The OneHealth Tool: Costs and Benefits

Overview

This document outlines how the OneHealth Tool produces costs and health benefit estimates for primary prevention and acute-phase treatment interventions. Briefly, the Tool:

1. Specifies how many people will receive an intervention. To do so it relies on users' input, including the intervention's "relevant" population (e.g., 40-65 year olds), the prevalence rate of a given disease within the relevant population, and treatment coverage levels.
2. Calculates the costs of treatment. Each intervention in the Tool has a standard treatment regimen (consisting of prescribed drugs and outpatient/inpatient visits) that is based off of WHO protocols and expert opinion. It assesses the quantity of drugs needed to treat the target population (see Step 1), and multiplies the quantity of each drug by its price. The Tool allows users to provide inputs for human resources, infrastructure, logistics, health information systems, governance and leadership, and other policies. However, given the time required to gather such inputs, the Tool offers a second option to use a mixed-method approach, whereby the average price of an outpatient/inpatient visit can be entered in order to approximate all other medical and non-medical costs of a treatment.
3. Calculates the avoided incidence of disease and disease events, by modeling the effect of clinical treatment.

We cover each of these steps in detail below. For simplicity, we use a single intervention—treatment of those with a 10-year Cardiovascular Disease (CVD) risk ≥ 30 percent—as an illustrative example.

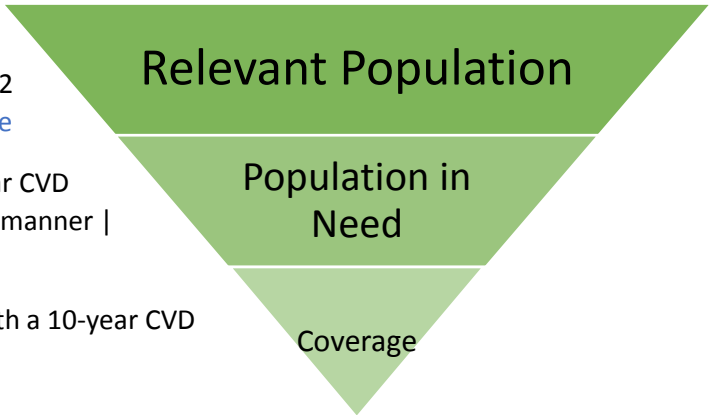
Specifying the intervention recipients

Relevant population: All adults ≥ age 40 | 849,000 people

Population in Need (prevalence): Of all adults ≥ 40, about 4.2 percent have a 10-year CVD risk ≥ 30 percent | 35,658 people

Baseline Coverage: About 40 percent of adults with a 10-year CVD risk ≥ 30 percent are already being treated in the prescribed manner | 14,263 people

Target Coverage: The goal is to treat 65 percent of adults with a 10-year CVD risk ≥ 30 percent by 2030 | 23,178 people



Assume that the country scales up its coverage rates in a linear fashion over a fifteen year period: from covering 40 percent of adults with a 10-year CVD risk in 2016, to covering 65 percent of those adults in 2030.

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
40	41.8	43.6	45.4	47.1	48.9	50.7	52.5	54.3	56.1	57.9	59.6	61.4	63.2	65

The OneHealth Tool takes into account changing demographics (population growth by age groups). But, for the sake of this example assume that population stays the same between 2016 and 2017. If Mongolia increases its treatment coverage from 40 to 41.8 percent, it will treat an additional 642 people with a 10-year CVD risk ≥ 30 percent.

$$(35{,}658 * 0.418) - (35{,}658 * 0.4) = (14{,}905) – (14{,}263) = 642$$

These 642 people represent the incremental change in treatment from 2016-2017: Thus, we want to discover how much it would cost to treat them, as well what health benefits are expected as a result of the treatment.

Costs

The OneHealth Tool contains default regimens that are based on standard WHO protocols and expert opinion. The intervention regimens include: 1) required drugs and supplies, and 2) number/length of outpatient and inpatient visits. While default regimens are embedded in the Tool, each input can be modified to represent a given country's context.

In order to understand how much it will cost to treat the 642 individuals, we need to know the average prescribed treatment regimen for individuals with a 10-year CVD risk ≥ 30 percent. In this section, we describe the drugs and supplies, and medical care that are assumed for treatment of this group in order to provide an example of how we cost additional treatment as a result of scaled up coverage.

Drugs and supplies

The table below represents the average drug treatment regimen for individuals with a 10-year CVD risk ≥ 30 percent. Different patients receive different drugs. For example, 95 percent of patients will receive Hydrochlorothiazide, but only seven percent will receive Prednisolone.

