**Appendix 1. Converting elasticities to absolute health effects**

*Deaths averted*

Elasticities of the effect of expenditure on mortality are converted into health effects using 2018 data from Saudi Arabia. This involves calculating deaths averted and converting these into survival effects, calculating morbidity effects and bringing them together in a generic measure of health, like DALYs or QALYs, which accounts for changes in both survival and morbidity.

The elasticities of the effect of a change in expenditure on mortality from Andrews et al (2017) and Lomas et al (2019) are for the whole population, so deaths averted are calculated by applying these elasticities to estimated deaths among Saudi citizens in Saudi Arabia based on mortality data from the Household Health Survey 2018, General Authority for Statistics by five-year age category .[[1]](#footnote-1)

Equation 1:

Ochalek et al (2020) estimate the effect of expenditure on under-5 mortality, mortality among adult males and mortality among adult females separately (, , respectively). Therefore, deaths averted are calculated for the relevant age group using the relevant elasticity in combination with mortality data, which is disaggregated by 5-year age category). Equation 2 calculates deaths averted in children under-5.

Equation 2:

Equation 3 calculates deaths averted among adult males.

Equation 3:

Equation 4 calculates deaths averted among adult females.

Equation 4:

Summing equations 2, 3 and 4 gives deaths averted among the Saudi Arabians aged 0-4 and 15-60.

Equation 5:

*Survival effects*

To determine the survival effects of a change in expenditure, we apply conditional life expectancy to deaths by 5-year age category using data from the Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease (GBD). Equation 6 shows the calculation of survival effects for the total population based on the Andrews et al (2017) and Lomas et al (2019) elasticities.

Equation 6:

Equation 7 shows the calculation of survival effects for the population aged 0-4 and 15-60 based on Ochalek and Lomas (2020).

Equation 7:

We then calculate the survival burden of disease among the total population from the survival among the population aged 0-4 and 15-60. We apply proportion of the survival burden of disease among the population age 0-4 and 15-60 estimated to be alleviated to the proportion to the survival burden of disease among the total population (Equation 8).

Equation 8:

*Morbidity effects*

To calculate morbidity effects, we assume that the same proportion of the morbidity burden of disease among Saudi Arabian citizens is averted as survival burden of disease alleviated by a change in expenditure (Equation 9). This accounts for the direct effect of expenditure in alleviating morbidity burden of disease.

Equation 9:

In the other direction, morbidity burden of disease will increase due to increases in survival. This is the indirect effect, which we account for by applying the per capita morbidity burden of disease to the calculated survival effects.

Equation 10:

*Health effects*

The overall health effects of a change in expenditure are calculated by summing the survival and morbidity effects (Equation 11).

Equation 11:

Cost per unit of health is then calculated based on a 1% change in expenditure (Equation 12).

Equation 12:

1. Not publicly available [↑](#footnote-ref-1)