advisory Panel (TAP) members further prioritized the list of interventions according to their efficacy and feasibility of adoption from a policy viewpoint. Due to time constraints, discussions were limited to high-priority interventions. The results acknowledged the following as the high-priority variables: taxation, RBT, primary-care brief interventions, and mass media campaigns. Furthermore, after a review of the literature and an assessment of available information required to model each intervention, the list per category now includes:

- **Taxation**: Excise tax increase (25% and 50%) from the base year level. Scope of intervention includes initial investments in passing legislations, media advocacy, ongoing management and monitoring activities.
- **Random breath testing**: Most vehicles in Vietnam (95%) are motorcycles. Random breath testing has not been implemented widely in Vietnam due to lack of resources; e.g., police, breathalysers. Thus, this intervention was defined to implement RBT in all provinces in Vietnam. The intervention was analyzed based on two scenarios: with and without booze bus. The scope of intervention includes initial investments in equipment, salary, media advocacy, ongoing management, and law-enforcement activities.
- **Mass media campaigns on the dangers of drinking and driving**: This intervention is defined as the implementation of a series of mass media campaigns through television, radio, newspapers, journals, internet, and electronic billboards. There are two programs: One targeting the whole population and another that specifically pertains to drunk driving. The scope of the intervention includes development of educational messages for different media, overall management, and operational activities.

- **Brief intervention by primary care practitioner**: Brief intervention is not included in the current health care practice. As its name implies, these are brief interventions provided by physicians at commune health centers under two scenarios: the first being government funded; and the other, being non-governmental organization (NGOs) funded. The scope of intervention includes initial investment in training, salary/allowance, mass media advocacy, and ongoing management.

3.2   Estimating Cost-Effectiveness of Interventions

Study perspective: In estimating both costs and benefits, this study adopted the public health sector's perspective. Thus, its analysis gathered expenditures on diagnosis, treatment, emergency from health service providers or health insurance companies; and expenditures from patients and their family. Costs of interventions were estimated over a 10-year full implementation, but taxation was assumed to be over a lifetime. Time horizon for the analysis was longer (That is, the population aged 18 and over in base year of 2006 were followed up until their death).

Target population: The target population was selected based on the intervention that will be applied.

3.3   Modeling Approach

The ACE-drunk driving model, which estimates cost and cost effectiveness of interventions, was adapted after the technique created by Professor Jan Barendregt (University of Queensland) and Professor Chris Doran (University of New South Wales). Input parameters were adjusted to Vietnam's case.

3.3.1   Key Input Parameters of the Model

Injury models

- All mortality and disability rates were derived from the country's health information profile (Vietnam-Western Pacific Region Health Databank, 2005 version).

- Data on the prevalence of alcohol dependence were from the results of an epidemiology survey on Alcohol Use and Alcohol Consumption-Related Problems in Rural Vietnam by Giang et al. (2008). Meanwhile, the level of alcohol consumption was based on the Health Strategy and Policy Institute's (HSPI) survey on alcohol consumption in Vietnam (2008).

- Relative risks of mortality or disability from alcohol-related traffic accidents were assumed to be similar to those found in the study of Tam et al. (2008) and the figures after an intervention were assumed to be similar to the trends in the Australian model[2].

Cost of interventions

- CostIt (developed by WHO) provided the analytical framework for estimating costs. The bottom-up "ingredient approach" was used predominantly in the measurement phase while the top-down approach was used in generating estimates of unit prices from the budget and other government reports/documents.

- Costs of health care services cover treatment, care, diagnosis, emergency care, follow-up consultations, and rehabilitation. Non-health care costs such as travel cost, accommodation cost, and indirect costs such as the cost of workday losses were considered.

- Estimates on the cost of interventions assume that the interventions were implemented at their full potential; that trained personnel were available to deliver the intervention; and that the necessary infrastructure was available. Costs were collected from different secondary sources.

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[2] As mentioned in an earlier section of this paper, the Australian model showed that by lowering the legal BAC from 0.08g/100ml to 0.05g/100ml, authorities succeeded to reduce the number of crashes between 1975 and 1986 (Homel 1994).

- Costs were measured by multiplying the quantity of the resource unit by its relevant price at the time of data collection. Prices were adjusted using a deflator.

- For those resource costs with no available data for Vietnam, the estimated costs from other countries were used and adjusted to the Vietnamese context. Estimation methods included:

  o Method 1: Unit cost of other countries was converted to international dollars.

  o Method 2: A conversion factor was calculated based on the percentage of the gross domestic product (GDP) dedicated to the resource (f) of the country

$$\text{Unit cost of other country x} \quad \frac{f\,(\text{Vietnam})}{f\,(\text{the country})}$$

- Cost was expressed in Vietnam dong and US dollars.

Effects of interventions

- Effects of each intervention were largely based on existing literature. Health gains arising from the interventions were expressed as Disability-Adjusted Life Years (DALY) averted.

Cost-effectiveness ratios

- In the cost-effectiveness analysis of each intervention, the ratio was expressed as cost per DALY averted.

- An incremental cost-effectiveness ratio (ICER) was used to compare two alternative interventions. This was done by dividing the different total net costs and the different DALY averted between the two alternative interventions.

