

Case for investment in tobacco cessation: a population-based analysis in low- and middle-income countries

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Suggested citation Sandoval GA, Totanes R, David AM, Fu D, Bettcher D, Prasa V, et al. Case for investment in tobacco cessation: a population-based analysis in low- and middle-income countries. *Rev Panam Salud Publica*. 2022;46:e71. <https://doi.org/10.26633/RPSP.2022.71>

ABSTRACT

This study aimed to estimate the return on investments of three population-level tobacco cessation strategies and three pharmacological interventions. The analysis included 124 low- and middle-income countries, and assumed a 10-year investment period (2021–2030). The results indicate that all six cessation programmes could help about 152 million tobacco users quit and save 2.7 million lives during 2021–2030. If quitters were followed until 65 years of age, 16 million lives could be saved from quitting. The combined investment cost was estimated at 1.68 United States dollars (US\$) per capita a year, or US\$ 115 billion over the period 2021–2030, with Caribbean countries showing the lowest investment cost at US\$ 0.50 per capita a year. Return on investments was estimated at 0.79 (at the end of 2030) and 7.50 if benefits were assessed by the time quitters reach the age of 65 years. Disaggregated results by country income level and region also showed a return on investments less than 1.0 in the short term and greater than 1.0 in the medium-to-long term. In all countries, population-level interventions were less expensive and yielded a return on investments greater than 1.0 in the short and long term, with investment cost estimated at US\$ 0.21 per capita a year, or US\$ 14.3 billion over 2021–2030. Pharmacological interventions were more expensive and became cost beneficial over a longer time. These results are likely conservative and provide support for a phased approach implementing population-level strategies first, where most countries would reach break-even before 2030.

Keywords

Tobacco use cessation; investment; cost-benefit analysis; developing countries.

Tobacco cessation is a critical public health investment. It saves lives, protects health, and ultimately saves money. The entry into force in 2005 of the WHO Framework Convention on Tobacco Control (FCTC) – the World Health Organization’s (WHO’s) first global health treaty – has accelerated global progress in reducing tobacco use (1). However, the total number of tobacco users is still expected to reach 1.3 billion in 2025 (2). Tobacco use leads to significant health and economic consequences and is a marker of social inequity. Over 80% of tobacco users live in low- and middle-income countries where there are limited cessation services available (1, 3).

Currently, only about 32% of the world’s population has access to appropriate tobacco cessation services (4), even though a substantial percentage of smokers (about 60%) typically report that they want to quit (1). The relative paucity of global and national investments in tobacco cessation likely has many reasons. During the period of ratification and early implementation of the WHO FCTC, efforts tended to focus on control strategies to reduce demand for tobacco. These strategies were essential to create health-promoting environments that discouraged tobacco use and generated heightened demand for tobacco cessation. There exists, however, a skewed

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perspective that focuses predominantly on the clinical aspects of cessation, rather than on population-based cessation models. This view creates the perception that cessation is too expensive and that benefits accrue slowly, which have made global donors and governments reluctant to invest sufficient resources in cessation, particularly in low- and middle-income countries.

To support global tobacco cessation efforts, this brief communication presents preliminary results of a model that simulates the implementation of six evidence-based cessation strategies, including three population-level interventions (brief advice, quit-line services, and mCessation which involves text messages delivered via mobile telephones) and three pharmacological interventions (nicotine replacement therapies and two non-nicotine pharmacotherapies) – with effectiveness ranging from 2% to 15% (5). The objective of this modelling was to estimate return-on-investment ratios for 124 middle-income countries and low-income countries, with an estimated population of 6.50 billion and 1.05 billion tobacco users aged 15 years and older in 2021.

METHODS

The approach used in the analysis builds from previous methodologies and tools developed over the past 2 decades to support the implementation of the WHO best-buy interventions for noncommunicable diseases, for which tobacco use is a major risk factor (6–9). This study used predominately publicly available data from WHO, the United Nations Population Division, the World Bank, and the International Labour Organization. The WHO-CHOICE price database was also used; it produces global prices for major cost categories (e.g., personnel and utilities) built to facilitate the estimation of support costs for disease control programmes at the individual country level (7).

