

Health and Economic Impact of Health Warnings and Plain Tobacco Packaging in Seven Latin-American Countries: Results of a Simulation Model

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Introduction: The burden of disease attributable to tobacco use in Latin America is very high. Our objective was to evaluate the 10-year potential impact of current legislation related to cigarette packaging and warnings and expected effects of moving to a higher level of strategies implementing cigarette plain packaging on health and cost outcomes in Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, and Peru, using a microsimulation model.

Methods: We used a probabilistic state-transition microsimulation model, considering natural history, costs and quality of life losses associated with main tobacco-related diseases. We followed up individuals in hypothetical cohorts and calculated health outcomes annually to obtain aggregated long-term population health outcomes and costs. We performed a literature review to estimate effects, and analysed studies and information from ministries, relevant organizations, and national surveys. We calibrated the model comparing the predicted disease specific mortality rates with local statistics.

Results: Current graphic warnings already in place in each country could avert, over 10 years, 69,369 deaths and 638,295 disease events, adding 1.2 million years of healthy life and saving USD 5.3 billion in the seven countries. If these countries implemented plain packaging strategies, additional 155,857 premature deaths and 4,133,858 events could be averted, adding 4.1 million healthy years of life and saving USD 13.6 billion in direct healthcare expenses of diseases attributable to smoking.

Conclusion: Latin American countries should not delay the implementation of this strategy that will alleviate part of the enormous health and financial burden that tobacco poses on their economies and healthcare systems.

Implications:

Tobacco smoking is the single most preventable and premature mortality cause in the world. The Framework Convention on Tobacco Control, supported by the World Health Organization, introduced a package of evidence-based measures for tobacco control. This study adds evidence on the potential health effects and savings of implementing cigarette plain packaging in countries representing almost 80% of Latin American population; findings are valuable resources for policy makers in the region.

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INTRODUCTION

Tobacco smoking is the single most preventable, premature mortality cause in the world, with about six million deaths every year.^{1,2} Globally, the amount of healthcare expenditure for smoking-attributable diseases surpasses USD 400 billion, and the economic cost of smoking represents USD 1,436 billion; about 40% of this cost corresponds to low- and middle-income countries.³ In Latin America, the annual consumption of tobacco per person is estimated 160 to 2,000 cigarettes with a prevalence between 6.4% and 35.2%.⁴

Due to the increasing smoking-related health costs and the high toll of smoking-attributable diseases, several interventions to counter chronic diseases' risk factors have been prioritised as “best buys” by World Health Organization (WHO), meaning they could favourably and efficiently improve population health.^{5,6} In 2007, WHO promoted the Framework Convention on Tobacco Control (FCTC) that included six evidence-based measures, referred as MPOWER for its acronyms; measures were Monitoring tobacco use and tobacco control measures; Protecting people from tobacco smoke; Offering help to quit tobacco; Warning people about the dangers of tobacco; Enforcing bans on tobacco advertising, promotion and sponsorship; and Raising tobacco taxes.⁷ Although many MPOWER strategies have been implemented in various countries, with almost 3 billion people now covered by at least one measure at its highest level of achievement, their application in Latin America has encountered several barriers as a result of the heterogeneity in target populations and public health policies in the region, as well as to tobacco industry interference through aggressive lobbying, litigation against policies, or misinterpretation of scientific evidence, among other tactics.⁸

The concept of plain packaging (sometimes referred to as standardized packaging) is defined as those “measures to restrict or prohibit the use of logos, colours, brand images or promotional information on packaging other than brand names and product names displayed in a standard colour and font style (plain packaging)”.^{9,10} Plain packaging pursues reducing the attractiveness of tobacco products, eliminating the effects of tobacco packaging as a form of advertising and promotion, addressing design techniques directed to show that some

products are less harmful than they really are, and increasing the noticeability of health warnings.⁹⁻¹¹

Health warnings and messages on tobacco product packaging and labelling may be in the form of or include pictures or pictograms. Article 11 of FCTC on "Packaging and labelling of Tobacco Products" stipulates that each packet and package of tobacco products and any outside packaging and labelling of such products carry health warnings describing the harmful effects of tobacco use, with other appropriate messages; such warnings shall be approved by the competent national authority, shall be rotating, shall be large, clear, visible and legible, should be 50% or more of the principal display areas but shall be no less than 30% of the principal display areas, and may be in the form of or include pictures or pictograms. Evidence shows that health warnings and messages that contain both pictures and text are far more effective than those that are text-only.¹² They also have the added benefit of potentially reaching people with low levels of literacy and those who cannot read the language(s) in which the text of the health warning or message is written.^{9,10,13-15}