- A discount rate of 3 percent was applied to all costs and effects.

- In the guidelines proposed by the WHO Commission on Macroeconomics and Health, a cost-effectiveness ratio that is less than the per-capita GDP is described as

"very cost-effective", while one that is less than three times the per-capita GDP is described as "cost-effective" (WHO 2001). These standards are used by this paper in evaluating the interventions in Vietnam.

3.3.2 Modeling

- A multi-state and multiple cohort life table approach was adopted to evaluate outcomes over the lifetime. The model simulates the impact of interventions on a population's health. A reduction in alcohol consumption due to the intervention affects the incidence, prevalence, and mortality of alcohol-related injuries, which in turn, influence the overall mortality and disability rates of the population. The model was built in Excel and used the Ersatz software for the uncertainty analysis.

3.3.3 Data Sources

- Population: Census 1999, Population Change Survey 2006

- Alcohol prevalence: HSPI Survey 2009

- Intervention costs: State Budget Regulations, Government Expenditures, NGO rates, existing literature on the subject

- Cost-offsets: Hospital data based on guidelines of the Ministry of Health on diagnosis and treatment

- Disease parameters: Burden of Disease study 2008 (Nhung et al. 2014)

3.3.4 Uncertainty Analysis

The uncertainty analysis was carried out with epidemiological parameters and intervention cost and effect estimates.

3.4   Second-Stage Criteria

While the ACE-Drunk driving method focuses on cost-effectiveness, there are other criteria that can influence the priority ranking of the selected interventions. These additional criteria can function as a second filter by which each of the interventions are judged upon before recommending the allocation of more or less resources. The criteria considered in ACE-Drunk driving include:

- Strength of evidence;

- Capacity of the intervention to reduce inequity;

- Acceptability to stakeholders;

- Feasibility;

- Sustainability; and

- Potential for other consequences.

In this study, TAP assisted in judging each of the interventions using the additional criteria as a second filter. Using the costing information and results of the cost-effectiveness analysis, the TAP members prioritized the interventions based on their efficacy and feasibility of adoption from a policy viewpoint.

4. RESULTS

Target groups and effects of each intervention are summarized in Table 1. There is a wide variance in the intervention costs. These range from only US$14.9 million (95% uncertainty interval [UI]: US$12.6 million – US$17.2 million) for taxation increases to US$495 million (95% UI: US$416 million – US$571 million) for RBT with Booze Bus (Table 2).

Table 1. Target Groups of Intervention and Effects of Intervention

Intervention	Target Group	Mean Effect In

		Target Group
Taxation - Increased by 25% - Increased by 50%	100% population aged 18+ years	- 0.99% g/day consumption - 1.7% g/day consumption
Brief intervention	57% risky drinkers aged 18-79 years old	- 6.3 g/day consumption
Random Breath Testing (RBT)	100% drivers aged 18+ years	- 16% road traffic accidents
Mass media - for whole population - for drunk driving	100% population aged 18+ years 100% drivers aged 18+ years	- 2% g/day consumption - 11% road traffic accidents

Table 2. Intervention Costs (VND Billion)

Intervention	Cost Offset	Intervention Cost	Net Cost
Tax increase of 25%	59 (-82 to -40)	14.9 (12.6-17.2)	-45 (-68 to -25)
Tax increase of 50%	-100 (-140 to -68)	14.9 (12.5-17.2)	-85 (-120 to -53)
Brief intervention (Government fund)	-6 (-9.2 to -3.7)	55.2 (46.8 - 64)	49.1 (40.3 - 58.3)
Brief intervention (NGO fund)	-6 (-8.8 to -3.7)	97.6 (83 - 113)	91.5 (76.8 - 107)
RBT (with bus)	-2.1 (-5.7 to -0.5)	495 (416 - 572)	494 (413- 569)
RBT (without bus)	-2.4 (-5.6 to -4.7)	288 (243 - 333)	285 (240 - 331)
Mass media campaign directed at whole population	-0.76 (-0.96 to -0.57)	129 (109 - 149)	129 (109 - 148)
Mass media for drunk driving campaign	-1.6 (-3.5 to -0.5)	35 (29.7 - 40.4)	33.5 (27.8 - 39)

Results suggest that the health gains that can be achieved, measured by DALYs, range from 129.5 (95% UI: 43.8 - 286.4) for the mass media campaign on drunk driving, to 26,336.3 (95% UI: 20,296.7 - 33,539.7) for a tax hike of 50 percent (Table 3).

