ECONOMIC EVALUATIONS ON INTERVENTIONS TO REDUCE ROAD TRAFFIC INJURIES: A LITERATURE REVIEW

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Introduction

In this paper, we conduct a literature review with the aim of gathering and comparing economic evaluations of road-traffic injury prevention measures—road safety management, improved vehicles, improved roadways, safe road users, and adequate post-crash response—and selected health problems with a major social impact. Our final goal is to provide some comparable evidence that can help improve understanding of the life-saving implications of social intervention investments.

Road traffic injuries (RTIs) are a growing but neglected global health issue that, along with other relevant life-saving problems, require effective prevention investment. One approach to setting priorities in social investments is the comparison of the likely costs and impacts of each possible strategy. Here is where economic evaluation, by seeking resource allocation efficiency as a guide for policy-makers, becomes relevant. More specifically, a resource-constrained setting assessing RTIs–related life-saving costs can help policy makers prioritize and choose the most appropriate interventions to control and prevent RTIs (see Bishai and Bachani, 2012).

Our main take-away from this review regarding RTI measures is that they are mostly competitive, in terms of cost-effectiveness (CE), in less-developed countries and when local needs are the focal point. On the other hand, based on what has been found in the literature, the interventions do not seem especially competitive when RTI measures are implemented in high-income countries (HICs), relative to other major social problem interventions. In any case, research and funding of the actions of RTIs seem to be underrepresented relative to the burden they impose.

A somewhat similar literature review was done in 1995 (Tengs et al., 1995). The study reviewed 587 interventions focused on different aspects, but all the life-saving interventions reviewed were implemented in the U.S. In all, 10.5% of the interventions reviewed targeted a reduction in RTIs and, similar to our results for RTIs, the estimates were slightly over the mean median cost when HICs were considered. Finally, we would like to acknowledge that further research in the field of comparative resource allocation frameworks is needed to provide the necessary tools to help decision makers if CE tools are to be used as a social investment criterion.

The paper is organized as follows: In Chapter 1, we provide a contextualization of the main reasons for the relevance of road traffic safety strategies when it comes to priorities in social investment. In Chapter 2, we illustrate the literature selection process and describe the inclusion/restriction criteria. Chapter 3 exposes and summarizes the different findings of the studies included, with a special focus on the results of the CE of RTIs, while contextualizing them vis-à-vis other health interventions. In the last part of the study, we provide some explanation of the main limitations of the review, together with a short overview of the main results and their policy and research implications.

1. Why do Interventions to reduce Road Traffic Injuries (RTI) matters?

1.1 Health impact

The first argument in the framework of global health is that RTIs were ranked the 6th leading cause of disability-adjusted life years (DALYs)[1] in 2015 (see Table 1). RTIs moved from the 9th position in 2009, and, unless significant actions are taken, road traffic deaths are expected to rise up the list of leading causes of death (WHO, 2015). Meanwhile, other relevant conditions, such as HIV/AIDS, and neonatal birth complications have shown a significant decrease as leading causes of DALYs, with a shrink of 1.6 and 0.7 percentage points between 2007–2016, respectively. However, the major leading cause of DALYs, cardiovascular diseases, is still increasing year after year, reaching a share of 14.8% of all DALYs in 2016. In global terms, other conditions in the group with a "positive" percentage change are diabetes, depressive disorders, and drug use.

Even though global RTIs have remained almost stable, with a share of approximately 3% between 2000–2016 (see Table 2), the evolution of each leading cause of death is very much socio-development dependent (see Figure 1). If we zoom in the evolution of RTIs by socio-demographic development level (SDI) (IHME 2018), we find that the increasing trend is led by countries with low and low-middle SDI, while the high, middle-high, and middle social developed countries are losing between 0.3 and 0.7 percentage point (see Table 3).

[1] You can find the definition of DALY in Chapter 2, page 4.

Although the number of motor vehicles per capita is considerably higher in high-income countries, 91.8% of the total of DALYs caused by road traffic correspond to low-and-middle income countries (LMICs) (see Table 4) and are lived mostly by people who do not either own or have access to a car, i.e., pedestrians, motorcyclists, cyclists, and users of public transport.

The main rationale of this phenomenon is in line with the continued economic growth in LMICs, especially in countries currently considered as middle-income countries. The strong increase in traffic volume has been a result of continued economic growth, but it has come without the "proper" investment in road safety strategies. The result of these processes is an increase in traffic-related deaths and injuries, which currently account for roughly a third of the burden from all unintentional injuries (World Bank, 2018).

One of the United Nations' goals is to halve the number of global deaths and injuries from road traffic crashes for 2020 [see SDG (Sustainable Development Goal) 3.6]. Another target related to road safety is to "provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport (..)" (SDG 11.2). Decision-makers and global health advocates will have to analyze best practices, identify health financing gaps, mobilize funds, and use funds efficiently to achieve the SDGs.

1.2 Economic impact

Negative impacts on productivity levels are likewise important points to consider when RTIs interventions are assessed. The lack of proper road traffic-safety measures is translated into: (1) The death of almost 1.2 million people a year, (2) Injuries or disabling conditions affecting between 20 million and 50 million people, particularly people of productive ages (15–44 years) and (3) Worldwide costs amounting to 518 billion US$ a year (WHO, 2015).

A World Bank (2018) study, that links road traffic injuries and economic growth, stresses that reducing road traffic deaths and injuries could be followed by substantial long-term income gains for LIMCs. The

study indicates that countries that do not invest in road safety could be missing between 7% to 22% of potential per capita GDP growth over a 24-year period.[2]

Road safety competes not only with other budget demands for road transport, such as congestion, but also with budget demands for social problems. Regarding international financial support, the major dilemma related to the under-investment of RTIs in relation to its position as a leading cause of deaths, is the lack of recognition of injuries as a public health problem, relative to other major problems with even smaller shares of DALYs caused annually. One good example of this is the latest review of the distribution of global health funding developed by the Institute for Health Metrics and Evaluation (IHME), which is supported by the World Health Organization (WHO). The report (IHME, 2016) reviews the distribution of funding between the leading causes of DALYs. Apart from national health system strengthening, the major spending of the last few years (2010–2016) has been directed towards HIV/AIDS. More specifically, approximately one-quarter of the $37.6 billion investment in development assistance for health in 2016 to HIV/AIDS. The second-largest level of investment was in children's and newborns' health, while RTIs, the 6th leading cause of DALYs, is not even included in the report (compare Tables 1 and 2).

2. Methodology

The main objective of this review is to offer an indicative picture of the areas and interventions related to life-saving investments that have been economically evaluated in the literature. We focus on studies centered mostly on the CE approach so that we can compare the levels of CE related to RTI interventions with those related to other major public health problems.

When it comes to its policy implications it is important to note that the CE analysis methodology evaluates the cost of obtaining an additional unit of health outcomes for a specific intervention. The most cost-effective strategy can be easily identified by comparing the different strategies and their attributable

[2] Over 2014–2038, halving deaths and injuries due to road traffic could potentially add 22% to GDP per capita in Thailand, 15% in China, 14% in India, 7% in the Philippines, and 7% in Tanzania (single LMIC countries analyzed in the study).

incremental health outcomes. The cost–effectiveness ratio of an intervention can be estimated by using different metrics of health outcomes. In this review, the metrics of interest are mainly the DALYs saved. The DALYs indicator is the aggregation of the Years of Life Lost from a premature death and the Years of Life lived with Disability. In a few cases, where no study using DALYs was available for an important intervention we have also reviewed studies using metric units of averted death; either Quality-Adjusted-Life-Years (QALYs) or Years of Life (YLs) (see Annex II, Tables 8, 9, and 10).

There are some important observations related to the CE literature published; First, such studies are typically done when new measures are to be implemented in the future. Second, some conditions are over-represented in the CE-literature, for example, infectious and parasitic conditions, such as Malaria, HIV, and Diarrheal diseases. This is probably due to the fact that these health problems have been traditionally prioritized by international donors. Likewise, the evaluation of the effectiveness of drugs and vaccine interventions is over-represented, since manufacturers use CE data as part of their bargaining strategy (Horton et al., 2017). Moreover, since 2007, there has been considerable growth in the publication of studies related to health improvement and using cost-per-DALY. Most of these published articles focus on sub-Saharan Africa, followed by Southeast Asia, East Asia, and Oceania (Neumann et al., 2016). Finally, it is worth mentioning that while studies using cost-per-DALY are currently more common for interventions in LMIC, the cost-per-QALY is more strongly used in the analysis of interventions in HICs. This seems to be an arbitrary decision, rather than a rational one (ibid.).

The selection process that we have followed to identify the included studies is illustrated in Diagram 1. The inclusion criteria are mapped out in 4 steps, capturing the number of records identified in addition to those included and excluded. The first step, identification, refers to a systematical search in PubMed and Google Scholar for articles containing the concept “Cost Effectiveness” and at least one of the CE metrics previously mentioned, either in titles or abstracts. The selected studies also had to fulfill the following characteristics: published between 2000 and 2017; published by a peer-reviewed journal or relevant organization, such as the World Bank and the WHO; and evaluating a topic directly related to one of the SDGs. However, after screening the abstracts to identify the relevance of each study, just 86 studies were chosen from 275 studies matching these three criteria. Finally, we imposed three additional criteria on

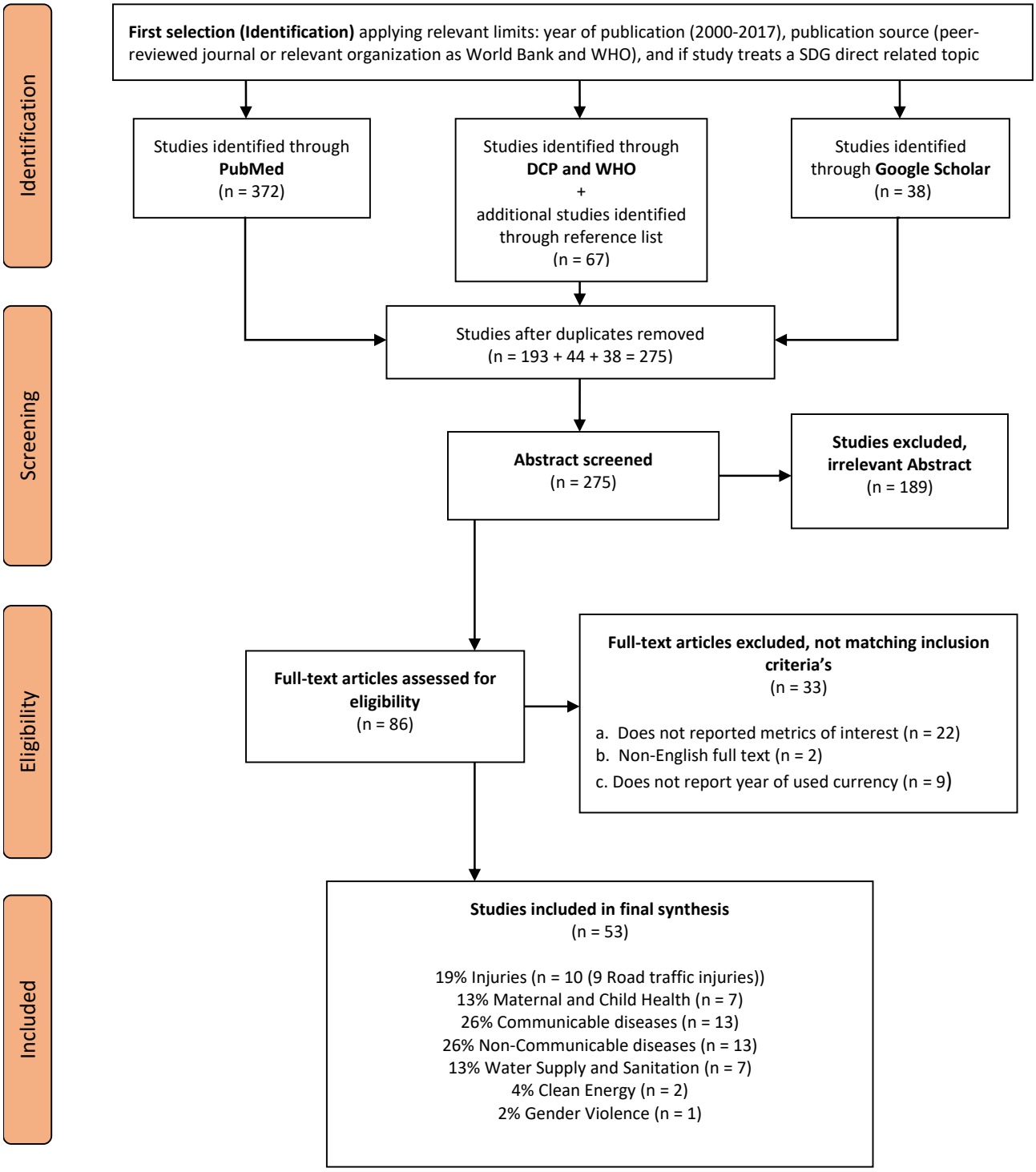
these 86 studies: Reporting CE metrics; year of currency; geographic region; population under consideration; time frame of the study; as well as being published fully in English. Following the imposition of these additional criteria, our final sample consisted of 53 studies.