Australia was the first country to implement plain packaging in 2012, followed by France in 2016, the UK and Ireland in 2017, Hungary, New Zealand, and Norway in 2018; Thailand and Uruguay in 2019, while other countries such as Canada, Singapore, Belgium, Romania, Turkey, Finland, Chile and South Africa have taken steps towards the introduction of this measure.¹⁶ An increasing number of Latin American countries have been adopting MPOWER measures with dissimilar results. Studies on the potential effects of implementing measures and on the level of current implementation through modelling are crucial for policy makers. Uruguay has been the first country in Latin America to adopt the plain packaging strategy.¹⁶ In Latin America, hurdles to policy change still exist, with persisting knowledge gaps in many aspects; however, researchers have been working to produce local high-quality information in conjunction with policy makers.¹⁷ Hence, our model was designed to provide evidence on the health and financial burden of smoking in the region and cost-effectiveness of interventions to curb the tobacco epidemic.¹⁸ Of the countries studied, only Colombia currently has a level of implementation of health warnings that cover between 30% and 49% of the surface of the pack; the other six countries have health warnings ranging between 50%

to 80% of the pack. In 2009, Uruguay introduced legislation to increase the size of health warnings with significant subsequent increases in effectiveness indicators.^{16,19}

The objective of this study is twofold: 1) to estimate the health and economic benefits that can be achieved through the current cigarette packaging policies in Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, and Peru; and 2) to estimate the health and financial impact of improving current strategies through the implementation of cigarette plain packaging in these seven Latin American countries.

METHODS

The model used in this study is an individual-based Markov model (first-order Monte Carlo technique)¹⁸ that has been previously validated and applied in several studies to estimate the tobacco burden of disease, and the expected impact of tobacco tax increases and other tobacco control interventions.²⁰⁻²⁴ Through the model, the health and economic impact of tobacco under the present conditions in each country is estimated (status quo), and compared to hypothetical scenarios of reduced smoking prevalence as a consequence of the tobacco control interventions being evaluated (in the present paper we assess graphic warnings and plain packaging policies).

The model considers the natural history, costs and quality of life losses associated with main tobacco-related diseases (coronary and non-coronary heart disease, cerebrovascular disease, chronic obstructive pulmonary disease, pneumonia, influenza, lung cancer and nine other neoplasms). Simulating each individual's lifetime, we followed up individuals in hypothetical cohorts and calculated health outcomes on an annual basis to obtain aggregated long-term population health outcomes and costs. For acute events, we calculated age and gender-specific absolute risks based on national mortality rates and the lethality of the event. Then, the baseline risk in non-smokers is calculated based on the smoking prevalence in each age and sex group, and the relative risk of smoking associated with each event. For cancers, we obtained incidence statistics for each age and sex with GLOBOCAN for each country.²⁵

The model updates input parameters for each subject in yearly cycles and calculates individual lifetime risks of occurrence of each event, disease progression and death, based on demographic attributes, smoking status, and clinical conditions based on the underlying risk equations. The main outcomes are life years, quality-adjusted life years, disease events, hospitalisations, disease incidence and disease costs. We calculated the years of life lost (YLL) due to smoking-related diseases at a population level as the sum of years of life lost due to premature death (PYLL); and years of life lost due to living with a poor quality of life (YLL-QL). As the model does not directly calculate the consequences of passive smoking and perinatal effects, based on the results of previous studies, we assumed that these causes impose an additional burden of 13.6% for men and 12% for women.²⁶

Modeling of policy effect

Tobacco control policies have an effect mediated by a reduction in consumption. This lower consumption at the country level is a consequence of both a reduction in the number of cigarettes smoked per smoker, and lower tobacco prevalence due to an increase in quitting rates (short term) and lower tobacco initiation rates in the medium and long term. To estimate the impact of implementing plain tobacco packaging, the smoking prevalence post-intervention was calculated as:

$$Prevalence_{post} = Prevalence_{pre} - (Em * Ip * Prevalence_{pre})$$

Where $Prevalence_{pre}$ is the prevalence of smokers before the intervention, Em is the effectiveness of the intervention expressed as relative reduction in tobacco consumption, and Ip it is the proportion of variation in consumption that impact smoker prevalence. Different studies have estimated that, in the short and medium term, approximately half of the reduction in consumption is a consequence of reduced prevalence and the other half is explained by reduced consumption of continuing smokers.²⁷⁻³¹

Model scenarios

To estimate the potential impact of tobacco control policies we analysed three scenarios in each country.