Table 3. Health Gains and Incremental Cost-Effectiveness Ratio (ICER, VND per DALY)

Intervention	DALYs Averted	Median ICER (VND/DALY)	ICER (US$/DALY)
Tax increase of 25%	15,688 (12,047-19,5,00)	-2.8 million VND (-3.8 mil. to -1.8 mil.)	-177.37 (-244.7 to -113.3)
Tax increase of 50%	26,336.3 (20,296.7 – 33,539.7)	-3.2 million VND (-4.2 mil. to -2.3 mil.)	-204.4 (-267.8 to -144.5)
Brief intervention (Government fund)	2,691.4 (1,584-4,002)	19.2 million VND (11.2 mil. to -32.7 mil.)	1,204.5 (704-2,057.7)
Brief intervention (NGO fund)	2,659.2 (1,612.8-3,958)	35.7 million VND (21.7 mil. to 59.7 mil)	2,244 (1,367-3,753.8)
RBT (with Bus)	172 (37.8-464)	2.86 billion VND (1.04 bil. – 1.31 bil.)	179,903.3 (65,207-821,987)
RBT (without Bus)	185 (37.8-455)	1.54 billion VND (0.6 bil. - 7.63 bil.)	96,721.4 (38,202-479,383)
Mass media campaign directed at whole population	176.5 (147.7-208.5)	0.73 billion VND (0.57 bil. -0.91 bil.)	45,682 (35,814-57,294)
Mass media for drunk driving campaign	129.5 (43.8-286.4)	0.26 billion VND (0.11 bil. - 0.78 bil.)	19,254 (6,597-49,119)

4.1 Increased Taxation

Excise taxation is a dominant strategy. The intervention is estimated to cost 14.9 billion VND (discounted to 2006 figures), but the potential cost offset arising from a change in drinking and driving behavior is estimated at 59 billion VND (for tax increase of 25%) and 100 billion VND (for tax increase of 50%), leading to a net cost savings of 45 billion VND (95% UI: -68 billion VND to -25 billion VND) for the tax increase of 25 percent, and of 85 billion VND (95% UI: -120 billion VND to -53 billion VND) for the tax increase of 50 percent. The health gain achieved from excise taxation is estimated at an additional 15,688 DALYs averted (95% UI: 12,047 – 19,500).

Figure 1 and Figure 2 provide the cost-effectiveness chart for volumetric taxation and demonstrate that all results fall in the south-east quadrant, indicating dominance.
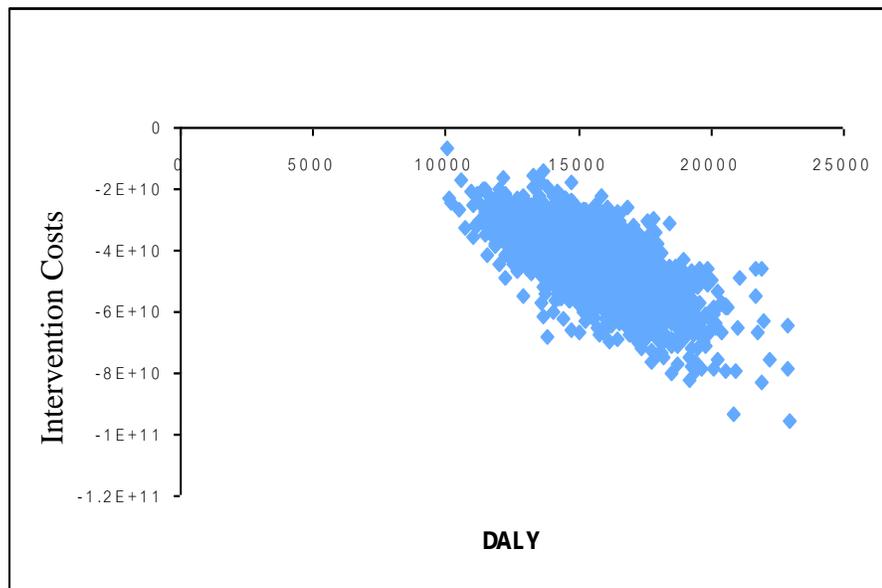
Figure 1. Cost-Effectiveness Chart of Excise Tax Increase By 25 Percent
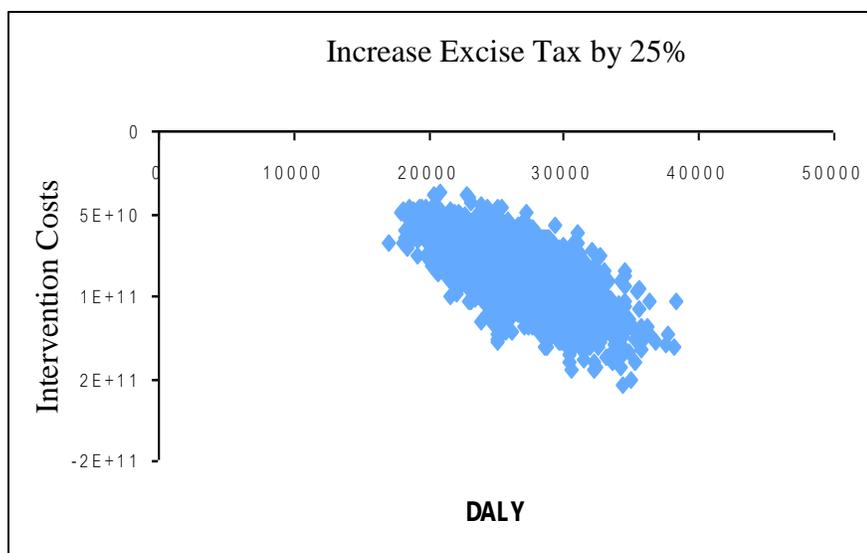
Figure 2. Cost-Effectiveness Chart of Excise Tax Increase By 50 Percent

The increased taxation type of intervention has been modeled as a low-cost, relatively easy-to-implement strategy that will generate significant savings to the health care system. As planned, this was further discussed among stakeholders and experts, including representatives from the Ministry of Industry and Trade, Ministry of Health, National Assembly, and journalists during the second stage of the review. Results and potential impacts on the health care system and population's health are likely to be acceptable to key stakeholders. While there were concerns on the feasibility and sustainability of this intervention---especially with regard the possible increase in homemade alcohol---such feasibility is really dependent on the government's dedication and commitment. It is important to note that there are already existing systems in place that, if tapped properly, can implement and monitor the interventions. Once the interventions are implemented, they would need minimal resources to ensure their sustainability.