Of those final 53 studies, 2% correspond to gender violence, 4% correspond to clean energy, 13% correspond to water supply and sanitation, 26% correspond to non-communicable diseases, 26% correspond to communicable diseases, 13% correspond to maternal and child health, and 19% correspond to injuries. Furthermore, 9 of the 10 papers on injuries correspond to road traffic safety. For each article, we collected the following information: 1) Type of intervention, 2) Country of intervention, 3) CE ratio (absolute or range), 4) Year and type of currency, 5) Author, year, and journal of publication.

To make the CE comparison possible, we extracted 141 estimates of interventions drawn from the 53 studies and converted the CE ratios in US$ 2012, adjusting by the exchange rate based on the concept of purchasing power parity, or PPP. The first part of the reference chapter provides the list of papers included in the final synthesis.

Forty of the 53 CE studies use DALYs as a CE measure, and they include 120 interventions. The distribution of outcomes for each intervention is illustrated in Figure 2. From this figure we can already recognize the difference of the distribution of costs per DALY averted between HICs and LMICs. More than 50% of the studies grouped in the LMICs cost US$ 0–500 per DALY averted, while more than 50% of the studies corresponding to HICs have a CE-ratio of US$ 5,000 or more.

Diagram 1: Details of search and selection strategy



Source: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses

3. Results

3.1 Comparing CE between different road traffic safety measures

Six of the 9 road traffic safety studies included in the literature review used US$/DALY as the CE ratio. They are included in this sub-chapter, as follows: a study from Kenya (Habyarimana and Jack, 2015); a study modelling three different road traffic interventions for a large part of LMICs and two country-specific interventions in China and South Africa (Bishai and Hyder, 2006); another study from China (Stevenson et al., 2008); a study from Thailand (Ditsuwan et al., 2013); and two regional studies reviewing different WHO-regions, the first analyzes the sub-Saharan African and the South-East Asian sub-regions, and the second analyze these two regions plus North America and West-Pacific Asia.[3]

We want to highlight some facts to introduce the road traffic safety frame: the road environment can vary by type of location (rural or urban, less or more developed infrastructure), by type of road (highway or street), by the degree of visibility, and by the traffic flow. A road user can be either a driver or a passenger of trucks, cars, or motorcycles; a cyclist; or a pedestrian. Further, vehicles can be either motorized or non-motorized (e.g., bicycles).

Ditsuwan et al. (2013) review two RTIs related to reducing drink-driving-related accidents in Thailand. The two interventions are a media campaign (television, radio, and posters) and a sobriety test. This test is split in two: either random or selective. According to the authors, mass media campaigns, sobriety checkpoints, and breath testing are all cost-saving in comparison to no action. However, if averted treatment costs are not included in the equation and enforcement costs alone are considered[4]—CE calculus used in this study—the interventions are not cost-saving, but have a low cost per DALY averted, costing between US$ 301 and US$ 417 (see Figure 3). According to Ditsuwan et al., not only are drink-driving strategies very cost-effective but also applying both interventions (checkpoints and media campaigns) simultaneously can reduce the potential of road-accidents under the influence of alcohol to 24%. Another

[3] See Annex, Part II to find the graphs summarizing the interventions reviewed across the 6 studies. Figure 3 summarizes studies with the references 9, 19, 23, and 48. And Figures 4, 5, and 6 cover the studies from Chisholm et. al (2008, 2012).

[4] Calculating 10–15 officers for a typical period of 2 hours for each checkpoint (Ditsuwan et al., 2013)

author focuses on different actions to reduce alcohol consumption in Australia, where the less effective action reviewed was drink-driving mass media, with US$ 15,195 per DALY averted (see ref. 17).[5]

In China three different strategies—seatbelt use, bicycle helmet use, and motorcycle helmet use (see Figure 3)—to reduce RTIs were analyzed in two different studies (Stevenson et. al., 2008; Bishai and Hyder, 2006). From Stevenson et. al., the different interventions to increase the use of seat belts over a 12-month period are police training, enforcement, social marketing, and health education. This combined strategy results in a 12% increase in seat belt use and implies a CE ratio of US$ 476 per DALY averted. From Bishai and Hyder, the second and third interventions, legislation and enforcement to improve bicycle helmet and motorcycle helmet use, have a CE-ratio of US$ 139 and 531/DALY, respectively. Of the three measures analyzed, the bicycle helmet improvement strategy proves to be the most cost-effective strategy for the case of China.

Another strategy reviewed by Bishai and Hyder (2006), for South Africa, is the distribution of child-resistant containers. An extensive part of Sub-Saharan Africa still employs bottles, similar to drinking bottles, to store kerosene. The intervention consisted in distributing 200,000 child-resistant containers to reduce paraffin intoxication in children. Assessing a very low-priced intervention, costing US$ 79 per DALY averted.

However, the most cost-effective road traffic intervention included in this literature review is the introduction of speed bumps at dangerous junctions, with a CE-ratio of US$ 2–9/DALY, in LIMCs. Here, it is important to consider that, for this specific strategy, the dangerous junctions must be recognized first (a process not included in the cost calculation). Furthermore, the second most effective intervention focuses on diminishing numbers of road-victims due to bad bus-driving in Kenya. The intervention consisted of encouraging bus-users, through messages on buses and radio announcements, to denounce bad bus-driving practices. This intervention had a CE range of between US$ 10–60 per DALY averted.

[5] This intervention is not included in Figure 10, since the high value covers the overview of the rest of interventions.

When focusing on the two studies done at regional level by Chisholm and Naci (2008, 2012) (see Figures 4, 5, and 6), it is important to assess the variation in cost per DALY across sub-regions.[6] For both single and combined interventions, North America shows a much higher cost per DALY averted than do the other three sub-regions. The Western Pacific sub-region is the second sub-region with the most expensive RTIs in most of the cases.[7] These differences can be attributed to several factors, such as the level of road development (infrastructure), equipment and vehicle development (e.g., vehicle with crash protection), legislation and safe-driving public education, and the amount of public expenditure allocated to road safety (e.g., expenditure on police officers). These factors are significantly higher in both North America and the Western Pacific sub-regions, compared to the sub-regions of Sub-Saharan Africa and Southeast Asia.

When looking at the breath-testing evaluation done by Chisholm and Naci (2008), it is noticeable that the effectiveness of breath-testing checkpoints, as an enforcement strategy to reduce road accidents under the influence of alcohol, also varies importantly across regions. For example, in regions such as Southeast Asia and Sub-Saharan Africa, the reported CE-ratios are US$ 2,612/DALY and US$ 3,190/DALY, respectively. On the other hand, in regions such as Western Pacific Asia and North America, the same intervention entails a cost per DALY saved of US$ 10,708 and US$ 30,644, respectively.

Furthermore, the predominant type of road users (e.g., pedestrians, bus users, and drivers) and the predominant related risk factors (e.g., speeding, drink-driving, not using seatbelt) also vary importantly across countries. In Sub-Saharan Africa most road users are pedestrians (57%), bus-users/drivers (30%), and bicycle users (11%), while, in Southeast Asia, close to 46% are bus-users/drivers and approximately 39% are either motorcycle or car users/drivers (Chisholm et al., 2012). Therefore, the lack of use of seatbelt and motorcycle helmet (legislation and enforcement) is a more relevant risk for Southeast Asia

[6] The WHO sub-regions included in these studies are: (1) *AmrA*: Cuba, Canada and United States, (2) *WprB*: Malaysia, China, Japan, Viet Nam, Laos, Mongolia, the Republic of China, Cambodia, and Philippines, (3) *AfrE*: e.g., Botswana, Kenya, Congo, Uganda, Tanzania, Ethiopia, Zimbabwe, and South Africa, and (4) *SearD*: Bangladesh, Bhutan, Democratic Republic of Korea, India, Maldives, Nepal, and India.

[7] Excepting the single intervention of motorcycle helmet use (legislation and enforcement)

than for sub-Saharan Africa. Since the number of motorcycles is higher in Southeast Asia, most RTIs in this region involve motorcycle riders and passengers. Consequently, the costs of motorcycle helmet RTIs amount to US$ 1,981 per DALY averted in the Southeast Asia region, while the same intervention costs US$ 7,805/DALY in Sub-Saharan Africa, US$ 6,686/DALY in Western Pacific Asia, and US$ 22,227/DALY in North America. In Africa, the victims of road injuries are mainly vehicle occupants and pedestrians; thus, for this sub-region, the most cost-effective RTIs interventions are related to bicycle use and speed limit enforcement (US$ 1,440 and US$ 1,971 /DALY, respectively).[8]

When it comes to evaluating the CE of a combination of road traffic enforcement strategies, the results of the reviewed studies show that in most of the cases the synergy of the simultaneous application can be translated into higher health outcomes per dollar invested. In the case of North America, the most cost-effective road traffic combined strategy (speed cameras + breath-testing + motorcycle helmet use) costs 13,610 US$/DALY. Furthermore, the enforcement of motorcycle helmet use alone is reported to be the most cost-effective single intervention for this region with a cost of 22,227 US$/DALY (see Figure 6).

The most cost-effective action to be taken in the sub-region Southeast Asia when it comes to the reduction in road traffic accidents is also a combination of different interventions: seatbelt and motorcycle helmet use, drink-drive legislation and enforcement and speed limits enforcement via cameras. The costs for this combination of strategies amounts to 1,379 US$/DALY, again, less than any other single intervention evaluated.

Therefore, it seems clear now that road traffic injuries in long-term highly motorized countries are mostly related to car drivers, whereas in certain countries of Asia it is motorcycle riders. Also, in many LIC occupants of multiple passenger vehicles (such as buses) and pedestrians are the most affected by road traffic injuries. In summary, the literature published between 2000 and 2017 covers interventions of *traffic control*, per police and sanction enforcement, speed control and reduction of driving under the influence of alcohol. There are also papers focusing on the promotion of *crash protective equipment* as seatbelt and

[8] Most cost-effective combined strategy: Speed cameras + breath-testing + motorcycle helmets + seatbelt + bicycle helmet (1,597 US$/DALY)

helmet use. We have also reviewed one paper analyzing one *equipment safety measure*, i.e. the supply of childproof containers for paraffin and another paper analyzing one *road design strategy*, i.e. speed bumps in dangerous junctions. The covered strategies match with the road traffic safety priorities setting of the OECD (2016) that defines as the road worldwide biggest challenges the reduction of accidents under the influence of alcohol, speeding control and the use of seat belts and motorcycle helmets. Nevertheless, the literature does not cover any cost-effective evaluation related to vehicle design or driver education.

Since most of the economic evaluation interventions are for low-and-middle countries, the paper by Elvik et al. (2007) can complement our findings by providing references of some beneficial RTIs reductive interventions for a high developed country (Norway). However, the interventions analyzed in Elvik et al. (2007) were not assessed by any CE analysis as they were evaluated via a cost-benefit analysis.

The authors results show that the most cost-beneficial action is the enhanced neck injury protection, with a cost-benefit ratio of 20,25, followed by the introduction of seatbelt reminders, the alcolock for drivers convicted of drink-driving and the electronic stability control (see Table 5). On the other hand, the road traffic interventions evaluated as the less cost-beneficial in this study are the use of vehicles with at least 4 stars in the ranking of Euro NCAP (a safety ranking). The other less cost-beneficial measures are speed enforcement, road lightening, use of cars with front pedestrian protection and an intelligent speed adaptation system.

3.2 Comparing CE of road traffic safety interventions with other major social interventions

Besides road traffic reduction strategies, we selected one additional paper that studies another injury-related intervention (Rahmanet al. (2012). The paper evaluated two interventions, reduction in drowning accidents through swim-classes for children aged 4–12 years, and a direct swimming supervision of children aged 1–5 years old, both of which were introduced in Bangladesh. The results of the paper show a median CE-ratio of US$ 381/DALY for both interventions. From the two interventions analyzed, the swim classes proved to be the most cost-effective, with a CE-ratio of US$ 89/DALY.

For 2000–2017, just two studies, both developed for India (Pitt et al., 2016 and Crooper et al., 2017), related to environmental improvement were found and selected. The first study evaluated the effectiveness

of a private-public mixed subsidy to support the transition from coal to LPG fuel in households. This intervention resulted in a CE-ratio of US$ 24/DALY. However, this calculation did not include any assessment of outdoor air pollution. The second paper analyzed the health impacts of an installation of 72 Flue-Gas Desulfurization units at a coal-fired power plant to reduce the plant's SO2-emissions by 90%. More specifically, the health outcomes evaluated were strokes and ischemic heart diseases, and the intervention reported a CE-ratio range of US$ 953–48,010/DALY and an average of US$ 5,066/DALY (see Figure 7).

Gender equality–related studies include very little literature on CE evaluations. Only one relevant study (Jan et al., 2011) that could be included in this review; the study focuses on the evaluation of a microfinance and gender training program to reduce intimate partner violence in South Africa. Two interventions were reviewed, a scale-up program and a trial program, and CE-ratios of US$ 2,804 and US$ 9,344 US$/DALY, respectively, were calculated for these interventions.