Investment costs

The investment costs were estimated following the costing tool and approach for noncommunicable diseases (8). The costs were grouped into two categories: (a) support and programme management costs and (b) intervention costs. Category (a) incorporates all costs directly associated with supporting and managing the planning, development, and implementation of the cessation programmes (e.g., human resources, training, and rent for space). Category (b) includes costs directly related to the six cessation interventions: these costs are largely variable and capture programme costs required to reach a target coverage of users.

The target coverage for a national toll-free quit line was set at 5% for all countries, following the case of New Zealand (10). Based on some evidence, current coverage was set at 0% in countries where no quit line is available and at 0.5% in countries reporting a quit line service (4). Direct costs include the telecommunication provider fee and salaries of quit-line counsellors. These costs were based on the assumption of two calls per tobacco user reached, with a total of 40 minutes of counselling. Unit price was derived from the International Telecommunication Union in combination with public US information on costs associated with toll-free 800 call services (10). Investment costs include a computer per counsellor and a

mainframe computer to house the communication system. Quit line counsellors were assumed to work remotely and take 5280 calls a year. Salaries were modelled using data available from the International Labour Organization up to 2019.

Brief advice takes advantage of tobacco-user encounters with the health-care system. Based on information reported to WHO (4), countries were classified into five groups to represent current coverage, which was estimated to range from 0% to 40% (Group 1: advice provided to 0% of tobacco users; Group 2: advice provided to 10%; Group 3: advice provided to 20%; Group 4: advice provided to 30%; and Group 5: advice provided to 40%). The target coverage was set at a 30% increase on the current coverage. The cost is based only on a fee paid to a health-care provider; it does not incorporate expansions in health-system capacity. The brief advice intervention follows the Canadian incentive model: a flat fee (15.6 Canadian dollars (Can\$)) paid to a general practitioner if counselling is provided to the patient within a regular consultation visit. To standardize this approach across countries, the fee was combined with data reported by a previous study which estimated the average cost of an outpatient visit in 188 countries (11). In Canada, this average cost of an outpatient visit was estimated at Can\$ 120 in 2020, which allows the relative incentive of counselling in relation to the average cost of an outpatient visit to be estimated (i.e., 13% (15.6/120)). This rate was then used in every country to estimate the unit cost of a brief advice intervention (one counselling or advice a year per tobacco user).

The mCessation was modelled based on a program delivered in the United Kingdom of Great Britain and Northern Ireland, which consisted of text messages over 31 weeks (12). Target coverage was set at 3.5% of the yearly base of tobacco users: in India, for example, mCessation subscribers represent slightly less than 1% of total tobacco users (1). For almost every country, current coverage for mCessation was assumed to be 0%. The total cost of this program was estimated at 16.12 pounds sterling (£) per smoker (12). To standardize the unit cost across countries, the cost of this program was modelled in relative terms and estimated at 7% of the United Nations (UN) daily subsistence allowance. The model also includes the cost of setting up and maintaining the messaging coding system, which was a fixed cost estimated at 1.7 times the UN daily subsistence allowance per year.

For nicotine replacement therapies, coverage was based on data and information reported to WHO and in research studies (4, 13, 14). Countries were classified into four groups to represent current coverage, which was estimated at 0% (nicotine replacement therapies unavailable in the country), 0.5% (nicotine replacement therapies available and not cost-covered), 0.8% (nicotine replacement therapies available and partially cost-covered, where provided), and 1.2% (nicotine replacement therapies available and fully cost-covered, where provided). The proportionally very low use of nicotine replacement therapies is based on the high price of the course of therapy and the fact that countries included in this study were only middle-income and low-income countries where the cost of nicotine replacement therapies is not commonly covered or only partially covered. In addition, in high-income countries where the cost of nicotine replacement therapies is partially covered, use among smokers averages at about 17%. In this study, a coverage scenario with an additional 5% of yearly tobacco users was used.