1. Short-term scenario: we assumed that a 50% of the reduction in consumption would have an impact on prevalence ($I_p=0.5$) and that the reduction in prevalence led to an increase in former smokers. This conservative scenario is more likely to occur in the short term, as it does not include effects that the intervention may have in preventing people from starting to smoke or the health benefits of smoking fewer cigarettes for those who continue smoking.
2. Mid-term scenario: similar to the previous scenario, but it also incorporates the potential effects associated with a reduction in the number of cigarettes smoked in continuing smokers. It is assumed that low-intensity smokers have in average 75% less excess disease risk than high-intensity smokers (82% less for lung cancer, 57% less for ischemic heart disease and 80% less for COPD)³², and consequently the reduction in the number of cigarettes smoked is modelled as a proportional reduction in the 75% of the excess risk difference between a smoker and a former-smoker.
3. Long-term scenario: maximum effect over ten years. Similar to the previous one, but here $I_p = 0.75$ and the entire reduction in prevalence results in an increased population of non-smokers,

The base case consisted of comparing health benefits and costs of current packaging policy in each country to those predicted by implementing plain packaging. To estimate disease burden and costs of plain packaging strategy, we assumed a linear evolution from scenario 1 to scenario 2 within five years, and then to scenario 3 between years six to ten.

The burden of disease attributable to smoking was estimated for these scenarios based on these estimates of changes in smoking prevalence and new proportions of smokers, former smokers and non-smokers. Health impact was calculated as the observed difference between baseline burden (*status quo*) and the plain packaging strategy estimates, in terms of deaths, disease events, years lived, disability, and health costs. More information about the model can be found in the publications in which it was described, evaluated or used, and in the

technical reports with findings on the burden of disease (available from www.iecs.org.ar/tabaco).^{18,20-24}

Policies

Argentina, Bolivia, Brazil, Chile, Mexico and Peru currently have health warnings covering between 50% and 80% of pack surface, whereas Colombia has warnings covering 30-49% of the cigarette package,⁷ (Figure 1).

Figure 1. Current implementation level of policies related to health warnings and plain packaging and estimated effect in prevalence reduction in seven countries in Latin America.

Information sources for the model

Epidemiological information

To populate the simulation model, we obtained data through a review of the literature on MEDLINE, EMBASE, CENTRAL, SOCINDEX, EconLit, LILACS, NBER, CRD and Cost Effectiveness Analysis Registry, the International Tobacco Health Conference Paper Index and Cochrane Tobacco Addiction Review Group register. Also, we reviewed grey literature from ministries of health or of finance, Pan American Health Organisation, and regional congresses proceedings. We obtained updated information on tobacco use from tobacco GATS surveys and national risk factor surveys. Researchers from participating countries provided information from civil registrations, vital statistics and hospital discharge databases to estimate specific case fatality rates.

Cost information

We performed a literature search to identify reported costs of events and developed a common costing methodology to estimate costs through a micro costing or macro costing approach, depending on the information availability. Then, we used a spreadsheet for each event, with frequency, use rate and unit cost of health resources. We constructed *ad hoc* micro costing exercises, based on experts' opinions, clinical guidelines and a review of healthcare facility records. The costs of malignancies other than lung cancer were based on cost of each cancer relative to lung cancer costs and consensus using a Delphi method exercise with oncology experts from studied countries. Where local information was unavailable, we extrapolated the model to approximate costs of events. In those cases, we used the average proportion that represents event cost divided by per capita GDP in Argentina, Chile and Mexico; then, on this average proportion, the per capita GDP of the country of interest was applied to obtain estimates.

All costs were first estimated in the local currency; then, consumer price indices, published by the statistics institutes of each country, were used for cost adjustments and finally, costs were converted to US dollars using the exchange rates published by each country's central bank. Exchange rates used were average value in 2015, as follows USD 1.00 was Argentina ARS 9.27, Bolivia BOB 6.91, Brazil BRL 3.34, Chile CLP 654.07, Colombia COP 2743.39, Mexico MXN 15.84, Peru PEN 3.18.