It is worth mentioning another paper (Babigumira et al., 2012) that estimates a hypothetical new contraceptive program to achieve universal access to modern contraceptives in Uganda. By comparing the intervention with the status quo, in which access to modern contraception is limited, the authors calculated a US$ 200–500 investment to save one DALY.

Conversely, when focusing on communicable diseases, we found a significant body of economic evaluation literature. An evaluation of an integrated preventive campaign against communicable diseases done by Marseille et al. (2014) assessed a general cost for 70 different countries, comprising 76% of the world population and 98% of its disease burden. The results showed a range of CE ratios of US$ 7–16,000 /DALY. With the exception of Afghanistan, the 30 countries with the most favorable CE rate were based in sub-Saharan Africa. The main message to be extracted from this review is the broad diversity in costs and policy impacts across regions—these are closely related to the different needs and infrastructures in those regions. Other communicable diseases covered by further studies were Dengue (n=2), Diarrheal diseases (n=1), Hepatitis B (n=1) and HIV/AIDS (n=5) (see Appendix I). For each of these, prevention was reported to cost less than US$ 350 per DALY averted, while the cost corresponding to treatment was

reported to be between US$ 467/DALY and US$ 6,667 /DALY. Therefore, it seems clear that prevention is more cost-effective than is treatment for most of these diseases.

Two other communicable disease–prevention measures evaluated in the literature were: early vaccination for HPV in Honduras, which reported a CE-ratio of US$ 1,051/DALY (Aguilar et al., 2015), and a maternal influenza immunization program in Mali (Orenstein, 2017), which reported an estimated CE-ratio of US$ 857/DALY. Furthermore, we also want to emphasize the results of two studies for Malaria treatments in Africa (US$ 41–545 DALY) (Maheu-Giroux and Castro, 2014 and Rakuomi et al., 2017), one for Syphilis treatment in sub-Saharan Africa (US$ 1-442/DALY) (Kuznik et al., 2013) and one for a preventive program of tuberculosis screening and preventive therapy in Brazil, which reported a CE-ratio of US$ 2,273 /DALY (Azadi et al., 2014).

To summarize, we like to highlight the finding that, across the CE of preventive actions related to communicable diseases, the interventions with the lowest cost per DALY averted reported are HIV/AIDS preventive actions, with a median CE-ratio of US$ 99/DALY. On the other hand, the preventive interventions for Dengue and Rotavirus are reported to have the "lowest" CE, with a median ratio of US$ 2,473 and US$ 1,848 /DALY, respectively. Regarding the effectiveness of treatments of contagious diseases, the condition reported to have the lowest associated cost is Malaria, with a median CE-ratio of US$ 191/DALY while the highest-costing treatment is for HIV/AIDS, with a cost range of US$ 467–6,667 per DALY saved.

With respect to actions to improve mothers' and children's health, we reviewed four preventive and four treatment life-saving interventions from six different sources, covering not only single interventions but also case-dependent packages. The most complete study (Adam et al., 2005) was done for two sub-regions; sub-Saharan Africa and Southeast Asia. The study evaluated the CE of different interventions, such as a community case management of neonatal pneumonia, a newborn care package, skilled maternal care and immediate care in a case of newborn severe eclampsia, obstructed labor, breech presentation and fetal distress, and referral for postpartum hemorrhage. In the first sub-region, the CE ranges from US$ 8 to US$ 223/DALY, depending on the case and the package applied, while the cost in Southeast Asia ranges from US$ 27 to US$ 21,215 per averted DALY. The second paper (Goldie et al., 2013) includes a

safe motherhood initiative, evaluating a package of antenatal and postpartum care, with trained birth attendants (potentially in a health facility) for Afghanistan. The paper calculates an investment of US$ 153–1,021 to avert one DALY (ibid.). The third and last study (Sinha et al., 2017) evaluates a participatory learning program for women to improve birth outcomes for a rural area in eastern India and estimates a CE-ratio of US$ 77/DALY.

With respect to malnutrition, three actions have been included: one package for malnutrition of mothers and two for malnutrition of children. The nutrition package for mothers had an estimated CE ratio for 34 LMCIs of US$ 1,100/DALY (Bhutta et al., (2013). One of the two papers evaluating actions against malnutrition children was for Malawi (Wilford et al., 2012) and the other was for 34 different LMICs (Bhutta et al., (2013). The first paper reports a CE-ratio of US$ 52/DALY, while the second reports a CE-ratio of US$ 240–340 per DALY averted.

The CE literature on non-communicable diseases covers a variety of conditions. The most relevant ones, as already introduced in Chapter 2, are cardiovascular diseases. The preventive actions are specially related to salt consumption, where media campaigns and regulations like controlling the amount of salt in bread are introduced. The CE of these interventions varies strongly across countries; one study for Vietnam (Ha and Chisholm, 2011) reports a CE-ratio of US$ 150 and US$ 208 per DALY averted, while in Argentina, a cost-saving measure of as much as US$ 1,505 is reported (Rubinstein et al., 2009). In Ethiopia, the CE-ratio ranges from US$ 1,082 to US$ 10,340/DALY. With respect to treatments, a similar variation across countries and across types of treatment can be found, with a CE-ratio from US$ -246 to US$ +15,444/DALY (see Ha and Chisholm, 2011, Rubinstein et al., 2009, Stanciole et al., 2012).

We have selected two conditions covering addiction problems that are primarily related to consumption of the legal narcotics, alcohol, and tobacco. For alcohol consumption, we have focused on one meta-review (Laxminarayan et al., 2006) that compares the CE ratios of two interventions for two different artificial types of regions: “low-risk drinking regions” (East Asia and the Pacific and South Asia) and “high-risk drinking regions” (Europe, Central Asia, Latin America, Caribbean, Sub-Saharan Africa). For the low-risk drinking regions, the interventions are the following: (1) a tax increase of alcohol beverages by 25–50 percent and (2) a combination of advertising ban and reduced access to alcoholic beverage. The

first intervention has a CE of US$ 136–292 per DALY saved, while the second one has a CE of US$ 160–189 per DALY saved. For the high-risk drinking regions, the same interventions, specially the second (advertising and alcohol access intervention), are less effective, with a cost of US$ 3,242 per DALY averted.

Furthermore, a country-specific study (Cobiac et al., 2009) evaluates three interventions to reduce alcohol consumption in Australia. In this study, the most effective intervention is advertising bans, which have a CE ratio of US$ 1,251/DALY, followed by licensing controls, with a CE ratio of US$ 2,687/DALY.

Another two papers (Rubinstein, 2009 and Laxminarayan et al., 2006) show the influence that preventive and treatment actions in reducing the number of tobacco consumers can have. For Argentina, Rubinstein shows that the most cost-effective intervention is the preventive action through mass media, with a cost of US$ 3,049 per DALY saved. In comparison, treatment to stop smoking was calculated to have a cost of US$ 59,443/DALY. In a meta-review, Laxminarayan, et al. (2006) reveals that, for 34 LMICs, the most attractive preventive intervention is a 33 percent increase in cigarette prices, with a CE-ratio range of US$ 4–235/DALY. The same study evaluates a similar nicotine replacement therapy, the same treatment as in the case of Argentina, but with an estimated cost of US$ 71–97/DALY reported for general LMICs, which differs remarkably from the CE-ratio obtained in the Argentinian case.

Focusing on the effectiveness of preventing diarrheal diseases, we can see that the estimates are again strongly conditioned to the region studied. For example, when the purpose is to improve source- and household water quality in Africa, the cost range goes from US$ 59 to US$ 602/DALY (Clasen et al., 2008). On the other hand, the estimated cost of the same intervention in the sub-region of East-Europe ranges from US$ 1,113 to US$ 11,172/DALY (ibid.).

However, regarding water supply and sanitation interventions, the action reported to have the lowest cost per DALY averted is hygiene promotion/basic sanitation, with a modeled CE-ratio for 34 for LMICs of US$ 5/DALY (Cairncross and Valdimanis, 2006). Another study (Gühnter and Fink, 2011) also evaluates the CE of improved water sanitation in LMICS, in this case including different countries. The authors report a mean CE-ratio of US$ 3,633 considering all 70 countries, which reduces to 1,222 by just taking

into account sub-Saharan African countries. The action with the highest cost per DALY saved was specific privately piped water and flush toilets in LMICs, with a CE-ratio range of US$ 856-9,086/DALY (Cairncross and Valdimanis, 2006).

Finally, to give the reader an overview of the 120 included interventions, using DALY as a CE metric, we cluster each action by either condition or major social problem and then calculate a rough median per cluster. Figure 5 highlights the most "cost-effective" actions, including combating air pollution at the household level; preventing communicable diseases, such as CDV, HIV, Malaria, Syphilis, and Hepatitis B; prevention of drowning injuries through swim classes; universal access to contraceptives; and reduction of alcohol consumption in low-risk regions. Looking at the median, the most expensive interventions are HIV treatment, prevention of intimate partner violence, intervention in a power plant with the aim of reducing air pollution, prevention of breast-cancer, health actions for mothers and neonates in southeast Asia, and preventive measures for diarrheal diseases in eastern Europe.

Interestingly, there is strong variability in outcomes for same interventions across either countries or regions. For example, in the case of maternal and neonatal health, the interventions in Africa are in the list of the measures with the lower cost per DALY averted, with a CE- ratio ranging from US$ 8–223/DALY, while the same interventions in Southeast Asia can cost up to US$ 21,125/DALY. The same thing can be observed for preventive actions to reduce diarrheal diseases and actions to reduce alcohol consumption.

When we compare the CE-ratios reported for actions to reduce RTIs in single LMIC countries with the results of the non-road traffic interventions for the same countries we can see that RTI interventions are strongly competitive in the cases of China, Kenya, and Thailand.

When we try to make the same comparison by sub-regions, we conclude that the competitiveness is metric- and region-dependent. For example, for southeast Asia, the comparably strong cost-effective interventions are the combined intervention of speed cameras + breath-testing + motorcycle helmets + seatbelts (US$ 1,379/DALY) and bicycle helmet legislation and enforcement (US$ 1,440/DALY). On the contrary, the same interventions are less competitive in more developed regions: for example, in the case

of USA and Canada, a CE-ratio of US$ 345,687 /DALY is reported for the bicycle helmet policy, and a CE-ratio of US$ 67,668/DALY is reported for the seatbelt use legislation and enforcement policy (see Figure 8).

Ranking the 120 interventions by their mean values per DALY averted, we can see that, for cardiovascular disease in Argentina, drug-based treatment and prevention interventions (such as the reduction of salt in bread) are the most cost-effective strategies evaluated. Next is a basic sanitation promotion strategy in LMICs, with a CE-ratio of US$ 5/DALY. In 4th and 6th place we find two RTI interventions: speed bumps at most dangerous junctions in LMICs and encouragement for bus-users to denounce bad-driving experiences in Kenya. Nevertheless, the median value of RTI reduction strategies is ranked 18th out of 27 conditions, with a median value of US$ 1,981/DALY (see Figure 9).

Besides the interventions using DALY as a CE measure we are also interested in finding out how RTI-avoiding measures are ranked when other metrics are applied. Table 8 shows ten interventions, in which the CE of each intervention is evaluated by the YLs saved. The interventions with the major cost per YL saved are treatments of different cancers in USA and interventions related to water access improvement in LMICs. The one RTI-prevention measure included— traffic patrol enforcement in Uganda—appears to have the lowest CE-ratio, with a cost of US$ 312 per YL saved; this is followed by the CE-ratio of home visits of trained community members to reduce child neonatal mortality, with a cost of US$ 377/YL.

Another ranking can be identified in Table 9. In that table, we can observe that the same RTI measure costs less per DALY saved than does hygiene promotion in India, with an estimate of US$ 905 per death averted. The helmet policy in Vietnam has very low efficiency when it comes to fatal injuries, with a cost of US$ 11,000 per death averted. However, in the case of non-fatal injuries, the cost is heavily reduced, to US$ 800.

Finally, we have also reviewed eight actions, using the QALY saved as a health metric. Among those eight actions, the only RTI intervention evaluated is a neighborhood slow zone in the USA, and it has the highest cost, at US$ 46,832/QALY. Meanwhile, water and sanitation interventions proved to have the lowest cost per QALY saved (see Table 10).

Therefore, we can conclude that there seems to be a strong relationship between the type of metric used and the type of intervention evaluated when measuring the efficiency of each dollar invested in a major health problem. However, it seems that, for LMICs, the RTI interventions are still competitive in comparison with other interventions. The same cannot be said for interventions in HICs.