The nicotine replacement therapy unit price includes a full 8-week course of therapy using 532 gums. Pricing data were derived from the 2019 WHO report on the global tobacco epidemic (1). To standardize prices across countries, the price of gum therapy was linked to gross domestic product (GDP) per capita. In lower middle-income countries, the cost of therapy averaged 2.80% of GDP per capita. This cost was proportionally lower in countries with higher income. For this analysis, a rate of 2.0% of GDP was used for lower middle-income countries, 2.4% for low-income countries, and 1.4% for upper middle-income countries. These percentages assume lower unit prices due to the use of bulk purchasing mechanisms. A similar rationale was used to derive coverage and unit prices for the two other pharmacological interventions – bupropion and varenicline. Coverage was set to reach an additional 1.5% of yearly tobacco users. The cost of a full 12-week course of therapy was estimated at 8.5% (bupropion) and 7.5% (varenicline) of GDP per capita in lower middle-income countries, at 1.8% (bupropion) and 2.8% (varenicline) in upper middle-income countries, and at 10% (both medicines) in low-income countries.

Benefits

Benefits were measured using tobacco quitters and all-cause mortality averted due to quitting (i.e., lives saved). Tobacco quitters were estimated using effect sizes from meta-analyses and interpreted as the percentage of tobacco users who quit after the intervention (1). Effect sizes were built from studies with typically 6–12 months of follow-up, which allows confident extrapolation to permanent cessation (5). For this study, therefore, quitters were assumed to remain quitters over time. Effect sizes were also assumed to be independent and include 2% for brief advice, 5% for quit lines, 4% for mCessation, 6% for nicotine replacement therapies, 7% for bupropion, and 15% for varenicline. For any country, the model first estimates the total number of quitters using overall effect sizes. It then distributes quitters according to the actual sex and age distributions of tobacco users – re-estimated using global sex and age distributions of tobacco users (2). The model calculates dynamically tobacco users every year using UN population growth projections, trends in tobacco use prevalence, and yearly quitters estimated by the model. Country-level prevalence was from 2021 and modelled over the period 2021–2030 (4).

All-cause mortality averted due to quitting was estimated using sex- and age-specific 10-year risk ratios, where the mortality risk of former smokers was compared to that of current smokers (15). Sex- and age-specific all-cause mortality rates for former smokers and current smokers were estimated using UN country-specific life tables recalibrated to a 10-year cycle (15). The difference between mortality rates of current smokers and former smokers is the proportion of quitters whose lives are saved during a 10-year cycle because of quitting.

Lives saved were then translated into economic and social benefits using a conservative value of 1.45 times the GDP per capita for a life-year saved (i.e., value of a statistical life = 1.45). Economic and social benefits were estimated until 2030 and/or until quitters reach the age of 65 years (whichever came first). The value of a statistical life is based on previous work (16) and the value of 1.45 already incorporates adjustments to account for years lost due to disability (17). That is, in a 10-yr cycle, quitters whose lives have been saved can expect to live about

9 out of 10 years in good health, on average. The value of a statistical life in this analysis measures the direct contribution a person makes to the economy through the production of goods and services, and the indirect contribution a person makes to the rest of society, e.g., being a member of a community (16).

The analysis focused on the benefit-to-cost ratio, or return on investments (16). The ratio compares the net present value of the investment cost with that of the economic and social benefits, using a discount rate of 3%. The timeframe for the investment is from 2021 to 2030. Benefits were evaluated at the end of 2030 and when tobacco users who quit during the investment period reached the age of 65 years. The analysis included a base scenario where all six interventions (as a full package) were assumed to be introduced, and two additional scenarios where population-level and pharmacological interventions were separately modelled to estimate their contribution to cessation efforts. In all scenarios, disaggregation by country income level and region (Latin America and the Caribbean only) are also presented.