Estimation for intervention impact

To obtain data on the benefits of implementing health warnings and the plain packaging of tobacco products to populate the simulation model, we performed a three-stage systematic review. First, we performed a review of documents published by relevant international organizations, then an overview of systematic reviews on the effectiveness of graphic warnings and plain packaging interventions at the global level, and, finally a systematic review of this specific intervention in the seven Latin American countries included in this study (Argentina, Bolivia, Brazil, Chile, Colombia, Mexico and Peru). See supplemental file for the detailed methods. We incorporated the best assumption on effectiveness for the case

base, agreed upon by the group of authors. A sensitivity analysis with the extreme values of the range of effectiveness reported in the literature was additionally performed.

Calibration and validation of the model

We applied the International Society for Pharmacoeconomics and Outcomes Research criteria for model development and reporting to calibrate the model in each country, compared mortality rates predicted by the model with the national statistics for 16 conditions (excluding COPD mortality, which is widely underestimated in national statistics).³³ Sex- and age-specific model outputs were compared to the source and deviations from the expected values were analysed. Predicted rates were accepted if within 10% of references. In case of greater deviation, risk equations were modified until the parameter was within an acceptable range. Goodness of fit was assessed by plotting predicted versus observed values outcomes, fitting a linear curve through the points with the intercept set at zero, and obtaining a squared linear correlation coefficient. We externally validated the model comparing results of other epidemiological and clinical studies not used in our model.

RESULTS

Data to populate the model

We identified all the epidemiological and cost parameters needed to populate the model and show the main results of input parameters in Table 1. The systematic review on the effectiveness of health warnings showed that smoking prevalence could be reduced by 0.6% if non-graphic warnings covered less than one third of the pack, by 3% if they covered at least one third of the pack, and by 6% if they covered at least 50% of the pack. Due to the limited experience worldwide, there is greater uncertainty regarding the potential effect of implementing plain packaging. Available data indicate that this effect could be between an additional 3.15% to 15.2%.^{19,34-36} For the base case, we assumed that plain packaging would reach a relative reduction equivalent to the decrease achieved when moving from non-graphic warnings covering at least one third of the pack to graphic warnings covering at least 50% of the pack (6% reduction); and we explored the published range 3.15%-15.2% in the sensitivity analysis.

Model calibration and validation

After the calibration process was completed, the average rate of each predicted event was within 10% of the rate reported by national statistics (correlation between observed and expected results yielded R^2 values ranging from 0.700 to 0.999). External validation also showed a good correlation between predicted results and those in epidemiology studies. Supplementary material shows calibration and validation process in Argentina.

Health and economic benefits of current strategies

The health warnings policies that are currently in place in these seven countries (Figure 1), if properly applied and maintained, are already producing health and economic benefits thanks to their potential to avert a total of 69,369 deaths, 167,251 cardiac diseases, 47,768 cerebrovascular diseases, 86,776 COPD, and 305,836 cases of cancer, totalling 638,295 disease events, over a period of 10 years; which could add 1.2 million years of healthy life and save USD 5.3 billion in direct medical costs.

In Brazil, the country with the largest population in the group, 34,121 deaths and 223,585 events could be averted, with over 1 million healthy years lived, and USD 2.4 billion in savings. In number of averted deaths, Argentina and Mexico come in second and third places, with 11,024 and 10,229, respectively. Moreover, Mexico could prevent 316,077 events followed by Argentina, with 44,710 events (Table 2).

Potential impact of implementing a plain packaging strategy

So far, the studied countries have not implemented plain tobacco packaging. If the seven countries moved to health warnings of more than 80% of the pack and plain packaging, 155,857 premature deaths would be averted (range: 118,177 to 277,898) over a ten-year period. The implementation of this measure would also avoid 437,198 cardiac events (range: 331,267 to 780,290); 132,116 cerebrovascular events (range: 99,810 to 236,753); 117,283 COPD (range: 88,344 to 211,019), and 597,501 cancer diagnosis (range: 455,338 to 1,057,912); totalling 4,133,858 potentially avoidable disease events. A total of 4.1 million healthy years of life would be added (range: 3.1 to 7.3) and a total of USD 13.6 billion in

direct healthcare expenses of diseases attributable to smoking (range: 10.1 to 24.6) would be saved (Table 3) in the next ten years. In absolute values, Brazil leads in the number of deaths that could be avoided in plain packaging is implemented (120,730 deaths) followed by Argentina, with 39,007, and Mexico, with 36,193 averted deaths.