3.3 Clustering the social impact strategies in Sustainable Development Goals (SDGs)

The last exercise that we perform is to group all 120 measures by their corresponding SDG (compare figures 11, 12, 13, and 14 with table 9). We can see that, for most of the SDGs, there is a big variation in the CE ratio of the different interventions and countries. To provide some comparison among SDGs we have calculated the median value for each SDG. As a result, we can see that goal 5.2 is the least competitive target, while goals 3.1, 3.2, 3.3, 3.7., 3.A, and 6 are the most affordable goals. When splitting the 120 interventions by the level of income of the related country or region we can see several relevant differences (see Figures 11, 12, and 14). For example, for the case of road traffic interventions, which correspond to SDG goals 3.6 and 11.2, we observe that the median estimated for LMICs is US$ 1,614/DALY while the median for HIC is US$ 24,527 /DALY. Therefore, the position of SDG target 3.6 improves from 8th to the 6th when only LMICs are considered (compare Figures 13 and 14). However, the estimated median for road traffic SDGs for LMICs stays under those of other SDGs, together with maternal and neonatal mortality (3.1 and 3.2), communicable diseases (3.3), reproductive health (3.7), tobacco use, and water and sanitation programs (6). These last five goals have the most cost-effective interventions.

4. Discussion

4.1 Limitations of the study

The main reasons for the outcome variability across countries are basic demographics, risk factors, infrastructure, and relative costs of interventions, in addition to big differences in the model employed in each study. Among the included studies there was a significant variation in how authors chose to report the CE-ratio of the analysis; using different perspectives, time horizons, discount rates, and sensitivity analyses. Even though relatively few studies met the inclusion criteria, the external validity of the included studies appears to be one of the biggest problems when it comes to comparing different CE evaluations.

Furthermore, the limited and relatively weak evidence regarding CE analysis of interventions to prevent RTIs can be explained by the scarcity of not only data on the incidence and prevalence of non-fatal injuries but also expert opinions related to both the severity and the duration of injury sequalae (Chisholm and Naci, 2008). This fact, in turn, makes it difficult to derive estimates of CE without building a model of the intervention and applying several assumptions, which can translate into large variations between outcomes.

Another limitation of the study is that, by limiting the review to include mainly studies on CE analysis using US$/DALY as the CE-ratio, an important percentage of economic evaluations of interventions with social impacts have been excluded.

4.2 Results and implications

Some patterns can be recognized for all the RTIs reviewed, especially by comparing them with other investment competing interventions. In particular, when actions on RTIs are either planned for or have been implemented in a "developing" country, where strong increases in traffic volume have not been followed by adequate development of road safety strategies, the interventions are mostly competitive in terms of cost per DALY. However, interventions must be adapted to local needs, which vary strongly across countries. On the other hand, based on what has been found in the literature, actions do not seem especially competitive when preventive interventions for RTIs are implemented in HICs. An important fact that must to be kept in mind is that estimates of what works best in a given country or region depend crucially on the underlying distribution of fatal crashes and non-fatal RTIs by road user group (pedestrians, bicyclists, motorcyclists, car occupants, and bus/lorry drivers and occupants), in addition to various risk factors that are the target for interventions (speeding, drunk driving, and not wearing seatbelts or helmets).

Most of the 141 interventions have focused on actions to reduce loss of life, independent of the metrics, in Sub-Saharan Africa and Asia. However, regarding the topics researched, most of the studies have evaluated the CE of interventions related to either infectious diseases or parasitic diseases, whereas injuries, gender violence, and environmental problems are underrepresented relative to the burden they

impose. This underrepresentation is particularly important in the case of RTIs, being the 6th leading cause of DALYs worldwide. Thus, these research patterns may reflect the priority setting of funding agencies.

CE is an aspect of central importance in the economic evaluation of public health interventions. However, regardless of the progress made in comprehending the epidemiology and the economic burden of RTIs, understanding of the long-term effects of RTIs remains inadequate, especially when the argument of long-term productivity loss acquires weight. One reason for the lack of injury prevention estimates is the lack of recognition of injuries as a public health problem, not only per se but also in relative terms with respect to other major problems that have a lower share of annually caused DALYs (as stated in Chapter 2).

Further, despite the numerous calls for methodological homogeneity when performing economic evaluations (e.g., Polinder et al., 2011), there is still an important need for regional standardized studies and metrics to improve future resource allocation effectiveness.

Finally, the authors of this review are aware that economic evaluations are not the only important criteria for policy choices, although they provide a useful and comprehensible reference point. Not only are costs extremely different across countries but also the impacts of the interventions differ substantially from country to country. Therefore, the conclusions of the current review should be interpreted only as an attempt to provide a "sense of priority" among social measures and not as a prescription tool on how to rationalize the allocation of public resources.

Notes

1. This literature review has representative meaning.
2. The 120 measures included for the main analysis are in terms of cost per DALY averted and are, therefore, roughly comparable.
3. The interventions have been grouped in terms of condition either treated or prevented, income level of the region, and related SDGs in an attempt to facilitate the graphical presentation and the analysis.

Appendix

Part I

Table of cost-effectiveness ratio DALY per intervention (n=120)

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.9, 7.1 and 12.2	Air pollution / Power Plant Intervention	72 FDG Plants to reduce SO2 Emissions from Power Plants	India	953 – 48010 (μ=5065)	2017	19
3.9, 7.1 and 12.2	Air-Pollution / Household Energy Intervention	Subsidies to transition to LPG fuel: Governmental LPG subsidies for all households + connection charges from corporate social responsibility funds to the 2 lowest quintiles	Haryana, India	24	2017	37
3.5	Alcohol Use	Alcohol advertising bans	Australia	1251	2009	18
3.5	Alcohol Use	Drink driving mass media	Australia	15195	2009	18
3.5	Alcohol Use	Alcohol licensing controls	Australia	2687	2009	18
3.5	Alcohol Use	Advertising Bans and reduced access to alcoholic beverage	High risk drinking regions: Europe, Central Asia, Latin America and Caribbean and Sub-Saharan Africa	174 - 363	2006	42
3.5	Alcohol Use	Tax increase by 25-50 percent	High risk drinking regions: Europe, Central Asia, Latin America and Caribbean and Sub-Saharan Africa	136 - 292	2006	42
3.5	Alcohol Use	Advertising Bans and reduced access to alcoholic beverage	Low Risk Drinking Regions: East Asia and the Pacific and South Asia	160 - 189	2006	42
3.5	Alcohol Use	Tax increase by 25-50 percent	Low Risk Drinking Regions: East Asia and the Pacific and South Asia	>3243	2006	42

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

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Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.4	Cardiovascular Disease (Prevention)	Combination drug treatment (Prevention), Treatment of acute myocardial infarction (AMI) and secondary prevention of IHD and stroke	Ethiopia	1082 - 10340	2016	52
3.4	Cardiovascular Disease (Treatment)	Drug therapy provided to subjects with a 20%, 10% and 5% global CVD risk	Argentina	3903 - 4916	2009	43
3.4	Cardiovascular Disease (Prevention)	Media Salt campaign, media smoking campaign, media cholesterol campaign	Vietnam	150	2010	5
3.4	Cardiovascular Disease (Prevention)	Program to reduce salt	Vietnam	208	2010	5
3.4	Cardiovascular Disease (Prevention)	Reducing salt in bread	Argentina	-1505	2009	43
3.4	Cardiovascular Disease (Prevention)	Tobacco cessation with bupropion	Argentina	59443	2009	43
3.4	Cardiovascular Disease (Prevention)	Mass media campaign to promote tobacco cessation	Argentina	593	2009	43
3.4	Cardiovascular Disease (Treatment)	Low dose inhaled corticosteroids for mild persistent asthma	SearD	2500	2012	49
3.4	Cardiovascular Disease (Treatment)	Treatment of SBP<160mmHg (Dominated Results)	Vietnam	86	2010	5
3.4	Cardiovascular Disease (Treatment)	Combination treatment of cholesterol	Vietnam	916 - 2040	2010	5
3.4	Cardiovascular Disease (Treatment)	High-cholesterol lowering therapy with statins	Argentina	76993	2009	43

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.4	Cardiovascular Disease (Treatment)	High blood pressure (HBP) lowering therapy $7,716	Argentina	8368	2009	43
3.4	Cardiovascular Disease (Treatment)	Low dose inhaled corticosteroids for mild persistent asthma	AfrE	2500	2012	49
3.3	Communicable Diseases (Prevention)	Integrated prevention campaign (IPC) against diarrhea (household water filters), malaria (bed-nets) and HIV (counseling, testing, cotrimoxazole prophylaxis, referral to treatment & condom distribution)	70 countries	7-16000	2014	33
3.3	Dengue	Improve community participation in vector control and ULV-spraying	Mexico	3953 - 4472	2017	36
3.3	Dengue	Universal childhood rotavirus vaccination with the newly developed ROTAVAC vaccine in national Expanded Programme of Immunization	Bangladesh	728 - 740	2017	44
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	EmrD	100 - 887	2007	17
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	AfrD	59-529	2007	17
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	AmrB	950-8495	2007	17
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	AmrD	242-2153	2007	17
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	EmrB	650-5826	2007	17
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	SearB	516-4531	2007	17

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	SearD	71 - 1424	2007	17
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	WprB	541 - 5957	2007	17
3.9 and 6.3	Diarrheal diseases	Source- and household-based interventions to improve water quality	EurB	1133 - 11172	2008	17
3.9 and 6.1	Diarrheal diseases	Key diarrhea interventions (oral rehydration salts [ORS], zinc, antibiotics for dysentery, rotavirus vaccine, vitamin A supplementation, basic water, sanitation, hygiene, and breastfeeding)	LMIC (68 high child mortality countries)	432 - 648	2011	53
3.9 and 6.2	Diarrheal diseases	Source- and household-based interventions to improve water quality	AfrE	68 - 602	2007	17
3.1 and 3.2	Drowning	Anchal / direct supervision of children ages 1-5 years at child care center near bodies of water	Bangladesh	854	2012	39
3.1	Drowning	Anchal/SwimSafe Combined	Bangladesh	381	2012	39
3.1	Drowning	SwimSafe / teaching children 4-12 years about swimming, safety and rescue others from drowning	Bangladesh	89	2012	39
3.3	Hepatitis B	Universal vaccination Hepatitis B	Democratic People's Republic of Korea	267	2017	31
3.3	HIV/AIDS (Prevention)	Educational programs for high-risks groups	LMIC	1 - 99	2007	41
3.3	HIV/AIDS (Prevention)	Voluntary testing and counseling	LMIC	19 - 348	2006	42

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.3	HIV/AIDS (Prevention)	Social marketing and distribution of condoms	LMIC	25 - 273	2008	42
3.3	HIV/AIDS (Prevention)	Improve blood and needle safety	LMIC	5 - 68	2009	42
3.3	HIV/AIDS (Treatment)	Antiretroviral	LMIC	467 - 6667	2006	42
3.3	HPV	HPV Vaccination	Honduras	1051	2015	3
3.3	Influenza	Maternal influenza immunization program	Mali	857	2017	35
5.2	Intimate Partner Violence	Microfinance and gender training (scale-up period)	South Africa	2804	2011	25
5.2	Intimate Partner Violence	Microfinance and gender training (trial)	South Africa	9344	2011	25
3.3	Malaria	Microbial larvidicing	Tanzania	43 - 545	2014	32
3.3	Malaria	Malaria Treatment	Sub-Saharan Africa	41 - 133	2017	40
3.1 and 3.2	Malnutrition	Mothers nutrition package	LMIC / 34 countries	1100	2013	8
3.1 and 3.2	Malnutrition	Comprehensive Child Nutrition intervention—micronutrients, nutrition education with selected supplements regarding infant and young child feeding, and Community Management for Severe Acute Malnutrition	LMIC / 34 countries	240-340	2013	8

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.1 and 3.2	Malnutrition	Community-based management of acute malnutrition	Malawi	52	2012	54
3.1 and 3.2	Maternal and Child Mortality	Labor care + neonatal care package	SearD	27-21125	2005	2
3.1 and 3.2	Maternal and Child Mortality	Labor care + neonatal care package	AfrE	8-223	2005	2
3.1 and 3.2	Maternal and Child Mortality	Safe motherhood initiatives (a package combining antenatal and postpartum care with trained birth attendants, potentially in a health facility)	Afghanistan	153 - 1021	2013	21
3.1	Maternal Mortality	Stepwise improvements in family planning and safe abortion with consecutively implemented strategies	India	569	2010	22
3.2	Neonatal Mortality	Participatory Learning - Neonatal mortality	India	77	2017	29
3.4	Non-Communicable diseases (Treatment and Prevention)	Combination of health education through mass media programmes, legislation with food industry, detection and treatment of high risk individuals based on blood pressure, serum cholesterol, and absolute risk thresholds	Mexico	2344	2012	48
3.7	Reproductive Health - Contraception	Compare the incremental cost-effectiveness of a hypothetical new contraceptive program (NCP) that would achieve universal access to modern contraceptives in Uganda, to the current contraceptive program (CCP), i.e., the status quo in which access to modern contraception is limited	Uganda	200 - 500	2012	7
3.6 and 11.2	Road Traffic	Traffic Patrols enforcement	Uganda	709	2008	10