4.2 Brief Interventions

A brief intervention by a general practitioner is cost-effective, according to results of this study. It has an incremental cost-effectiveness (or ICER, in US$/DALY) of US$1,204.5 (95% UI: US$704 - US$2,057.7) if government funded and of US$2,224 (95%

UI: US$1,367 - US$3,753.8) if NGO funded (Table 3). This intervention is estimated to cost around 55.2 billion VND for the government fund and 97.6 billion VND for the NGO fund (discounted to 2006 figures) to implement, with potential cost offsets estimated at 6 billion VND, providing a net incremental cost of 49.1 billion VND (95% UI: 40.3 billion VND to 58.3 billion VND) for the government fund and 91.5 billion VND (95% UI: 76.8 billion VND to 107 billion VND) for the NGO fund (Table 2). The health gain achieved from the brief intervention is estimated at an additional 2,691.4 DALYs averted (95% UI: 1,584 - 4,002) for the government fund and of 2,659.2 DALYs averted (95% UI: 1,612.8 - 3,958) for the NGO fund (Table 3). Figures 3 and 4 show that brief intervention is the next most cost-effective intervention to tax increase. Different scenarios of brief interventions can lead to different cost-effective results.

There are some facts to consider when looking at a possible nationwide expansion of brief interventions by doctors. For starters, a proportion of young and healthy people who consume alcohol at harmful and hazardous levels would not think of visiting their general practitioners or commune health centers. Similarly, people who do not have easy access to either the general practitioners or commune health centers due to social, geographical, ethnic, health or economic constraints may be excluded from receiving the intervention.

Based on the second-level criterion (acceptability), policymakers and politicians are open to such intervention because it can address risky alcohol use with minimal additional efforts on the part of health care providers. However, there is a need for additional trainings to spur the dedication and commitments of general practitioners or commune health center staff. The feasibility criterion, on the other hand, is not an issue given that there are already existing trainings and orientations for these health care workers. Such trainings just need to be offered to a wider audience and promoted more within the existing health care system. This research acknowledges that the intervention needs the time, dedication and commitment of the health care workers, and thus, has assumed a modest uptake by general practitioners or health center in its model.

The program's sustainability is possible only through additional resources and monitoring. The institutional mechanism should be able to keep motivating, to regularly

monitor and to provide feedback and refresher trainings to general practitioners and health center staff. Also, there should be ways to deliver these interventions within the existing primary care system. The evidence base for this intervention is strong and, based on the results of the cost-effectiveness analysis and second-level criteria, the intervention represents a good use of scarce health care resources.
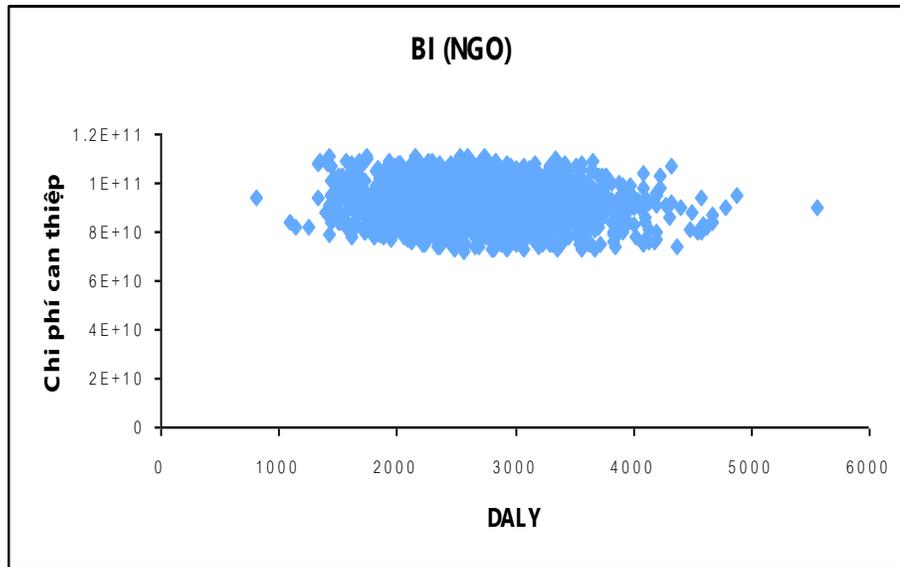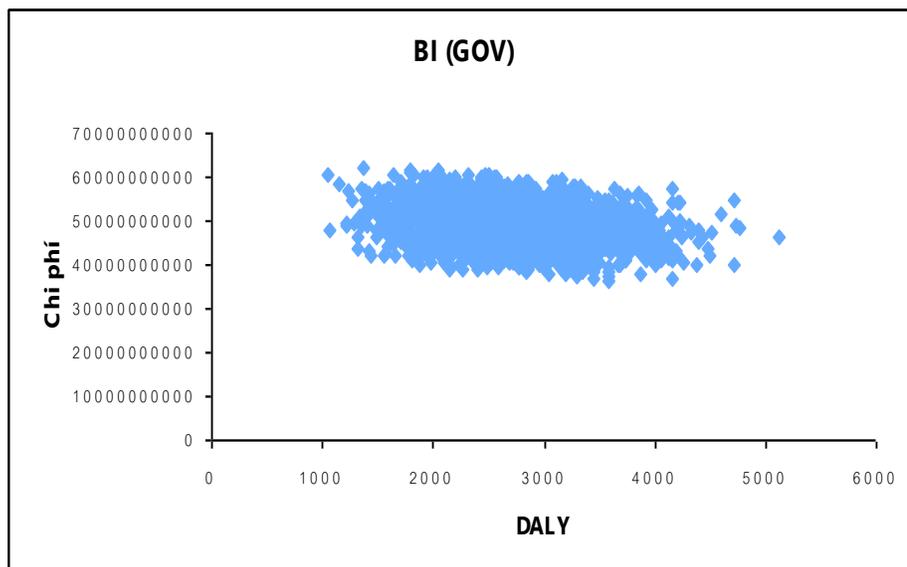