DISCUSSION

Our results show that the graphic health warning policies currently in place in these seven Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Mexico and Peru) are already producing non-negligible health and economic benefits; 69,369 averted deaths and USD 5.3 billions saved in direct medical costs every 10 years. However, these countries are missing the opportunity to obtain much greater benefits. If plain packaging plus graphic health warnings covering at least 80% of the pack were implemented, this strategy would increase the number of averted smoking-associated deaths by 224%, to 155,857. For the seven countries, the number of averted health events would increase by 218%, to 1.4 million, and savings in direct costs to the health system would increase by 258%, reaching US\$ 19.4 billion. Of note, these countries represent almost 80% of the population of Latin America.

We observed wide differences among countries regarding absolute values, mostly because of variations in total population (i.e. 207.8 million in Brazil and 10.7 million Bolivia) and in the prevalence of tobacco use, ranging from 6.4% in Mexican women to 35.2% in Chilean men. Colombia currently has the lowest level of warnings, for this reason the country would obtain extra benefits in relative terms from transitioning to plain packaging. Although the estimated health and economic benefits of moving to plain packaging varied widely among the analysed countries, these are still very high in the seven countries.

There is no single strategy capable to address the tobacco epidemic; and plain packaging should be used along with other evidenced-based measures such as increased taxation, product regulation, and others.³⁷ However, with at least one MPOWER policy at its highest level of implementation, 88 countries averted 22 million premature deaths, and the three most effective strategies were taxes increase, comprehensive smoke-free laws and graphic health warnings.³⁸ One of the strategies actively endorsed by WHO is the increase in taxes to tobacco products. In other studies, we estimated that higher benefits could be gained with a 50% price increase in tobacco through a raise of taxes compared with plain packaging. For example, in the case of Brazil, we estimated that a 50% increase in cigarette prices would

avoid 136,482 deaths, 507,451 cases of cardiovascular diseases, 64,382 cases of cancer, and 100,365 cases of stroke and the estimated economic benefit would be USD 25.5 billion in the next ten years; representing twice the expected benefit of plain packaging.²¹ We also estimated that if these seven countries fully implemented smoke-free air strategies, it would be possible to avert nearly 180,000 premature deaths and 1.2 million events, adding 5 million healthy years of life and saving USD 13.1 billion in direct healthcare costs. Our data show the expected benefits of the implementation of plain packaging would be significant even in the most conservative scenarios, and the effects achieved through the adoption of graphic and large health warnings over the last years could be further increased by adopting plain packaging.

In the Latin American region, only two observational studies assessed the decision to quit smoking after the implementation of warnings in Mexico and Uruguay.^{19,35} Tobacco Free Kids reported that in Brazil, health warnings led to 67% of surveyed smokers reporting their intention to stop smoking.¹⁶ Moreover, two systematic reviews of the effects of warnings on smoking prevalence showed inconclusive evidence and a high heterogeneity on the definition of reduction of consumption, measurement of exposure, study design, population, and statistical analysis.^{34,41} Reports such as Tobacco Atlas have shown that in Australia, smoking prevalence diminished after the implementation of plain packaging.^{8,42}

Levy et al estimated the effects of implementing graphic warnings in the United States, where only small and text-only labels on one side of the cigarette pack are required, and showed that smoking prevalence would be reduced by 5% in the first few years, and 10% in the long-term through the effects on initiation and cessation.¹² Although these figures are consistent with the scenarios explored in our analysis (3.15% to 15.2%), Levy et al did not include plain packaging in their model.¹² In our systematic review, we only found one study addressing the effectiveness of plain packaging; it was performed in Australia, where the tobacco prevalence has been decreasing as a result of the implementation of several strategies. Due to the uncertainty in how to extrapolate this result to Latin-America, we reached a consensus with experts and decided that the effectiveness in our region could be like that assumed with the implementation of large warnings.