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

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Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.4	Road Traffic Injuries	Evocative messages in matatus or minibuses to reduce road accidents	Kenya	10 - 45	2015	24
3.6 and 11.2	Road Traffic Injuries	Breath-testing	WprB	10708	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed Bumps of most dangerous junctions (requires the identification of such intersections)	LMIC	12	2006	9
3.6 and 11.2	Road Traffic Injuries	Bicycle helmet, even for motorcycle	LMIC	139	2006	9
3.6 and 11.2	Road Traffic Injuries	Motorcycle helmet legislation in East Asia	LMIC	721	2006	9
3.6 and 11.2	Road Traffic Injuries	Childproof containers for paraffin	LMIC	79	2006	9
3.6 and 11.2	Road Traffic Injuries	Enhanced speeding control	LMIC	83	2006	9
3.6 and 11.2	Road Traffic Injuries	Breath-testing	AMrA	13610	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed cameras + Breath-testing + Motorcycle helmets	AMrA	16514	2008	15
3.6 and 11.2	Road Traffic Injuries	Seatbelts + Speed cameras + Breath-testing + Motorcycle helmets	AMrA	18667	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed limits, Drink-drive laws, seat belt use, breath-testing, motorcycle helmets	AMrA	26827	2008	15

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.6 and 11.2	Road Traffic Injuries	Speed cameras + Breath-testing + Motorcycle helmets	SearD	1445	2008	15
3.6 and 11.2	Road Traffic Injuries	Seatbelts + Speed cameras + Breath-testing + Motorcycle helmets	SearD	1614	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed limits, Drink-drive laws, seat belt use, breath-testing, motorcycle helmets	SearD	1856	2008	15
3.6 and 11.2	Road Traffic Injuries	Breath-testing	SearD	3190	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed cameras + Breath-testing + Motorcycle helmets	WprB	4838	2008	15
3.6 and 11.2	Road Traffic Injuries	Seatbelts + Speed cameras + Breath-testing + Motorcycle helmets	WprB	5314	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed limits, Drink-drive laws, seat belt use, breath-testing, motorcycle helmets	WprB	7763	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed cameras + Breath-testing + Motorcycle helmets	Afr E	1557	2008	15
3.6 and 11.2	Road Traffic Injuries	Seatbelts + Speed cameras + Breath-testing + Motorcycle helmets	Afr E	1607	2008	15
3.6 and 11.2	Road Traffic Injuries	Speed limits, Drink-drive laws, seat belt use, breath-testing, motorcycle helmets	Afr E	1972	2008	15
3.6 and 11.2	Road Traffic Injuries	Breath-testing	Afr E	2612	2008	15
3.6 and 11.2	Road Traffic Injuries	Enforcement of speed limits via mobile speed cameras	Southeast Asia	1868	2012	16

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.6 and 11.2	Road Traffic Injuries	Drink-drive legislation and enforcement via breath testing campaigns	Southeast Asia	3210	2012	16
3.6 and 11.2	Road Traffic Injuries	Seatbelt use in cars	Southeast Asia	2941	2012	16
3.6 and 11.2	Road Traffic Injuries	Motorcycle helmet use	Southeast Asia	1994	2012	16
3.6 and 11.2	Road Traffic Injuries	Bicycle helmet use	Southeast Asia	4324	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras + drink-drive legislation	Southeast Asia	1691	2012	16
3.6 and 11.2	Road Traffic Injuries	Seatbelt use + motorcycle helmet use	Southeast Asia	2632	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras+ drink-drive legislation + seatbelt use	Southeast Asia	1534	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras+ drink-drive legislation + motorcycle helmet use	Southeast Asia	1454	2012	16
3.6 and 11.2	Road Traffic Injuries	Seatbelt use + drink-drive legislation + motorcycle helmet use	Southeast Asia	2256	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras + seatbelt use + motorcycle helmet use	Southeast Asia	1725	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras + drink-drive legislation + seatbelt use + motorcycle helmet use	Southeast Asia	1388	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras+ drink-drive legislation + seatbelt use + motorcycle helmet use + bicycle helmet use	Southeast Asia	1625	2012	16

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.6 and 11.2	Road Traffic Injuries	Drink-drive legislation and enforcement via breath testing campaigns	Sub-Saharan Africa	2629	2012	16
3.6 and 11.2	Road Traffic Injuries	Seatbelt use in cars	Sub-Saharan Africa	5383	2012	16
3.6 and 11.2	Road Traffic Injuries	Motorcycle helmet use	Sub-Saharan Africa	7857	2012	16
3.6 and 11.2	Road Traffic Injuries	Bicycle helmet use	Sub-Saharan Africa	1450	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras + drink-drive legislation	Sub-Saharan Africa	1653	2012	16
3.6 and 11.2	Road Traffic Injuries	Seatbelt use + motorcycle helmet use	Sub-Saharan Africa	6433	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras+ drink-drive legislation + seatbelt use	Sub-Saharan Africa	1743	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras+ drink-drive legislation + motorcycle helmet use	Sub-Saharan Africa	1567	2012	16
3.6 and 11.2	Road Traffic Injuries	Seatbelt use + drink-drive legislation + motorcycle helmet use	Sub-Saharan Africa	3204	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras + seatbelt use + motorcycle helmet use	Sub-Saharan Africa	2488	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras + drink-drive legislation + seatbelt use + motorcycle helmet use	Sub-Saharan Africa	1679	2012	16
3.6 and 11.2	Road Traffic Injuries	Enforcement speed limits via mobile speed cameras+ drink-drive legislation + seatbelt use + motorcycle helmet use + bicycle helmet use	Sub-Saharan Africa	1618	2012	16

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.6 and 11.2	Road Traffic Injuries	Enforcement of speed limits via mobile speed cameras	Sub-Saharan Africa	1961	2012	16
3.6 and 11.2	Road Traffic Injuries	Media	Thailand	301	2013	20
3.6 and 11.2	Road Traffic Injuries	Checkpoint and media	Thailand	303	2013	20
3.6 and 11.2	Road Traffic Injuries	Breathing test (selective) and media	Thailand	370	2013	20
3.6 and 11.2	Road Traffic Injuries	Breathing test (selective)	Thailand	379	2013	20
3.6 and 11.2	Road Traffic Injuries	Breathing test (random) and media	Thailand	394	2013	20
3.6 and 11.2	Road Traffic Injuries	Breathing test (random)	Thailand	417	2013	20
3.6 and 11.2	Road Traffic Injuries	Traffic safety enforcement: Interventions to increase the prevalence of seat belt use in high-income countries (enhanced training and enforcement practices along with raising of public awareness)	China	476	2008	50
3.9 and 6.1	Rotavirus	Rotavirus vaccination with monovalent (RV5) vaccine at 2, 4 & 6 months	Albania	3630	2015	4
3.9 and 6.1	Rotavirus	Live oral pentavalent rotavirus vaccine (RotaTeq $5.00 price per dose)	Ghana	67	2012	1
3.3	Syphilis	ICS syphilis screening, penicillin treatment in 43 countries in Sub-Saharan Africa	Sub-Saharan Africa	1 - 442	2013	30

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Related SDG[1]	Condition	Intervention evaluated	Country or Region[2]	Cost per DALY saved (US$ 2012)[3]	Year of Study	Reference
3.A	Tobacco Use	Taxes: policy to increase cigarette prices by 33 percent	LMIC	4-253	2006	42
3.A	Tobacco Use	Nonprice interventions, including	LMIC	70 - 874	2006	42
3.A	Tobacco Use	Nicotine replacement therapy	LMIC	71 - 97	2006	42
3.3	Tuberculosis	Tuberculosis (TB) screening and isoniazid preventive therapy (IPT) among human immunodeficiency virus (HIV) infected adults	Brazil	2273	2014	6
6.1, 6.2 and 3.7	Water Supply and Sanitation	Point of use water filters or HIV people	Uganda	106	2013	28
6.1, 6.2 and 3.3	Water Supply and Sanitation	Water Supply (Hand pump or stand post)	LMIC	125	2006	12
6.1, 6.2 and 3.3	Water Supply and Sanitation	Water Supply (Water sector regulation and advocacy)	LMIC	297	2006	12
6.1, 6.2 and 3.3	Water Supply and Sanitation	Water Supply (House connection)	LMIC	63	2006	12
6.1, 6.2 and 3.3	Water Supply and Sanitation	Basic Sanitation (Construction and promotion)	LMIC	360	2006	12
6.1, 6.2 and 3.3	Water Supply and Sanitation	Basic Sanitation (Hygiene promotion)	LMIC	5	2006	12
6.1, 6.2 and 3.7	Water Supply and Sanitation	Improved water among those affected by HIV	Uganda	1522	2006	46

[1] See Table 7
[2] See definitions of WHO Regions in footnote page 10
[3] The values are PPP and US$ inflation adjusted respectively, see original values in reference list

Appendix

Part II

Table 1: Global Health Estimates 2015

Rank	Cause	DALYs (000s)	% DALYs
0	All Causes	2.668.296	100,0
1	Ischemic heart disease	192.056	7,2
2	Lower respiratory infections	142.384	5,3
3	Stroke	139.874	5,2
4	Preterm birth complications	102.297	3,8
5	Diarrheal diseases	84.928	3,2
6	Road injury	76.020	2,8
7	Chronic obstructive pulmonary disease	72.815	2,7
8	Diabetes mellitus	70.667	2,6
9	Birth asphyxia and birth trauma	67.266	2,5
10	Congenital anomalies	64.825	2,4
11	HIV/AIDS	62.759	2,4
12	Tuberculosis	56.037	2,1
13	Depressive disorders	54.215	2,0
14	Iron-deficiency anemia	52.080	2,0
15	Back and neck pain	52.016	1,9
16	Cirrhosis of the liver	41.486	1,6
17	Trachea, bronchus, lung cancers	41.129	1,5
18	Malaria	38.520	1,4
19	Kidney diseases	38.104	1,4
20	Self-harm	37.672	1,4

Source: World Health Organization, global burden diseases estimates

Table 2: Trend 1990-2016 of selected leading causes of DALYs: % DALYs and DALYs (100s)

	1990	2000	2007	2016
HIV/AIDS	**0.7**	**3.2**	**4.0**	**2.4**
	161,549	810,066	1,001,336	575,753
Road Injuries	**2.6**	**2.9**	**3.1**	**3.0**
	647,884	719,551	747,861	713,950
CDV	**10.9**	**12.2**	**13.1**	**14.8**
	2,667,096	3,081,633	3,232,244	3,531,209
Neonatal Birth Complications	**4.6**	**3.6**	**3.3**	**2.6**
	1,127,672	909,350	800,007	620,316
All Causes	**100**	**100**	**100**	**100**
	24,484,306	25,154,992	24,806,824	23,912,582

Source: Institute for Health Metrics and Evaluation (IHME), Global Burden Diseases (GBD)

Table 3: % of Road Traffic Injuries (RTI) as DALYs leading cause, by development level

	1990	2000	2007	2016
Low SDI	1.4	1.4	1.7	2
Low-middle SDI	1.6	2.0	2.3	2.7
Middle SDI	3.7	4.3	4.4	4.1
High-middle SDI	4.0	4.0	4.1	3.4
High	3.7	3.1	2.6	2.1
Global	2.6	2.8	3.1	3.0

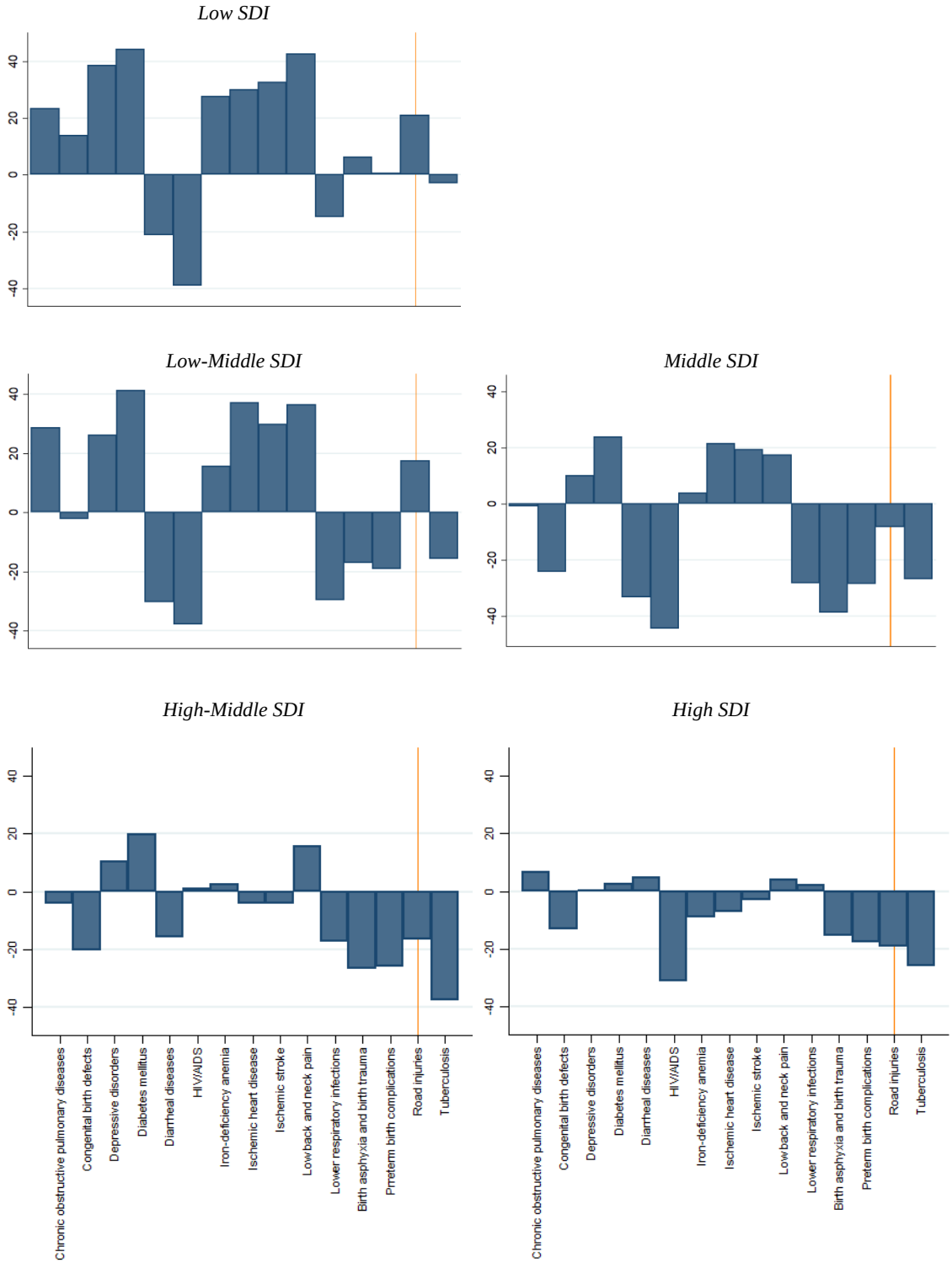
SDI: Sociodemographic Index, Source: Institute for Health Metrics and Evaluation (IHME), Global Burden Diseases (GBD)