Figure 3. Cost-Effectiveness Chart on Brief Interventions Via NGO Funding

Figure 4. Cost-Effectiveness Chart on Brief Interventions Via Government Funding

4.3 Mass Media Campaigns

The drunk driving mass media campaign targeting drivers over 18 years of age is *not* cost-effective based on its ICER of US$45,682 (95% UI: US$35,814 - US$57,294). Neither is the mass media campaign that zeros in on drunk driving cost-effective, as shown by its ICER of US$19,254 (95% UI: US$6,597 - US$49,119) (Table 3). The implementation and enforcement of campaigns directed at the whole population is estimated to cost around 129 billion VND while campaigns on drunk driving specifically are to cost 35 billion VND (discounted to 2006 figures), with potential cost offsets estimated at 0.76 billion VND (95% UI: 0.96 - 0.57 million VND) and 1.6 billion VND (95% UI: 3.5 billion VND - 0.5billion VND), respectively (Table 2).

The mass media campaign for the whole population has a net incremental cost of 129 billion VND (95% UI: 109 billion VND - 148 billion VND) while that of the mass media campaign that targets drunk driving is 33.5 billion VND (95% UI: 27.8 billion VND - 39 billion VND) (Table 2). The health gain achieved from the media campaign for the whole population is estimated at an additional 176.5 DALYs averted (95% UI: 147.7 - 208.5). Meanwhile, the mass media campaign targeting drivers has a health gain of US$129.5 DALYs adverted (95% UI: 43.8 − 286.4) (Table 3). The cost-effectiveness charts on the mass media campaign for both the whole population and for drivers in Figures 5 and 6, respectively, show that both interventions are not cost-effective.
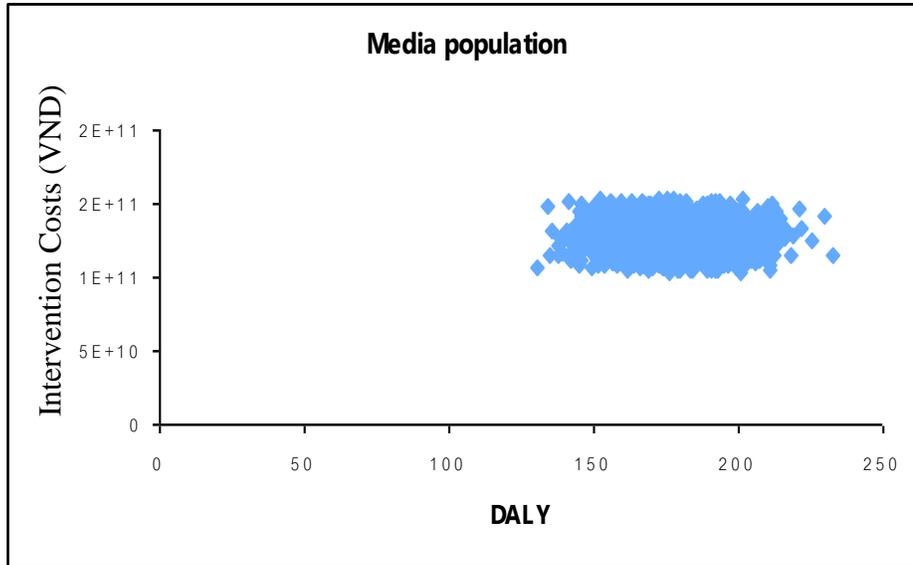
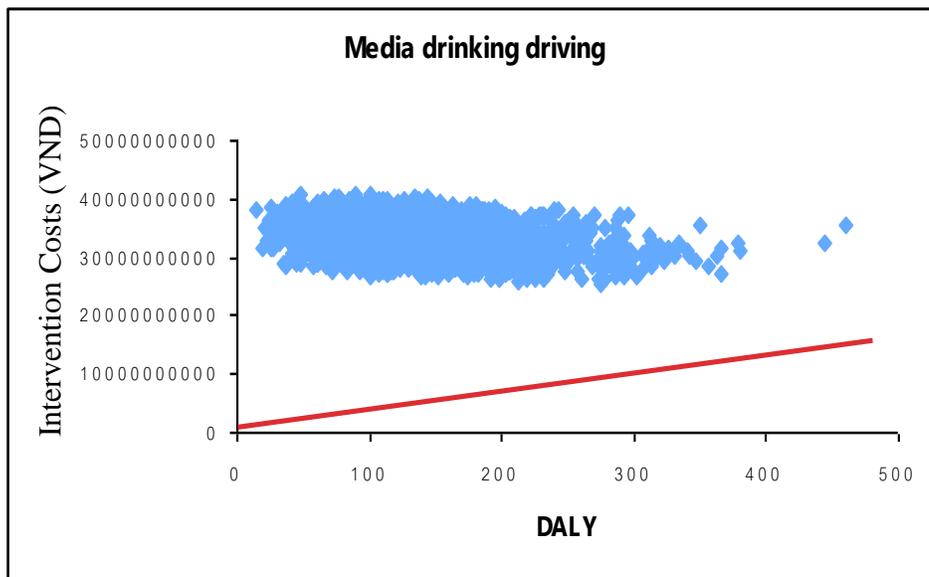**Figure 5. Cost-Effectiveness Chart on Mass Media Campaigns Targeting the Whole Population**