RESULTS

In 124 countries, the model estimated that all six cessation programmes could help about 152 million tobacco users to quit and save 2.7 million lives during the period 2021–2030 (Table 1). If quitters were followed until they reached 65 years of age, lives saved due to quitting could reach 16 million. The combined investment cost of these interventions was estimated at 1.68 United States dollars (US\$) per capita a year, or US\$ 115 billion over the period 2021–2030, with Caribbean countries showing the lowest investment cost at US\$ 0.50 per capita a year. The model estimated a return of US\$ 0.79 (measured at the end of 2030) for every US\$ 1.0 invested, and of US\$ 7.50 for every US\$ 1.0 dollar invested if benefits were assessed when quitters reached the age of 65 years (i.e., during productive life).

In all countries, population-level interventions were less expensive and yielded a return on investments greater than 1.0 in the short and long term, with the investment cost estimated at US\$ 0.21 per capita a year, or US\$ 14.3 billion over the period 2021–2030. Pharmacological interventions were more expensive and therefore became cost beneficial over a longer time, with investment cost estimated at US\$ 1.49 per capita a year, or US\$ 102 billion over the period 2021–2030. Additional disaggregated results by country income level and region showed similar patterns (Table 1).

DISCUSSION

The results of this simulation suggest that a per capita investment of US\$ 1.68 a year in tobacco cessation may yield large numbers of successful quitters, save millions of lives in the short and long term, and produce returns on investments that continue to accrue after the initial 10-year investment period. Upper middle-income countries would reach break-even by the end of 2030, whereas lower middle-income countries and low-income countries would do so at some point between 2030 and 2040 (i.e., 10 to 20 years after the initial investment in 2021). Population-level interventions yielded a positive return on investments relatively quickly and needed significantly lower annual per capita investment of 21 US cents. This means that most countries would reach break-even before 2030.

TABLE 1. Estimated return on investments (ROIs) for tobacco cessation interventions, investment period 2021–2030

Interventions	Number of countries	Population (2021), million	Number of tobacco users ≥ 15 years (2021), million	Total investment cost (cumulative 2021–2030), million US\$	Average per capita investment cost a year, US\$	Total number of quitters (2021–2030), million	Investment cost per quitter, US\$	ROIs until 2030	ROIs until 65 years of age	Number of lives saved until 2030, million	Number of lives saved until 65 years of age, million
All six interventions											
All MICs and LICs (world)	124	6524	1054	114 988	1.68	152	756	0.79	7.50	2.7	16.0
Upper MICs (world)	49	2890	541	75 577	2.56	79	952	0.98	9.60	1.4	7.0
Lower MICs and LICs (world)	75	3633	513	39 410	1.01	73	542	0.44	3.44	1.3	8.9
Latin America & Caribbean only ^a	22	586	55	7 310	1.21	7.5	979	0.83	4.75	0.124	0.732
Caribbean only ^a	8	16.7	0.93	87	0.50	0.132	657	0.63	3.33	0.0028	0.018
Population-level interventions^b											
All MICs and LICs (world)				14 313	0.21	88	164	3.58	35.4	1.4	9.3
Upper MICs (world)				9 957	0.34	46	217	4.20	43.1	0.8	4.1
Lower MICs and LICs (world)				4 356	0.11	42	105	2.20	18.0	0.7	5.2
Latin America & Caribbean only ^a				1 153	0.19	4.3	270	2.91	17.45	0.067	0.424
Caribbean only ^a				27	0.16	0.077	358	1.10	6.10	0.0015	0.011
Pharmacological interventions^c											
All MICs and LICs (world)				101 884	1.49	66	1553	0.40	3.60	1.3	6.8
Upper MICs (world)				66 357	2.25	34	1951	0.50	4.60	0.6	3.0
Lower MICs and LICs (world)				35 527	0.92	32	1125	0.22	1.66	0.6	3.8
Latin America & Caribbean only ^a				6 291	1.04	3.2	1941	0.44	2.40	0.058	0.313
Caribbean only ^a				76	0.44	0.057	1338	0.33	1.65	0.0013	0.0077

MICs, middle-income countries; LICs, low-income countries.