Table 4: Global and regional DALYs provoked by RTIs in 2016

	% of Road traffic DALYs	DALYs (000s)
High income	8,2	58,674
Low-and-middle income	91,8	655,276
Global	100	713,950

Source: Institute for Health Metrics and Evaluation (IHME), Global Burden Diseases (GBD)

Figure 1: Percentage change of DALY share 2006-2016 by cause and SDI-level



Source: Institute for Health Metrics and Evaluation (IHME), Global Burden Diseases (GBD)

Figure 2: Distribution of Interventions by DALYs per US$ as Cost-effectiveness ratio (n=120)

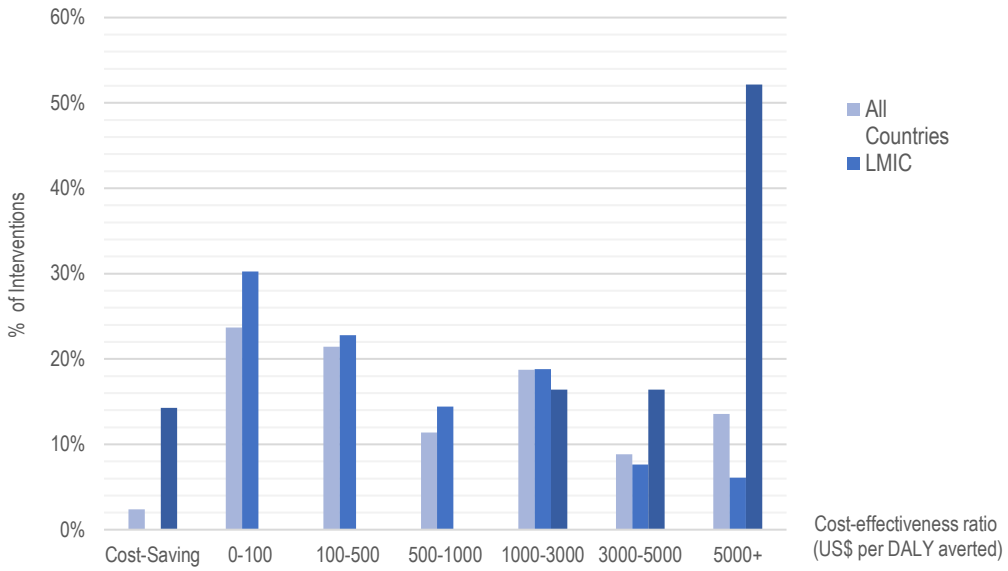
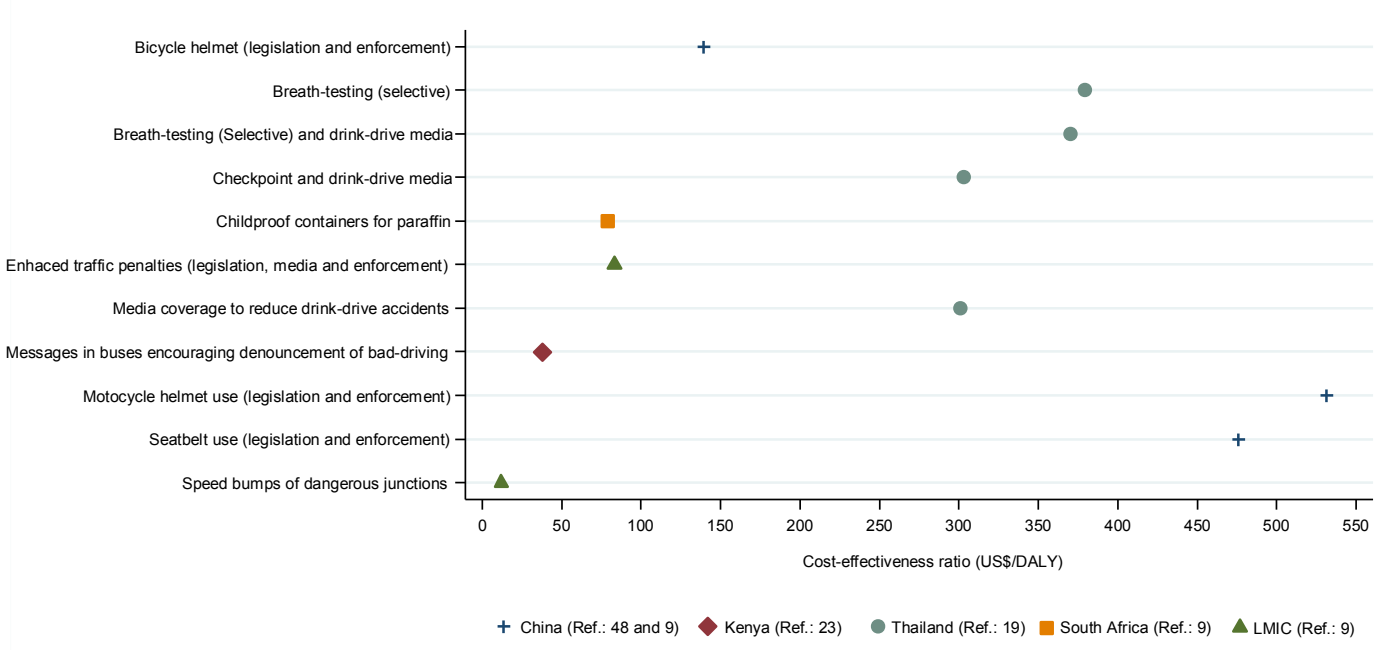
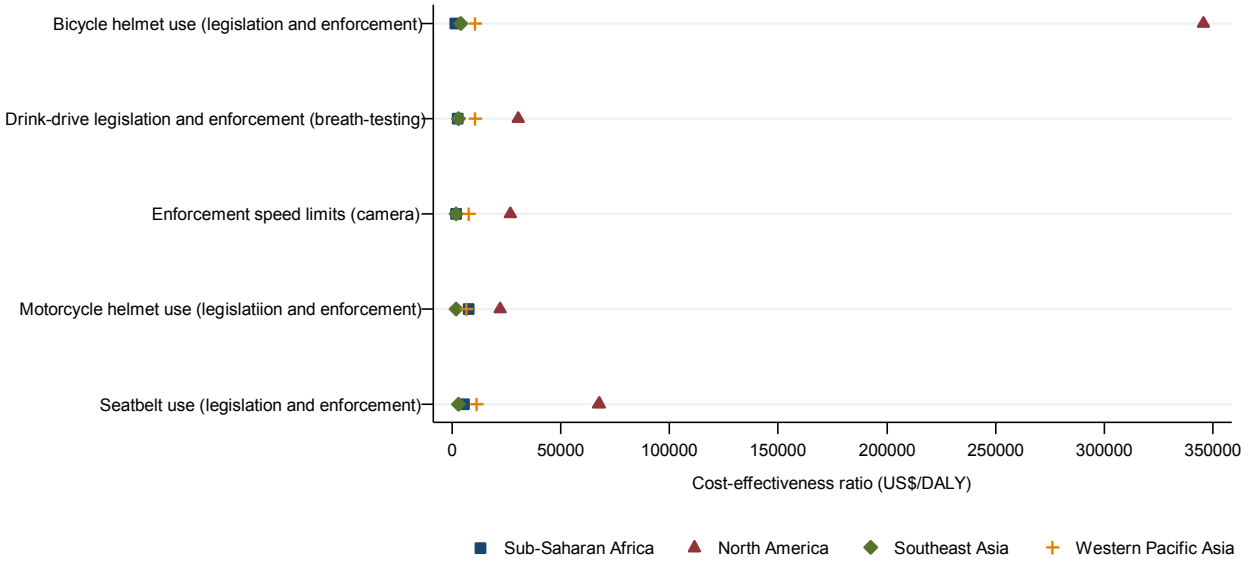


Figure 3: Summary of RTIs cost-effectiveness by country (n=11)



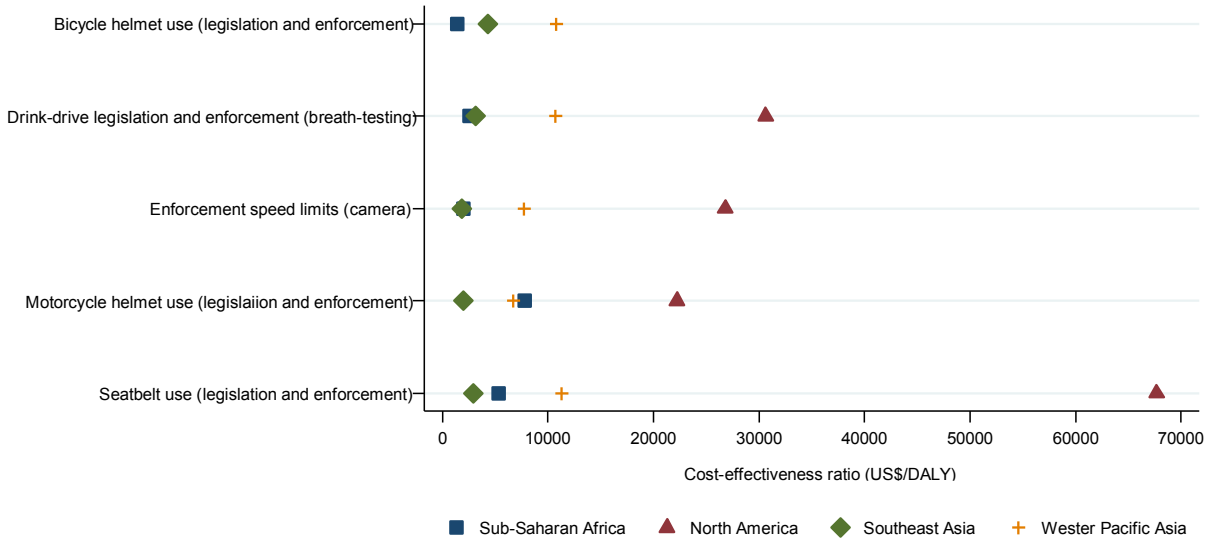
Source: Reference nº 9, 19, 23 and 48

Figure 4: Summary of single RTIs cost-effectiveness ratio by WHO-Regions (n=20)



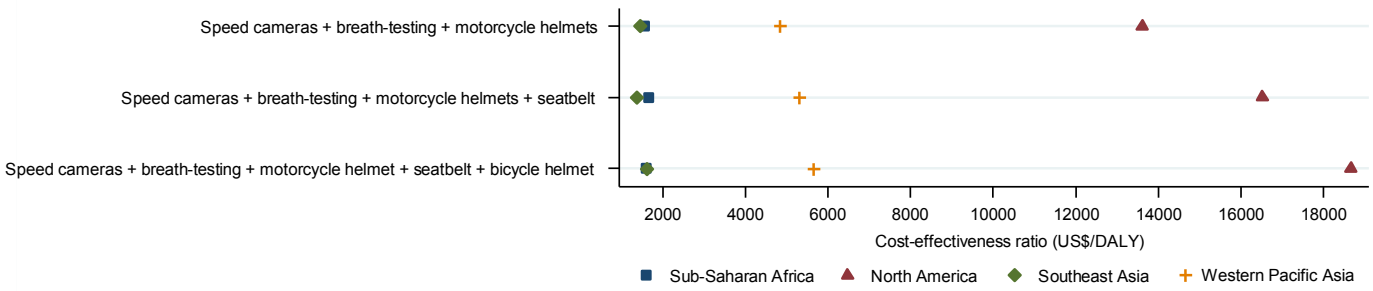
Source: Reference nº 14

Figure 5: Summary of single RTIs cost-effectiveness by WHO-Regions, without outlier (n=19)