Figure 6. Cost-Effectiveness Chart on Mass Media Campaigns Targeting Drivers

As far as the second-level criteria are concerned, the issue of equity in the mass media campaigns tends to be a minor one. After all, any restrictions (e.g., alcohol

restrictions) espoused by the campaign would affect the population as a whole. In the TAP discussions, everyone was in agreement that the intervention would be widely accepted by stakeholders. It is also feasible since the infrastructure is already in place, and there has been a precedence in alcohol restrictions. The program will be sustainable as long as there are ongoing additional resource input and monitoring in place.

Although the evidence base on this intervention is weak, a campaign is widely promoted as an important component of any strategy to minimize alcohol abuse and one that fits well alongside RBT.
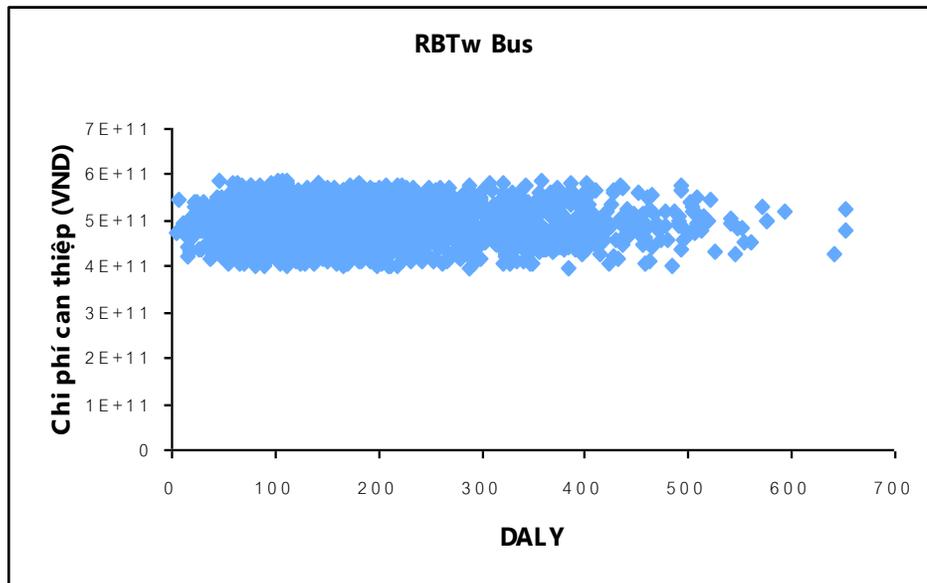

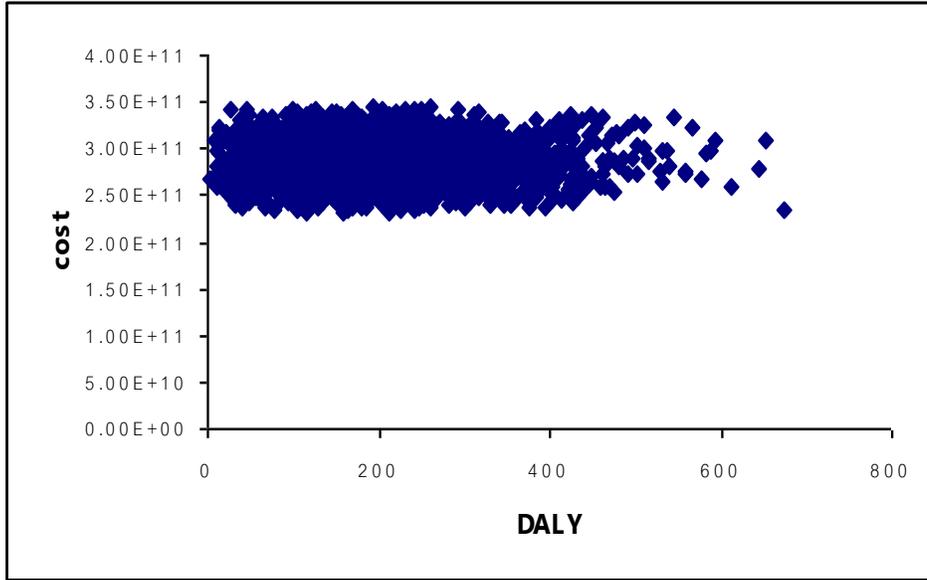**Figure 7. Cost-Effectiveness Chart for Random Breath Test with Booze Bus**