The tobacco industry and other opponents of health warnings and plain packaging measures argue that these strategies will increase counterfeit and illicit tobacco purchasing or decrease revenues; the industry has challenged the measures adopted in Australia and Uruguay adducing breaches of international trade agreements and intellectual property legislation.⁴³ Another strategy used by the tobacco industry to respond to these initiatives was the introduction of new products, extended brands or pack sizes options.^{44,45} Evidence suggests that plain packaging does not increase retail transaction times or the use of illicit or counterfeit tobacco; importantly, the decisions on legal cases may depend on the evidence indicating health benefits outweighing the manufacturers' interests.⁴³ Our study, in accordance with previous research on the effects of other measures, shows that taking this measure to its highest level would avert significantly deaths, disease events, add and save money.^{19,38,46-54}

Our study has important limitations that should be considered. The main limitation is the scarcity of high-quality evidence addressing the effectiveness of plain packaging implementation. For this reason, a conservative base case scenario was assumed, and parameter uncertainty was addressed through sensitivity analysis. Some conditions that could be related to smoking such as kidney failure, breast cancer or diabetes were not included, and indirect costs were not assessed. Despite having a negligible effect, this could underestimate the burden of smoking-related diseases and the benefits of the interventions. We have been conservative about the benefits of a reduction in consumption not mediated by quitting, although this remains controversial. Also, we did not include the effects of tobacco products other than cigarettes and did not differentiate the effects of graphic warnings and plain packaging on the quantity smoked, smoking cessation and initiation. However, this limitation closely mimicks real-world scenarios as plain packaging policy and enlarged graphic warnings were introduced simultaneously.³⁹ Moreover, the effects depend on the projections of smoking prevalence. The model relies on data provided by official institutions of the participating countries; therefore, potential inaccuracies and the lack of good-quality epidemiological and cost information in the region represent a threat. The relative risks used in our model are based on studies from other countries and could vary in Latin America. Despite these limitations, given the large number of countries and medical conditions included, our results offer a robust estimate of the benefits of implementing plain packaging strategy in Latin America.

In summary, the graphic health warning policies currently in place are producing non-negligible health and economic benefits. However, our study shows that these seven countries could still significantly improve population health and reduce healthcare costs through the implementation of a plain packaging strategy. Latin American countries should not delay this decision which would substantially alleviate the enormous health and financial burden that tobacco poses on their economies and healthcare systems.

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Table 1. Main inputs for the simulation model.

Characteristics	Argentina	Bolivia	Brazil	Chile	Colombia	Mexico	Peru
Population (2015)	43,416,755	10,724,705	207,847,528	17,948,141	48,228,704	127,017,224	31,376,670
Smoking prevalence ¹							
Male	23.4	20.1	18.0	35.2	20.1	19.8	23.5
Female	18.6	17.7	11.3	31.3	9.9	6.4	15.3
Crude mortality rate (Male / Female per 10,000)²							
Acute myocardial infarction	46.1 / 33.1	8.4 / 5.5	16.0 / 11.0	8.3 / 4.9	19.0 / 13.7	19.9 / 13.9	74.6 / 57.3
Other cardiovascular causes	118.7/104.5	0.9 / 0.5	3.8 / 2.9	7.4 / 8.4	2.3 / 1.7	2.2 / 3.1	51.8 / 57.2
Cerebrovascular disease	52.5 / 43.9	8.4 / 8.0	8.8 / 7.9	9.8 / 9.6	8.5 / 9.3	8.1 / 8.1	52.6 / 50.7
Pneumonia, influenza	104.4 / 72.4	17.4 / 15.9	9.1 / 8.5	4.2 / 4.0	3.6 / 3.1	4.0 / 3.1	221.0/199.0
COPD	4.3 / 1.9	1.1 / 1.3	6.6 / 4.5	3.7 / 2.8	7.9 / 5.8	7.5 / 5.6	33.2 / 25.3
Lung cancer	15.6 / 4.6	3.7 / 3.1	4.3 / 2.5	3.9 / 2.2	3.3 / 1.9	2.5 / 1.2	13.5 / 10.4
Estimated direct health costs of smoking-related conditions in USD millions							
Acute myocardial infarction	3,242	5,114	5,006	3,944	3,835	4,848.6	2,663
Other cardiovascular causes	2,432	3,835	1,881	2,702	1,534	3,190.4	1,850
Annual cardiovascular follow-up.	1,283	2,024	409	1,444	34,795	1,240.6	1,171
Cerebrovascular disease ³	4,294	5,232	4,304	4,431	2,174	4,119.1	5,058
Pneumonia /influenza	217	276	361	235	325	1,309.9	174
COPD ⁴	4,394	3,969	4,824	6133	3,463	9,236.2	4,363
Lung cancer ⁵	17,392	8,862	12,279	21,727	10,499	13,792.6	14,081
Mouth cancer ⁵	12,523	6,381	9,602	15,644	7,560	9,930.6	9,251
Oesophageal cancer	14,610	7,444	12,161	18,251	8,820	11,585.7	11,828
Stomach cancer ⁵	14,262	7,267	15,074	17,816	8,610	11,309.9	11,546