Source: Reference nº 14

Figure 6: Summary of combinated RTIs cost-effectiveness ratio WHO-Regions (n=12)



Source: Reference nº 14

Table 5: RTI Interventions with cost-benefit ratio

Condition	Interventions evaluated	Country or Region	Year	CB-ratio
Road Traffic - Vehicle related	4 or 5 stars in EueroNCAP	Norway	2007	1,24
Road Traffic - Enforcement related	Speed Enforcement	Norway	2007	1,49
Road Traffic - user related	Speed Enforcement	Norway	2007	1,85
Road Traffic - Road related	Road Lightening	Norway	2007	1,94
Road Traffic - Vehicle related	Design of Car front to protect pedestrians	Norway	2007	1,95
Road Traffic - Vehicle related	ISA (intelligence speed adaptation), system that prevents the driver from exceeding the speed limit	Norway	2007	1.95
Road Traffic - Enforcement related	Speed Cameras	Norway	2007	2,11
Road Traffic - Vehicle related	Event Recorders	Norway	2007	2,15
Road Traffic - Enforcement related	Feedback signs for speed	Norway	2007	2,35
Road Traffic - Enforcement related	Seat belt enforcement	Norway	2007	2,44
Road Traffic - Enforcement related	Law requiring pedestrian's reflective devices	Norway	2007	3,49
Road Traffic - Vehicle related	Electronic Stability Control	Norway	2007	3,98
Road Traffic - Enforcement related	Alcolock for drivers convicted of drink-driving	Norway	2007	8,75
Road Traffic - Vehicle related	Enhanced neck injury protection	Norway	2007	20,25
Road Traffic - Vehicle related	Seat Belt reminders	Norway	2007	16,21

Source: Reference nº 54

Figure 7: Cost-effectiveness ratio by condition for LMICs (n=98)

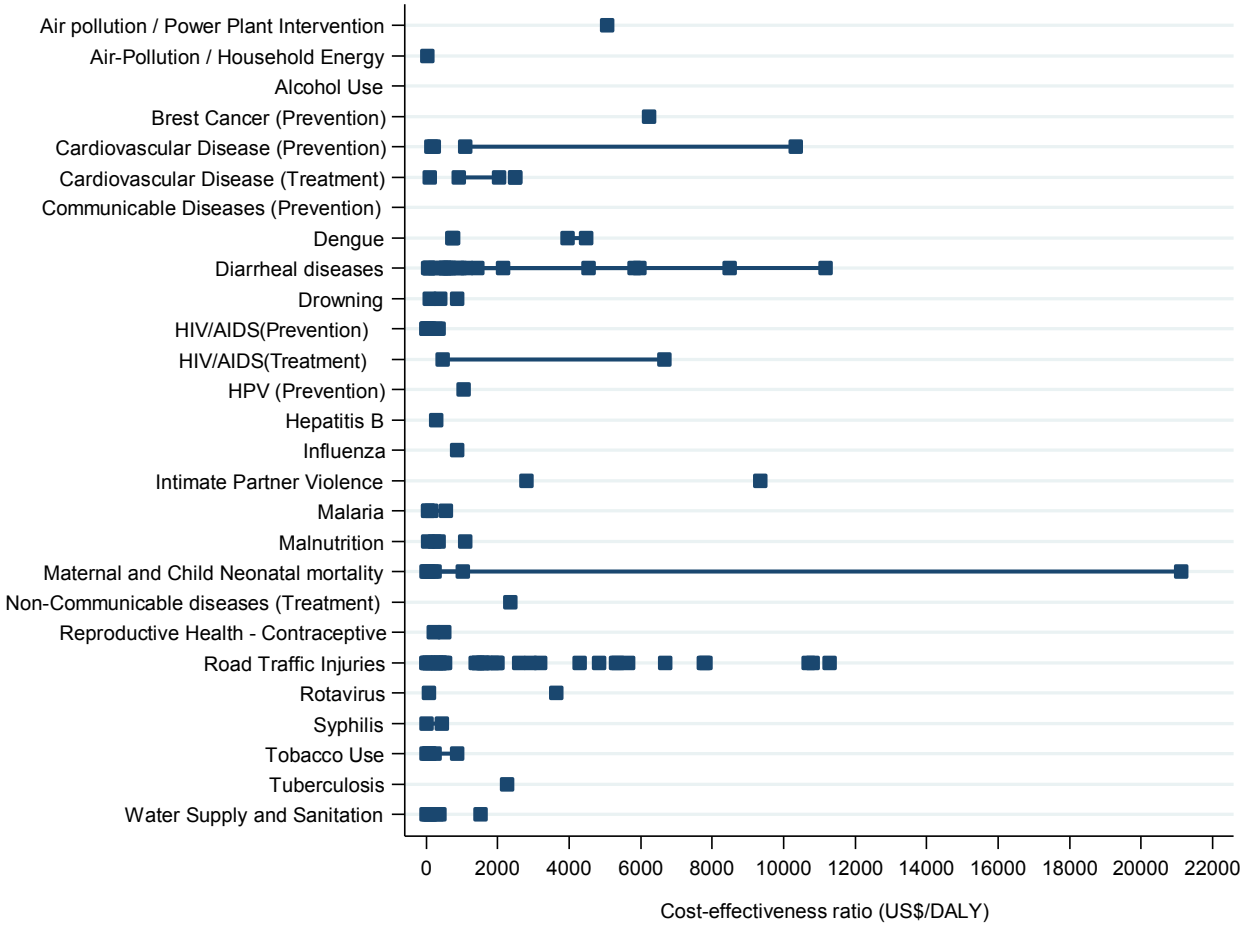


Figure 8: Cost-effectiveness ratio by condition for HICs (n=17)

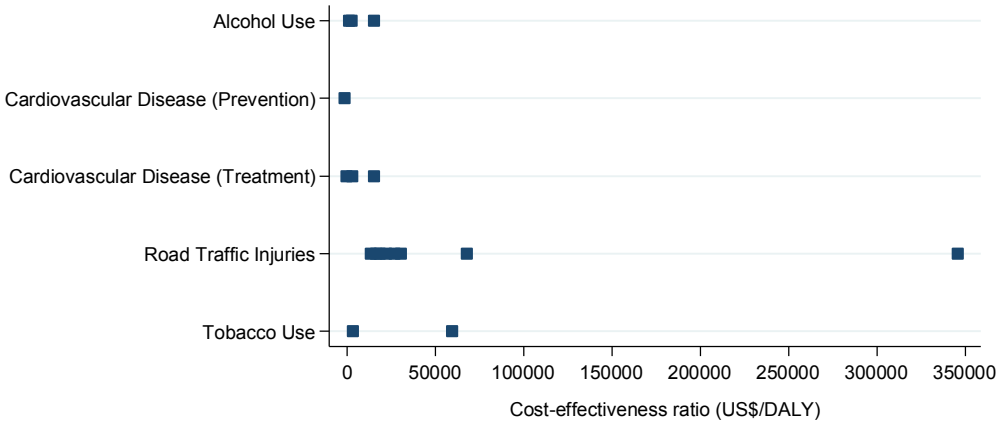


Figure 9: Median of cost-effectiveness per condition (n=120)

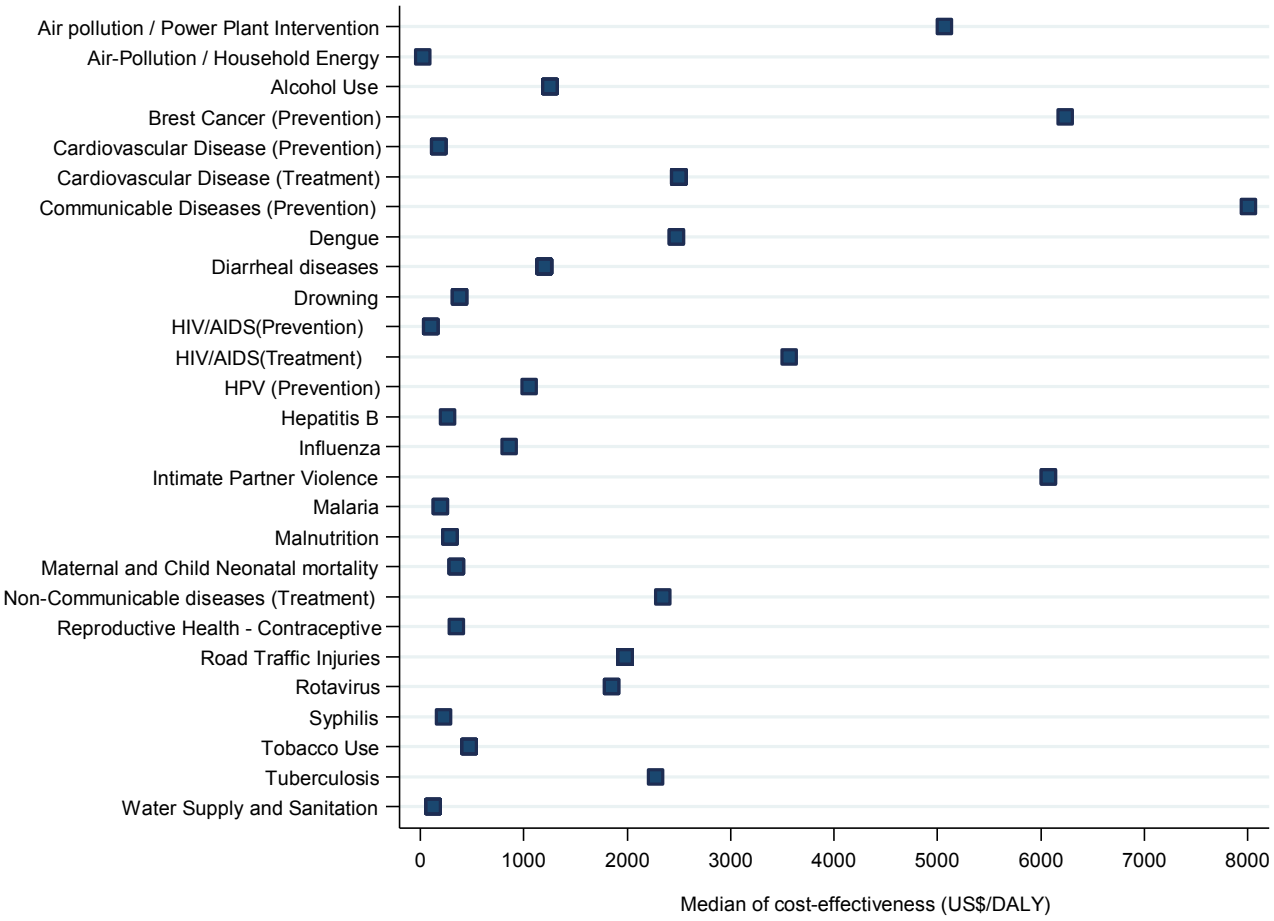
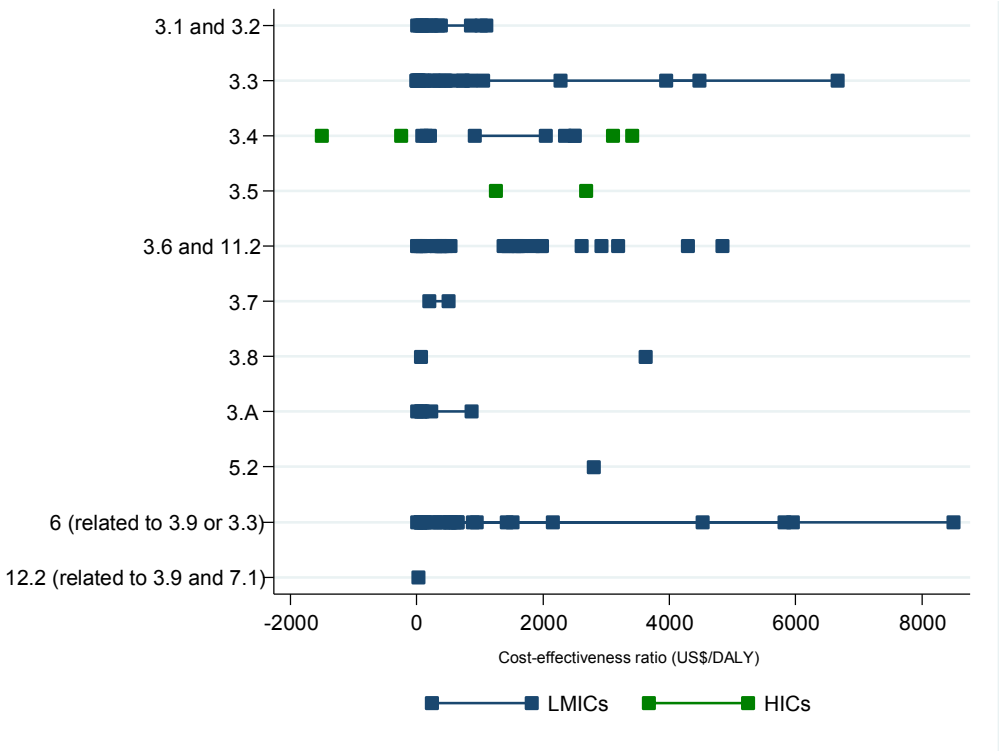