Reading left to right in the table, reveals how the OneHealth Tool calculates the cost of drugs and supplies. For 50 mg Atenolol tablets: 25 percent of all those who are treated for CDD risk ≥ 30 percent are prescribed to take one-and-a-half 50 mg tablets (75 mgs) atenolol each day during the year (365). Thus, the total # of units per case is 548 (365 *1.5 = 548 atenolol tablets each year.

To arrive a final cost, the Tool multiples quantity by price. It multiplies the percent of people who will receive the treatment x the total # of 50mg Atenolol tablets per case x the unit cost:

25% x 548 tablets x $210 ≈ $28,743.15[1] cost per average case

Drug/Supply	% who receive treatment	# of units of the drug or supply required	# of Days per case	Total # of units per case	Unit cost (MNT)	Cost per average case (MNT)
Drugs and supplies required per client						
Hydrochlorothiazide, tablet, 25 mg	95	1	365	365	549.99	190.709.84
Enalapril, tablet, 20 mg	40	1	365	365	430.00	62,780.07

[1] Not exact due to rounding in the table

Atenolol, tablets, 50 mg	25	1.5	365	548	210.00	28,743.15
Amlodipine, tablet, 10 mg	40	0.5	365	183	310.01	22,630.63
Simvastatin, 15 mg	100	1.0	365	365	78.81	28,766.53
Prednisolone, tablet, 5 mg	7	30.0	14	420	350.01	10,290.17
Lab tests per client						
Blood glucose level test	30	1	1	1	3,940.62	1,182.19
Cholesterol test	30	1	1	1	3,940.62	1,182.19
Urine analysis	30	1	1	1	3,605.67	1,081.70
Urine sugar analysis	100	1	1	1	1,320.11	1,320.11
Total average cost per case						**348,686.57**

Across all of the medicines and lab tests, the total cost per average case for drugs/supplies is $348,686.57. Remembering the additional people 642 people receiving treatment as a result of increased coverage, the incremental cost of treating them with drugs and supplies would be $223,856,777.90 (642 x the average cost of treatment).

Cost of Care – Other medical and non-medical costs

The cost of drugs and supplies is only one aspect of the costs to extend treatment coverage. Other direct medical costs include things like personnel time (e.g., a doctor or nurses time, as monetized by salary and benefits). In addition, providing care relies on clinic or hospital administrators to facilitate care, physical facilities, overhead, utilities (e.g., electricity), and capital costs (e.g., equipment). These "non-medical" costs must also be taken into account.

The Tool allows users to provide inputs for human resources, infrastructure, logistics, health information systems, governance and leadership, and other policies. Using the same ingredients-based approach that drives the drugs and supplies costing, users can estimate the costs of each of these items. However, given the time and intensity required to gather such inputs, the Tool offers a second option to use a mixed-method approach, whereby the average price of an outpatient/inpatient visit can be entered in order to approximate all other medical and non-medical costs of a treatment. Then, the average price of an outpatient/inpatient visit is multiplied by the quantity of total outpatient/inpatient visits.

For example, the OneHealth Tool's default treatment regimen for individuals with a 10-year CVD risk ≥ 30 percent specified that 93 percent of all patients will receive three clinic outpatient visits per year, while seven percent will require as many as eight clinic visits per year. Across all treatment patients, this averages to about 3.4 outpatient visits per year.

We use the average cost of an outpatient visit as a proxy of the total cost of treatment (medical and non-medical costs). Assume that the average price of an outpatient visit is $16,500 MNT. The total cost of providing care:

= "Average price of an outpatient visit" x "# of people treated" x "Average # of outpatient visits"

=$16,500 x 642 x 3.4

= $36,016,200

Adding the cost of care to the cost of drugs and supplies, we arrive at the total cost to treat the 642 individuals.

Benefits[2]

Incidence avoided

The OneHealth Tool calculates the avoided incidence of disease and disease events as a result of clinical treatment. In our CVD example, the avoided events that are modeled in the Tool are stroke and IHD events. Let's look at how the Tool calculates avoided incidence of stroke for those with a 10-year CVD risk ≥ 30 percent.

We know that CVD risk ≥ 30 percent results from an assortment of factors, including an individual's BMI, cholesterol, diabetes, tobacco use, and blood pressure status.[3] Thus, the tool assesses the effect that clinical treatment will have on this risk factor profile, looking at individual risk factors one-by-one. Let's use high blood pressure as an example.