Characteristics	Argentina	Bolivia	Brazil	Chile	Colombia	Mexico	Peru
Pancreatic cancer ⁵	11,827	6,026	11,616	14,774	7,140	9,378.9	9,575
Kidney cancer ⁵	12,523	6,381	4,632	15,644	7,560	9,930.6	10,138
Tax revenue on smoking ⁶	1,926.2	21.5	9,511	1,346.5	174	2,237.4	73.5
GDP (2015) ⁶	583,168.6	33,197	1,774,725	240,215.7	292,080.1	1,144,331.3	192,083.7
GDP per capita (2015) ⁶	13,432	3,095	8,539	13,384	6,056	9,009	6,122
Price elasticity of demand	-0.299	-0.85	-0.48	-0.45	-0.780	-0.45	-0.7
Total health expenditure (% GDP)	4.8	6.3	8.3	7.8	7.2	6.3	5.5

Abbreviations: GDP, gross domestic product; COPD, chronic obstructive pulmonary disease. Key: 1. Population ≥ 35 years expressed in millions; 2. Mortality rate per 10,000 people; 3. Values include first and following years, as a summary, only first year is included in table. 4. COPD mild, moderate and serious included. 5. Treatment costs of following years are included. 6. In millions of US dollars; exchange rate as mean in December 2015 according to central banks in each country.

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Table 2. Ten-year cumulative benefits obtained with currently implemented strategies.

Country	Averted deaths	Averted events					Total events	Years lived due to prevented premature death and disability	Savings in USD millions
		Cardiac disease	Cerebrovascular disease	COPD	Cancer				
Argentina	11,024	17,460	6,326	15,830	5,094	44,710	265,013	\$906	
Bolivia	1,534	894	1,688	2,444	443	5,469	39,397	\$92.5	
Brazil	34,121	126,863	25,091	55,535	16,096	223,585	1,019,088	\$2,400	
Chile	5,467	6,878	6,399	12,433	2,206	27,916	143,120	\$545	
Colombia	3,465	10,936	4,844	5,657	1,339	22,776	90,285	\$196.4	
Mexico	10,229	26,418	6,430	3,845	279,384	316,077	279,384	\$934.5	
Peru	3,529	2,140	3,316	6,862	1,274	13,592	86,598	\$183	
Total	69,369	167,251	47,768	86,776	305,836	638,295	1,922,885	\$5,257	

Abbreviations: COPD, chronic obstructive pulmonary disease.

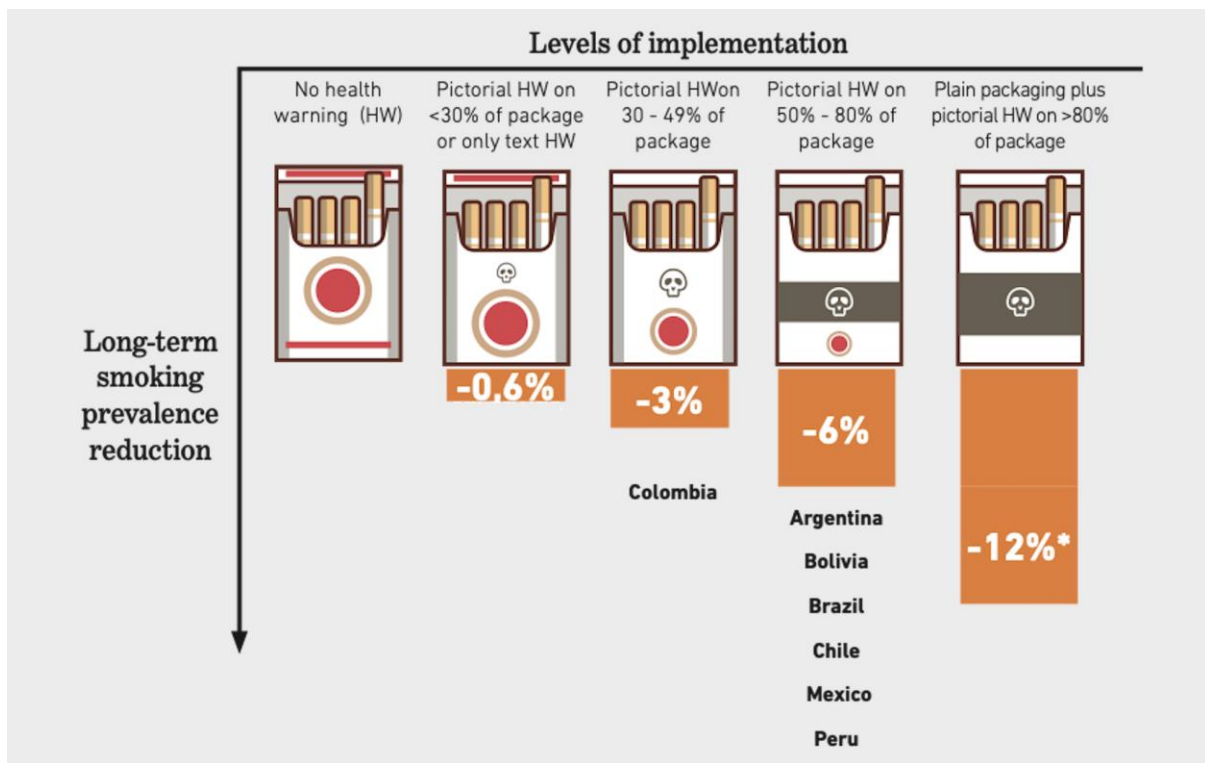
Table 3. Ten-year Cumulative benefits to be obtained by implementing plain packaging strategy, including current warnings benefits.