Table 6: Summary by sector and type of intervention reporting median

		Type of Intervention				
		Health Treatment	*Health Prevention*	*Toxin Control*	*Injury Reduction*	*All*
Sector of Intervention	*Clean Energy*	N/A	N/A	$2545 (n=2)	N/A	$2545 (n=2)
	Communicable Diseases	$258 (n=4)	$637 (n=14)	N/A	N/A	$417 (n=18)
	Gender Equality	N/A	$6074 (n=2)	N/A	N/A	$336 (n=8)
	Injury	N/A	N/A	N/A	$1914 (n=48)	$1914 (n=48)
	Maternal and Child Health	$320 (n=4)	$352 (n=4)	N/A	N/A	$320 (n=8)
	Non-Communicable Diseases	$2500 (n=9)	$862 (n=16)	N/A	N/A	$1478 (n=25)
	Water Supply and Sanitation	N/A	$494 (n=17)	N/A	N/A	$494 (n=17)
	All	$350 (n=17)	$587 (n=53)	$2545 (n=2)	$1914 (n=48)	$1315 (n=120)

Figures 11 and 12: Interventions Cost-Effectiveness ratio by assigned Sustainable Development Goals, SDG and income level (see Table 8, n=120)

a) Included Interventions have a mean <5000 US$/DALY



b) Included Interventions have a mean >5000 US$/DALY

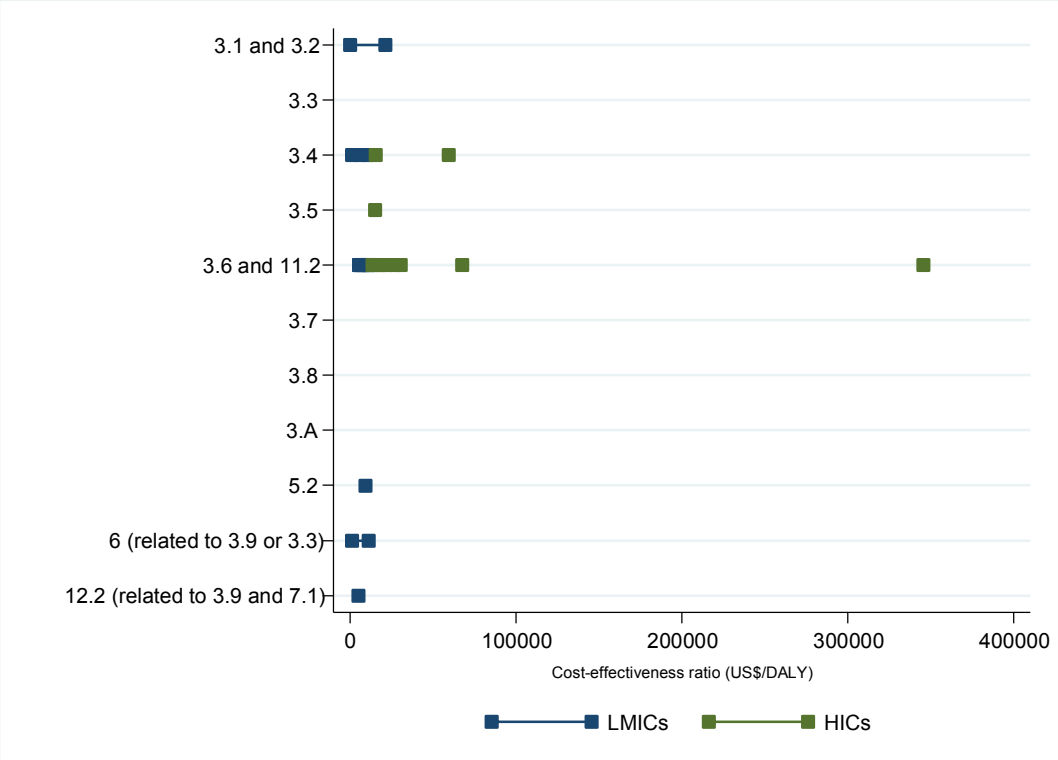


Figure 13: Median Cost-effectiveness by assigned SDG (see Table 8, n=120)

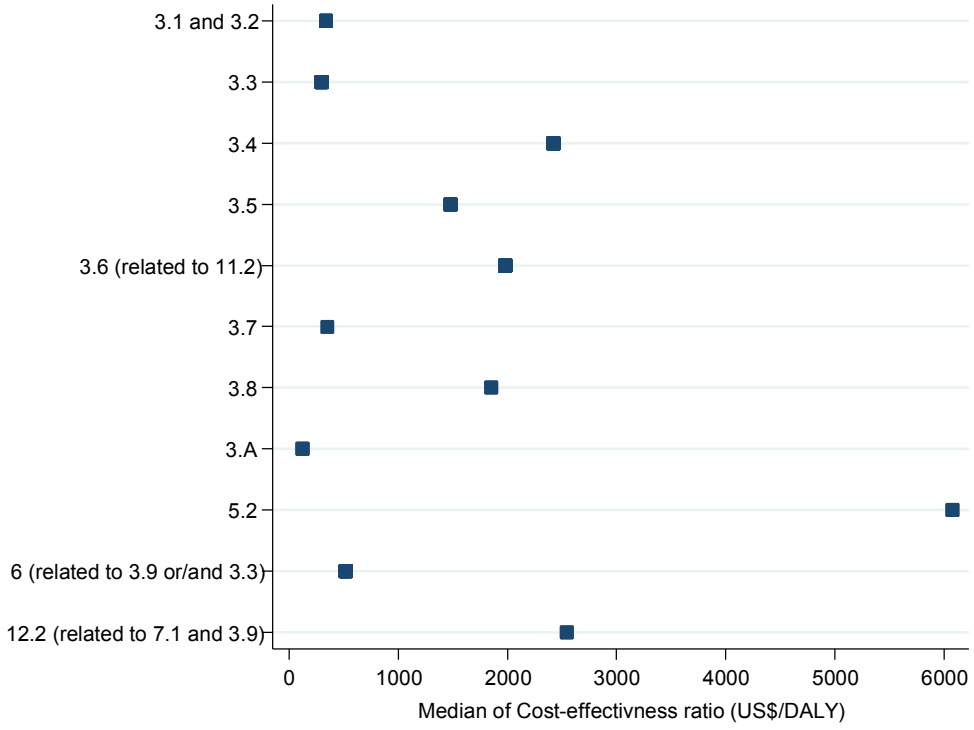


Figure 14: Median Cost-Effectiveness by assigned SDG and income level (see Table 8, n=115)

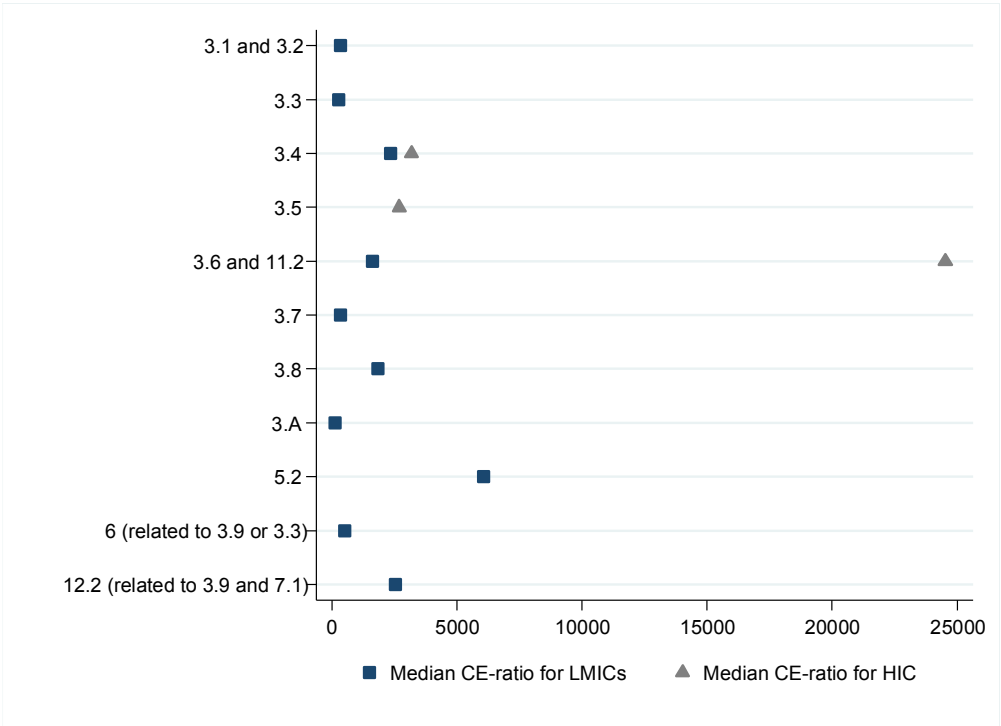


Table 7: specific targets and goals of assigned SDGs

Goals		*Targets*	
3	Ensure healthy lives and promote well-being for all at all ages	3.1	By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births
		3.2	By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births
		3.3	By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases
		3.4	By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being
		3.5	Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol
		3.6	By 2020, halve the number of global deaths and injuries from road traffic accidents
		3.7	By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programs
		3.9	By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
		3.A	Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate
		3.B	Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all
5	Achieve gender equality and empower all women and girls	5.2	Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation
6	Ensure availability and sustainable management of water and sanitation for all	6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all
		6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
7	Ensure access to affordable, reliable, sustainable and modern energy for al	7.1	By 2030, ensure universal access to affordable, reliable and modern energy services
11	Sustainable cities and communities	11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons
12	Responsible consumption and production	12.2	By 2030, achieve the sustainable management and efficient use of natural resources

Source: United Nations, Sustainable Development Goals (http://www.un.org/sustainabledevelopment/sustainable-development-goals)

Table 8: Interventions with Life Year (LY) as cost-effectiveness ratio

Condition	Interventions evaluated	Country or Region	Year	US$ per LY	Reference
Road Traffic	Traffic Patrols enforcement	Uganda	2008	312	10
Maternal Mortality	Family planning and safe abortion, increased skilled attendants, improved antenatal/postpartum care.	India	2010	569	20
Child mortality /Water Supply and Sanitation	Improved water/sanitation	70 LMIC countries	2011	3633 (823 - 8039)	22
Child mortality /Water Supply and Sanitation	Privately piped water and flush toilets in other developing countries	70 LMIC countries	2011	3530 (856 - 9086)	22
Water Supply and Sanitation	Privately piped water and flush toilets	70 LMIC countries	2011	1102 (554-2192)	22
Water Supply and Sanitation	Basic improved water and sanitation	70 LMIC countries	2011	1222 (663-2550)	22
Neonatal Mortality	New hints intervention / Home visits of trained community members	Ghana	2016	377	37
Brest Cancer (Prevention)	Brest Exam	India	2005	716- 1001	40
Brest Cancer (Prevention)	Mammography	India	2006	1170 - 2396	40
Cancer Various (treatment)	Various	USA	2006	1686 - 20754	40

Table 9: Interventions with Quality Adjusted Life Year (QALY) as cost-effectiveness ratio

Condition	Interventions evaluated	Country or Region	Year	US$ per QALY	Reference
Water Supply and Sanitation	Centralized water treatment system	South Africa	2011	47	13
Water Supply and Sanitation	Point of use water filters	South Africa	2011	84	13
Road Traffic	Neighborhood slow zones	USA, New York City	2017	46832	25
Cervical Cancer (Prevention)	HPV vaccination of females, particularly routine vaccination of 12-year-old girls in combination of a catch-up vaccination of 12 to 26-year-old women	Brazil	2012	224	26
Cervical Cancer (Prevention)	HPV routine vaccination of 12-year-old girls in combination of a catch-up vaccination of 12 to 26-year-old women	Brazil	2012	459	26
Cervical Cancer (Prevention)	HPV Vaccination against Cervical Cancer	Italy	2017	13713 (universal) 5875 (just girls)	43
Depression	Psychotherapy with booster sessions	Uganda	2008	1178	45
Chronic obstructive pulmonary disease	Umeclidinium/vilanterol combination therapy	UK	2015	804 - 24875	49

Table 10: Interventions with death averted saved as cost-effectiveness ratio

Condition	Interventions evaluated	Country or Region	Year	US$ per death averted	Reference
Road Traffic	Traffic Patrols enforcement	Uganda	2008	709	10
Lack of Hygiene	Hygiene promotion	Burkina Faso	2002	905	11
Road Traffic	Helmet Policy	Vietnam	2016	11000* (800 non-fatal injury)	33

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