First, let's look at how the Tool calculates a baseline for the incidence of stroke in the population of those with high CVD risk with elevated blood pressure. It employs the following formula:

$$S = \left(1 - cov(t_1)\right) * p * I_0 * R^{dB} + cov(t_1) * p * I_0 * R^{dB-E}$$

Where:

- S is incidence of stroke
- Cov (t_1) is the coverage of the intervention[4] for those who have high blood pressure, at time "1"
- p is the prevalence of those with high blood pressure
- I_0 is the baseline prevalence of a stroke event
- R is the relative risk of a CVD event for those with high blood pressure, starting from a baseline level for the risk factor
- dB is the average number of units above a baseline level for the risk factor
- E is the number of units of recovery towards a baseline level for the risk factor for those exposed to the intervention.

Then, the change in incidence of acute stroke with increased clinical treatment coverage is:

$$\Delta S = p * \Delta cov * I_0 * R^{dB} * 1 - R^{-E}$$

E is the effect of the intervention, which removes a certain percentage of the increased risk of stroke for those with CVD risk ≥ 30 percent as a result of clinical treatment.

For example, suppose:

- The average risk of an acute stroke is 1% per year ($I_0 = 0.01$)
- The baseline systolic blood pressure, below which no reduction in risk is observed, is 120 mmHg.

[2] The formulas and some of the descriptive text in the following section are derived from the OneHealth Tool manual. <http://avenirhealth.org/Download/Spectrum/Manuals/OneHealthManualE.pdf>
[3] The profile also takes into account demographic characteristics like age and sex, but because these are not modifiable, we ignore them here.
[4] This is the intervention described above in the cost section

- The prevalence of blood pressure > 160 mmH is 30 percent (p =0.30), and on average the population has a systolic blood pressure of 165 mmHg, which is 45 units above the baseline (dB = 45).
- The relative risk for an acute stroke event is 1.07 for each unit of systolic blood pressure above 120 mmHg (R=1.07).
- The change in coverage of an intervention to treat blood pressure is 20 percent, and it reduces systolic blood pressure by seven units. ($\Delta cov = 0.20$; $E = 0.07$)

Then the change in incidence I_0 of stroke is:

0.3 * 0.2 * 0.01 * 1.07^(45) *(1-1.07^(-7)) = 0.048, or about five percent.

Mortality avoided

The graphic below represents various health states of individuals, and the paths that they can take if they have a stroke.

Assume that one hundred percent of individuals begin in a healthy, disease-free state in which no one has yet had a stroke. In this simple model, one of three things can happen next: 1) the individual can remain healthy and in the disease-free state; 2) the individual can die of any given cause—"background mortality" (e.g., injury, disease, etc.), and; 3) the individual can have a stroke.

Transition rates are posted beside each of the transitions. These show how many people can be expected to move from one health state to another. The rates below are for illustration only, but, for each world region, the actual rates that are utilized in the OneHealth Tool are derived from WHO data sources and expert review.

Using the rates in the graphic below, let's follow a cohort of 10,000 people who have a CVD risk >30% through the various health states. Of 10,000 people who begin in a disease free state, it's estimated that 400 of them will have a stroke during the course of one year.