Country	Averted deaths N (range)	Averted events					Years of life due to premature death and disability. N (range)	Savings in USD millions. N (range)
		Base case (range)						
		Cardiac disease	cerebrovascular disease	COPD	Cancer	Total events		
Argentina	22,048 (16,812 to 39,007)	34,920 (26,626 to 61,779)	12,651 (9,647 to 22,382)	31,661 (24,141 to 56,013)	10,187 (7,768 to 18,023)	89,419 (68,182 to 158,197)	530,026 (404,145 to 937,704)	1,811 (1,381 to 3,204)
Bolivia	3,069 (2,340 to 5,429)	1,787 (1,363 to 3,162)	3,377 (2,575 to 5,974)	4,888 (3,727 to 8,648)	887 (676 to 1,569)	10,939 (8,341 to 19,353)	787,94 (60,080 to 139,399)	185 (141 to 327)
Brazil	68,241 (52,034 to 120,730)	253,726 (193,466 to 448,883)	50,182 (38,264 to 88,781)	11,250 (8,579 to 19,904)	11,408 (8,699 to 20,183)	427,821 (326,214 to 756,887)	2,038,177 (1,554,110 to 3,605,874)	4,866 (3,710 to 8,609)
Chile	10,934 (8,337 to 19,344)	13,757 (10,490 to 24,338)	12,798 (9,759 to 22,642)	8,808 (6,716 to 15,583)	4,412 (3,364 to 7,806)	39,775 (30,329 to 70,369)	286,240 (218,258 to 506,407)	1,095 (835 to 1,937)
Colombia	24,049 (17,673 to 44,707)	75,893 (55,772 to 141,082)	33,615 (24,703 to 62,489)	39,261 (28,852 to 72,985)	9,290 (6,827 to 17,269)	165,090 (121,006 to 307,913)	626,577 (460,453 to 1,164,783)	3,398 (2,404 to 6,608)

Mexico	20,458	52,836	12,860	7,690	558,768	632,154	400,849	1,869
	(15,599 to 36,193)	(40,287 to 93,475)	(9,806 to 22,752)	(5,864 to 13,605)	(426,060 to 988,553)	(482,017 to 1,118,385)	(305,647 to 709,169)	(1,425 to 3,307)
Peru	7,059	4,279	6,632	13,725	2,549	27,185	173,196	366
	(5,382 to 12,488)	(3,263 to 7,571)	(5,057 to 11,733)	(10,465 to 24,281)	(1,943 to 4,509)	(20,728 to 48,094)	(132,062 to 306,412)	(279 to 647)
Total	155,857	437,198	132,116	117,283	597,501	1,392,383	4,133,858	13,590
	(118,177 to 277,898)	(331,267 to 780,290)	(99,810 to 236,753)	(88,344 to 211,019)	(455,338 to 1057,912)	(1,056,817 to 2,479,198)	(3,134,755 to 7,369,748)	(10,175 to 24,639)

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Figure 1



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