Figure 8. Cost-Effectiveness Chart for Random Breath Test without Booze Bus

4.4   Random Breath Testing

Random breath testing is cost ineffective. The RBT with Booze Bus garnered an ICER of US$179,903.3 US$/DALY (95% UI: US$65,207 - US$821,987) while the RBT Without Booze Bus has an ICER of US$96,721.4 US$/DALY (95% UI: US$38,202 - US$479,383) (Table 3). Since RBT With Booze Bus and RBT Without Booze Bus have an estimated cost of 495 billion VND and 288 billion VND (discounted to 2006 figures), respectively, these interventions are the most expensive of the strategies in this study's model. The potential cost offsets are estimated at 2.1 billion VND for the RBT With Booze Bus and 2.4 billion VND for the RBT Without Booze Bus, providing a net incremental cost of 494 billion VND (95% UI: 413 billion VND - 569 billion VND) and 285 billion VND (95% UI: 240 billion VND - 331 billion VND), respectively. The health gain achieved is estimated at 172 DALYs averted (95% UI: 37.8 - 464) for the RBT With Booze Bus and 185 DALYs averted (95% UI: 37.8 - 455) for the RBT Without Booze Bus.

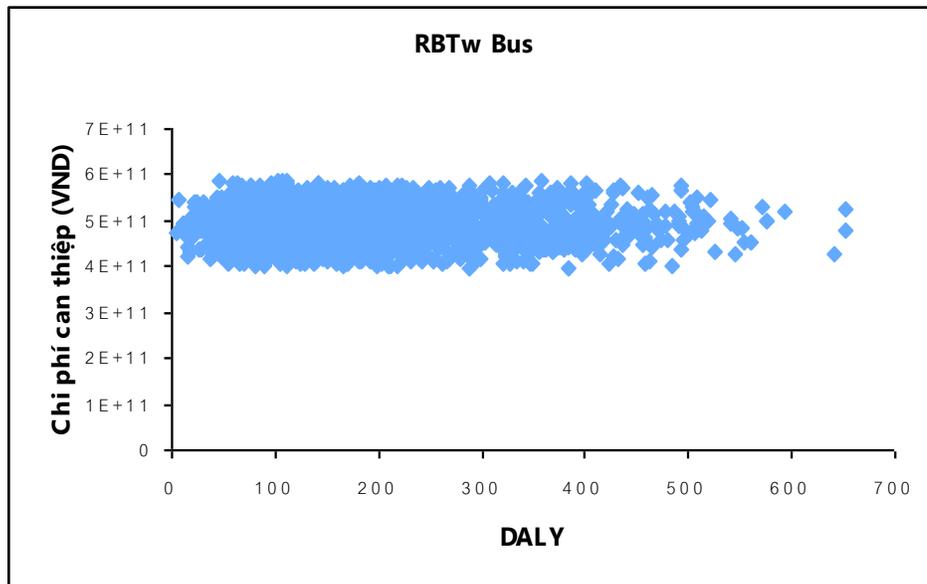Figures 7 and 8 show that RBT is not cost effective.

Figure 7. Cost-Effectiveness Chart on Random Breath Test With Booze Bus
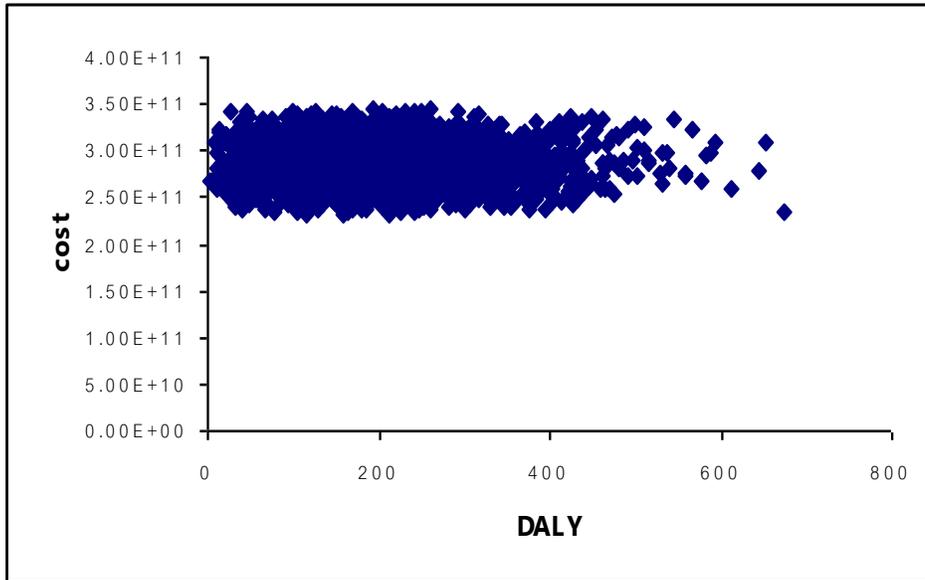
Figure 8. Cost-Effectiveness Chart on Random Breath Test Without Booze Bus