10,000 * .06 = 600

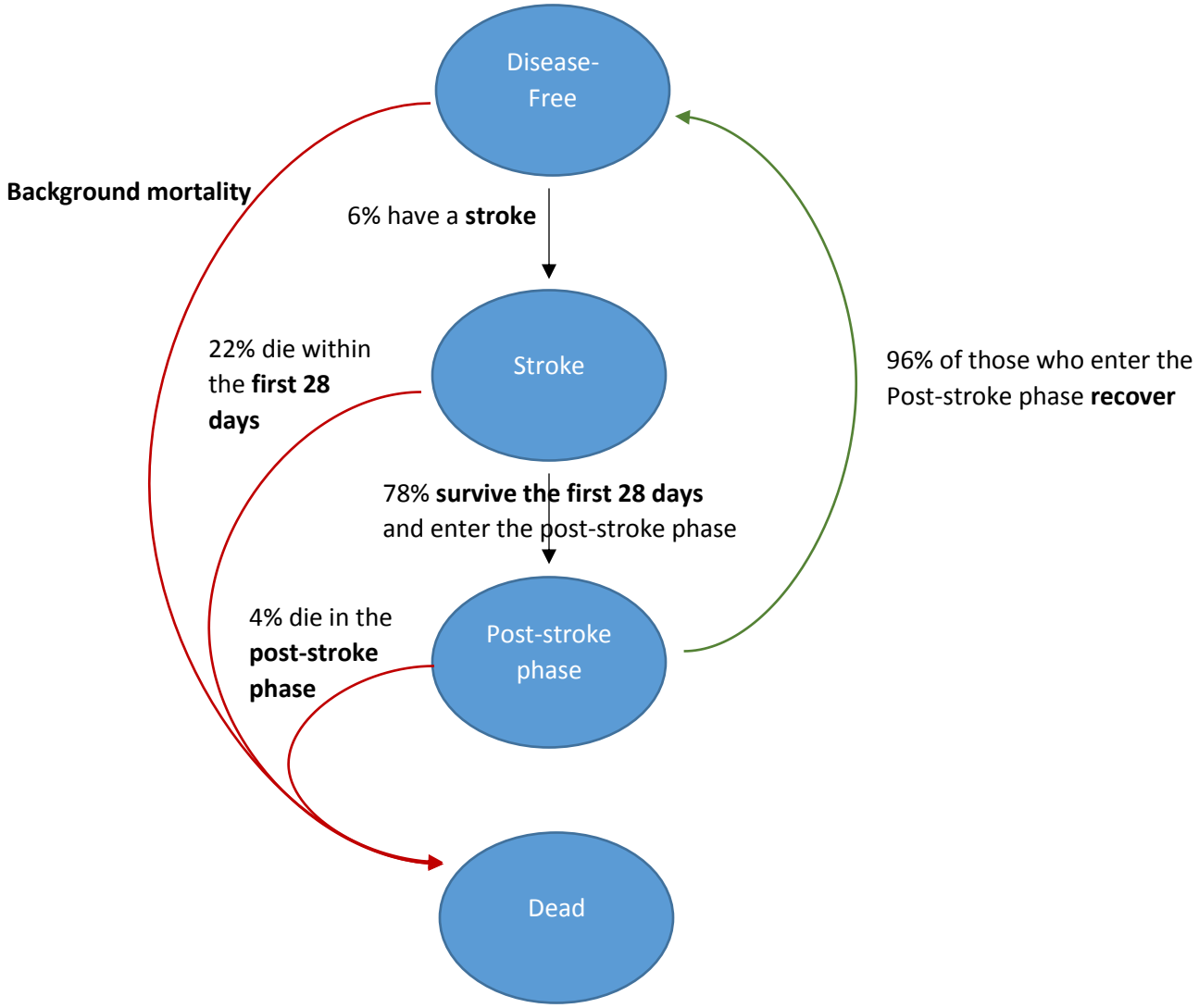
Of those 600 people, 22% will die in the first 28 days after having a stroke, while the remaining 78% will enter a post-acute stroke phase where they will attempt to continue to recover from the event. Thus, 132 (600 * .22) people will die from the stroke, while 468 (600 * .78) will move on the next health state.

Then, in the post-acute stroke state, an additional 19 people will die (468 *.04 is about equal to 19), while the remaining 449 (468 * .96) individuals are expected to recover and reenter the disease free state. Thus, in total, in this baseline scenario 151 people will die (132+19).

In the last section, we looked at an intervention that is expected to reduce the incidence of stroke by five percent in a population of individuals with CVD risk ≥30 percent. In order to calculate the mortality avoided as a result of this intervention, the Tool takes the difference in mortality between the baseline scenario in which the population doesn't receive treatment, and a treatment scenario in which it receives treatment.

We again have 10,000 people, but this time only 570 people will have a stroke because the treatment reduces the incidence of stroke by five percent. Thus, where 6 percent of people would have had a stroke before, now only 5.7 percent will [.06 – (.06*.05) = 5.7%]. As well follow through the same calculation used previously, we can see that of those 570 people, 143 will die. This is a difference of eight people from the baseline scenario (151-143). Thus, the mortality avoided is eight case.

Figure. Health State Transitions of individuals who have a stroke



Healthy Life Years

The final health benefit that the OneHealth Tool calculates is “healthy years lived”. In essence, this indicator:

> "measures the number of remaining years that a person of a certain age is still supposed to live without disability…[It] introduces the concept of quality of life. {It] is used to distinguish between years of life free of any activity limitation and years experienced with at least one activity limitation. The emphasis is not exclusively on the length of life, as is the case for life expectancy, but also on the quality of life."[5]

In the OneHealth Tool, Healthy years lived (HYL) at time t are estimated as follows:

$$HYL\ (t,S) = P(t,S) * \big(1 - DW(t,S)\big)$$

Where:

- P(t,S) is the prevalence of state S at time t
- DW(t,S) is the disability weight associated with state S at time t

[5] European Commission. (n.d.). Health Indicators – Healthy Life Years (HLY). Retrieved from <http://ec.europa.eu/health/indicators/healthy_life_years/hly_en>