Boosting subnational governance of NCDs through the use of a laboratory for simulation of health policies in Colombia

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1 Introduction

Interventions at the subnational level play a structural role on governance on NCDs. At one side, policies and interventions on NCDs target people's behavior and environments, and subnational authorities have an important number of policy instruments to carry out these interventions. At the other side, subnational governments have a decisive role on congress and can put political pressure on policymakers, which can be used to move the NCDs agenda forward. However, in Colombia as well as in other developing countries the lack of engagement of subnational authorities on NCDs policies is a major challenge for governance on NCDs, and is caused mainly by their poor awareness on NCDs coming mainly from meager local evidence on NCDs, risk factors, and expected local impacts of implementation of best-buy interventions.

The purpose of this paper is to present a subnational laboratory for simulation of health policies in Risaralda, Colombia, by using artificial societies and dynamic microsimulation to create a virtual replica of Risaralda's society.

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2 Contribution

The laboratory is useful mainly for generation of scientific evidence about the expected effects of health policies and interventions. This evidence can be used to support the design, advocacy, approval, implementation and strengthening of population-level interventions (public policies) or individual-level interventions (health risk management).

The main uses of the laboratory are as follows. First, target monitoring. This consists of monitoring targets set by national or subnational governments over time, in order to have information on whether those targets will be reached on time, or if additional actions are necessary to accelerate progress on health goals. This aspect is particularly important for Sustainable Development Goals because the laboratory is a powerful tool to generate evidence on whether subnational governments are in the right track to reach health-related Sustainable Development Goals, in particular those related to Noncommunicable diseases such as reduction on premature deaths. This monitoring is not possible to carry out with the available tools in subnational and even in national governments, because their monitoring is focused only on retrospective information but not in prospective information, not to mention the one or two years delay on availability of retrospective information.

The second use is evaluation of health policies and interventions before they are implemented (ex ante). Health interventions, especially the ones on non-communicable diseases, have high costs of implementation not only in terms of the direct cost of the policy adopted but mainly on the cost on human lives and health status of the population of implementation of wrong policies. The laboratory allows policymakers to have reliable information on the expected effects of health interventions such as public health policies targeting the whole population or individual interventions targeting groups of individuals with high risks on noncommunicable diseases. This gives a broader perspective on the term policymaker because the laboratory can be used for multiple agents that conform subnational governments, including public health authorities but also health providers and health insurers. In that way, subnational health systems can have evaluation systems of health policies that can lead to better decision making and therefore to better health conditions for the population.

A third use is integration of multiple sources of information. Subnational governments usually have multiple data available on different determinants of health, but do not carry out a systematic integration of these data to have a comprehensive perspective of health and health status of its population. By using statistical matching techniques it is possible to produce a synthetic dataset that integrates multiple

sources of information in a unique dataset. this unique dataset allows to disaggregate monitoring and evaluation indicators by socioeconomic conditions and by risk factors.

Last, but not least, the laboratory is a powerful tool to understand the mechanisms operating behind health policies, that is, the way policies are expected to have effects on the population. This understanding is the cornerstone of policymaking, and therefore the laboratory is able to inform subnational authorities on the expected and unexpected effects of the health policies and the causes behind these effects. Provision of this understanding to policymakers strengths subnational health systems and leads to better decision making.

Together, these contributions are expected to improve planning of health policies by subnational governments.

3 Methods and materials

The core method of the subnational laboratory is microsimulation of artificial societies using complex systems, based on complexity theory. Given the nature of Non-communicable Diseases and the medium-term nature of Sustainable Development Goals, the time horizon chosen for the laboratory was 2010-2050, and the time resolution chosen was annual. The laboratory was developed in three steps. Each step was implemented in R code.

In the fisrt step, the artificial society is represented in a synthetic dataset, that is, in a censual microdata set where each observation represents a person in Risaralda. This synthetic dataset is created by combining the best sources of information using statistical matching techniques. In that way, characteristics of every individual in the laboratory were calibrated using statistical matching to integrate all locally available datasets on NCDs and social determinants, including primary data from the Survey of Cardiovascular Disease Risk - ERICA. This calibration was done for a baseline year, in this case for 2010. Values of each individual's characteristic represent the initial condition (t_0) of the dynamic system developed in the second step.

The second step consisted on building a lifecourse rule of behavior for every characteristic of every individual in the artificial society, using the best evidence available. Each rule allows to generate a value for a given characteristic in $t+1$ using all previous information ($t-i, \quad i=0,\ldots,t_0$) in the artificial society, as well as contemporary information (t) for some variables that, by definition, depend on contemporaneous values of other characteristics. For instance, changes in Body Mass Index in year

t are determined by contemporary imbalance between calorie intake in t and calorie expenditure in t. Thus, the socioeconomic conditions, risk factors, health outcomes, use of healthcare and costs were simulated year-by-year for every person in the artificial society. In general every year, each person's conditions evolve according to a set of rules based on the best scientific evidence, mainly from the fields of demography, health sciences and economics. The application of these rules to every person in the artificial society is known as simulation. The simulation is carried out year by year from 2011 to 2050.

The third step consisted on measuring the evolution of the society over time. Once the whole artificial society has been simulated, a set of aggregate indicators is calculated. These indicators measure what is happening in the artificial society and represent the expected situation in Risaralda year by year, in terms structural and intermediate determinants of health, that is, in terms of demographic and socioeconomic conditions, health situation, healthcare utilization and costs and burden of disease.

This bottom-up approach generated yearly estimates of structural and intermediate determinants of NCDs, morbidity, mortality, use of healthcare, costs and burden of disease, and provided estimates of the expected impact of best buy NCDs policies on Risaralda's society.

4 Results

The laboratory generated evidence for the subnational helath system in Risaralda on the following dimensions. First, regarding structural determinants, the laboratory generated data on expected population and population components such as fertility, mortality and migration. In addition, the most important indicators produced by the laboratory on structural determinants of health were education and income. Second, related to intermediate determinants of health, the laboratory produced evidence on the expected behavior of smoking and alcohol consumption, on physical activity and on diet, including consumption of fruits and vegetables, sugar-sweetened beverages and calorie intake. By combining data on risk factors related to noncommunicable diseases, the laboratory also produced evidence on the expected behavior of obesity.

The third set of results is related to the health status of the population, and it includes morbidity and mortality due to noncommunicable diseases. To guarantee consistency of the data with other health outcomes all other diseases and causes of death were included and results for those outcomes are presented in an aggregated way. the last set of results is on utilization of healthcare and costs as well as on health insurance.

The main experiments at the population level run in the laboratory were as follows. First, an increase in the excise tobacco tax from COP $700 to COP $ 2100. Second, implementation of a sugar-sweetened beverage of 30% of their current value. Third, an increase of the health payroll tax that is the main funding source for the colombian health system.

The laboratory can be accessed in two ways. First, by using the experiments already available at the web application. The application has a set of indicators that measure the current situation in Risaralda and what is expected to occur in the short, medium and long run with or without interventions. The internet address of the web application is http://181.48.222.219/simudatsalud/simudat/. Second, it is possible to design and run new experiments in the laboratory, using code in R and following the methodology to run experiments in the laboratory. In order to carry out these new experiments as well as to access the methodology, please contact Carlos Arango (carlos.arango@salutia.org), director of Fundacion Salutia (www.salutia.org).

The evidence generated in the laboratory raised local awareness on NCDs. Framing NCDs as a local issue got the local authorities and the governor himself involved in political action to tackle NCDs. The positive results suggest that generation of local evidence allows to overcome the challenge of lack of engagement of local authorities for governance of NCDs.