^a With the exception of Haiti, all countries included in the analysis are MICs.^b Population-level interventions: national quit line, brief advice, and mCessation.^c Pharmacological interventions: nicotine replacement therapies, bupropion, and varenicline.**Note:** Price level in 2020/2021.**Source:** Prepared by authors from the results.

Pharmacological interventions cost more but produced positive returns in the medium-to-long term. Upper middle-income countries would reach break-even at some point between 2030 and 2040, whereas lower middle-income countries, low-income countries, and Caribbean countries would do so between 2040 and 2050.

These findings have some policy implications. First, cessation is more prevalent in high-income countries. However, these results show that low- and lower middle-income countries also stand to benefit significantly in terms of lives saved. Second, the results also support a phased strategy where, in resource-constrained settings, efforts may initially be directed towards the promotion of population-level cessation interventions. As resources and capacities grow, additional investment in pharmacological interventions may be made since, despite costing more, these interventions can save additional lives and generate positive returns in the medium-to-long term. Furthermore, additional simulation analyses showed that a return on investments greater than 1.0 may be possible in the short term if pharmacological prices are reduced, for example, from 7 US

cents to 5 US cents for the average unit price per gum (nicotine replacement therapies) in low-income and lower middle-income countries. The analysis also dispels the commonly held misconception that cessation is too expensive to be widely supported, which has held back the implementation of these policies in the past. Brief advice is the least expensive and, despite its low effectiveness (i.e., 2%), its implementation has the potential to reach many tobacco users given the nature of this intervention. However, implementation of this intervention may necessitate considerable adaptation of training to local cultures, infrastructure, and traditions to motivate and support practitioners and adapt health-care delivery systems to integrate brief advice into health-care systems (5).

Some limitations of this modelling are important to highlight. The model uses one effect size per intervention and assumes quitters remain quitters over time. Although some relapses are likely captured in these effect sizes, it is possible that additional relapses may occur over time, which would reduce the returns estimated in this analysis. It is also possible that effect sizes vary significantly across country, and by sex and age. This

variation would directly affect estimations at the country level. However, since our estimates are aggregated, it is possible that the use of the average effect size may have produced reasonable global estimates. Similarly, the risk ratios used in this simulation were from one study and were applied to all countries. This approach again has implications when estimating country-level returns. However, in the aggregate, this limitation may have been minimized. Some strengths of the modelling can also be highlighted. These results are likely conservative. As has been argued, the use of a value of a statistical life of 1.5 (or 1.45 in this study) is at the lower end of values used in the literature (16) – higher values would lead to greater returns. The analysis also assumed no difference in mortality risks due to tobacco use in younger populations, that is, the incremental 10-year mortality risk begins only at the age of 35 years. This assumption means the model did not estimate economic and social benefits for those aged 15 to 30 years when the time horizon of the analysis was 2030. If estimated, the benefits would have been greater. Beyond lives saved, quitting also leads to gains in productivity due to improvement in health. The current model does not however estimate the economic and social benefits related to these health gains: if these benefits had been estimated, the returns would have been greater.

In conclusion, this preliminary analysis suggests important returns over the medium-to-long term if all six interventions are implemented. It also supports a phased approach targeting population-level strategies first, where most countries would reach break-even before 2030.

Author contributions. GAS and RT conceived and designed the study and analyzed the data. GAS, RT, and AD drafted the article. All other co-authors participated in the conception of the study, interpreted the data, revised the analyses critically, and approved the final version of the article.

Conflicts of interest. None declared.

Acknowledgements. We thank technical staff from WHO in Geneva for providing useful comments and feedback during the analysis phase of this study.

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Manuscript received on 1 November 2021. Revised version accepted for publication on 11 April 2022.