If one considers the key second-level criteria, one finds that RBT is equitable since all motor drivers have a fair chance of being stopped and asked to take a random breath test. It, however, does not apply to those who consume alcohol at unsafe levels but do not drive. Acceptability for this strategy is high although enforcement is still too weak to address drunk-driving problems. There is no infrastructure in place, but workforce issues have been addressed.

Findings on RBT are reasonably solid, suggesting good value for money in most cases. The intervention is, however, very expensive and requires enforcement, sustained funding and regular educational campaigns.

5. DISCUSSIONS

This research aims to provide a comprehensive analysis of some interventions' cost-effectiveness so as to reduce the burden of harm associated with drinking and driving in Vietnam.

In conducting these analyses, the limitations should be acknowledged. For one, this study encountered difficulties in creating a model that shows the time gap between the change in drunk driving behavior and injuries or health outcomes. Example, the assumption that drunk driving risks do not decrease quickly with every shift in drinking-and-driving behavior was not reflected in the analysis due to the probable influence of other factors.

On the other hand, this study has its own strength. The costing of interventions has rigorously employed the ingredient approach where possible, thus providing higher accuracy on the estimated intervention costs.

Findings from the analysis suggest that changes in excise taxation should be a high priority of the government due to the huge potentials for cost savings. Brief interventions of general practitioners are also likely to be cost effective based on a US$2,181 per DALY threshold using a cost-effective line (US$2,006) of intervention in Vietnam as per WHO guidelines. The RBT (with or without a booze bus) and mass media campaigns (targeting either the general population or only drinkers who drive), however, are not cost-effective by this standard.

Experts at the TAP meetings believe that although RBT is not cost-effective, it should be established and implemented. The RBT is not yet in place in Vietnam. Thus, in the beginning, this would need a big investment, but data show that in the long-term, this strategy will become cost-effective. By all indications---the strength of evidences, acceptance of stakeholders, and positive effects on society---this intervention, without any doubt, should be encouraged.

In spite of the promising effectiveness gains, results of the cost-effectiveness analysis on the proposed interventions need to be reviewed vis-a-vis the second-level criteria. First, the strength of evidences underpinning the interventions is at best modest and differs between interventions. The types of evidences referred to here range from the

estimates on the effects of increased taxation on consumption, to analyses of pooled time series data and meta-analyses of randomized controlled trials (e.g., brief intervention).

Second, population-wide interventions such as changes to taxation and mass media campaigns may be more equitable than the targeted interventions such as campaigns directed toward drivers or brief interventions that depend on general practitioners' dedication to screen the target recipients and implement the intervention plan (i.e., regions that have a short supply of general practitioners or commune health centers may be at a disadvantage in this respect).

Third, the interventions that are based on one-off legislative changes (e.g., changes to taxation) may be most feasible and sustainable because the systems and infrastructure to implement and monitor the changes are already in place. In contrast, the feasibility and sustainability of brief interventions are less certain because they depend on an adequate workforce of motivated doctors and other health care staff to provide counseling and treatment. The feasibility of interventions may also be affected by broader social cost implications that are not captured in a purely health sector perspective in the analyses.

The sustainability of some interventions' effectiveness is an important unknown in this study's analysis. While the effectiveness of some interventions, such as RBT, are backed by more than 20 years of time series data (thus, proving sustainability), others--- such as brief interventions by general practitioners---underwent relatively short trial periods only; thus, the sustainability of these interventions' effects remains uncertain.

6. SUMMARY AND CONCLUSIONS

This study is the first attempt to provide evidences on the cost effectiveness of drunk-driving interventions in Vietnam. Increasing the tax on alcohol proved to be a low-cost, relatively easy-to-implement strategy that will generate significant savings to the health care system. The brief intervention provided by doctors at commune health centers and general practitioners is not cost-effective although its evidence base for this intervention is strong. Likewise, based on the results of the cost-effectiveness analysis and

second-level criteria, the brief intervention represents a good use of scarce health care resources.

Meanwhile, RBT is highly accepted although it is still saddled by weak policy enforcement on drunk driving. Infrastructure is wanting although the workforce issues have already been addressed. The implementation of the RBT is very expensive and requires an ongoing commitment from the government in terms of providing funds and police personnel to regularly conduct the testing.

Mass media campaigns bear a weak evidence and are not cost-effective. However, these are widely promoted as an important component of any strategy to minimize alcohol abuse and one that fits well with RBT.

Although there are uncertainties in some aspects of the analysis, the results from this study provide policymakers with clear evidences on how cost effective the interventions on drinking-and-driving problems in Vietnam can be.

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