Argumentos a favor de la inversión en iniciativas para el abandono del tabaco: un análisis basado en la población en países de ingreso bajo y mediano

RESUMEN

Este estudio tenía como objetivo estimar el rendimiento de la inversión de tres estrategias para el abandono del tabaco dirigidas a la población y de tres intervenciones farmacológicas. El análisis incluyó a 124 países de ingreso bajo y mediano y consideró que el período de inversión era de 10 años (2021-2030). Los resultados muestran que los seis programas sobre el abandono del tabaco podrían ayudar a unos 152 millones de personas a dejar el tabaco y salvar 2,7 millones de vidas en el período 2021-2030. Si se siguiera a las personas que dejan el tabaco hasta que cumplieren 65 años, el número de vidas que se podrían salvar sería de 16 millones. Se estimó que el costo combinado de la inversión era de 1,68 dólares estadounidenses (US\$) per cápita al año, o US\$ 115 billones durante el período 2021-2030, y que el costo de inversión más bajo se encontraba en los países del Caribe (US\$ 0,50 per cápita al año). Se estimó que el rendimiento de la inversión era de 0,79 (a finales de 2030) y de 7,50 si se tenían en cuenta los beneficios que obtienen las personas que dejan el tabaco hasta que alcanzan los 65 años. Los resultados desglosados por nivel de ingresos de los países y región también mostraron que el rendimiento de la inversión era inferior a 1,0 a corto plazo y superior a 1,0 de mediano a largo plazo. En todos los países, las intervenciones dirigidas a la población fueron menos costosas y produjeron un rendimiento de la inversión superior a 1,0 a corto y largo plazo, con un costo de las inversiones estimado en US\$ 0,21 per cápita al año, o US\$ 14,3 billones durante el período 2021-2030. Las intervenciones farmacológicas fueron más costosas y solo fueron generaron beneficios en función de los costos a más largo plazo. Probablemente son unos resultados prudentes, pero sirven de base para adoptar un enfoque gradual en la aplicación de estrategias dirigidas a la población primero donde la mayoría de los países alcanzarían el punto de equilibrio antes del 2030.

Palabras clave Cese del uso de tabaco; inversiones en salud; análisis costo-beneficio; países en desarrollo.

Análise de viabilidade de investimento na cessação do tabagismo: um estudo populacional em países de baixa e média renda

RESUMO

Este estudo teve como objetivo estimar o retorno dos investimentos de três estratégias de cessação do tabagismo no nível populacional e de três intervenções farmacológicas. A análise incluiu 124 países de baixa e média renda e presumiu um período de investimento de 10 anos (2021-2030). Os resultados indicam que todos os seis programas de cessação poderiam ajudar cerca de 152 milhões de usuários de tabaco a parar de fumar e salvar 2,7 milhões de vidas entre 2021 e 2030. Se houvesse acompanhamento até os 65 anos de idade daqueles que parassem de fumar, 16 milhões de vidas poderiam ser salvas. O custo de investimento combinado foi estimado em 1,68 dólares americanos (US\$) per capita por ano, ou US\$ 115 bilhões no período 2021-2030, com os países do Caribe apresentando o menor custo de investimento, a US\$ 0,50 per capita por ano. O retorno dos investimentos foi estimado em 0,79 (no fim de 2030) e 7,50 se os benefícios fossem avaliados até o momento em que aqueles que pararam de fumar chegassem aos 65 anos de idade. Os resultados desagregados por nível de renda nacional e por região também mostraram um retorno dos investimentos inferior a 1,0 no curto prazo e superior a 1,0 no médio e longo prazos. Em todos os países, as intervenções no nível populacional foram menos caras e renderam um retorno dos investimentos superior a 1,0 no curto e longo prazos, com um custo de investimento estimado em US\$ 0,21 per capita por ano, ou US\$ 14,3 bilhões entre 2021 e 2030. As intervenções farmacológicas foram mais caras e tiveram um bom custo-benefício durante um período mais longo. Estes resultados são provavelmente conservadores e servem de apoio para uma abordagem em fases que implemente primeiramente estratégias no nível populacional, onde a maioria dos países atingiria o ponto de equilíbrio antes de 2030.

Palavras-chave Abandono do uso de tabaco; investimentos em saúde; análise custo-benefício; países em desenvolvimento.
