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Me h d ed i he Li e Sa ed T (LiST)

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Abstract

Background: Choosing an optimum set of child health interventions for maximum mortality impact is important within resource poor policy environments. The Lives Saved Tool (LiST) is a computer model that estimates the mortality and stillbirth impact of scaling up proven maternal and child health interventions. This paper will describe the methods used to estimate the impact of scaling up interventions on neonatal and child mortality.

Model structure and assumptions: LiST estimates mortality impact via five age bands 0 months, 1-5 months, 6-11 months, 12-23 months and 24 to 59 months. For each of these age bands reductions in cause specific mortality are estimated. Nutrition interventions can impact either nutritional statuses or directly impact mortality. In the former case, LiST acts as a cohort model where current nutritional statuses such as stunting impact the probability of stunting as the cohort ages. LiST links with a demographic projections model (DemProj) to estimate the deaths and deaths averted due to the reductions in mortality rates.

Using LiST: LiST can be downloaded at http://www.jhsph.edu/dept/ih/IIP/list/ where simple instructions are available for installation. LiST includes default values for coverage and effectiveness for many less developed countries obtained from credible sources.

Conclusions: The development of LiST is a continuing process. Via technical inputs from the Child Health Epidemiological Group, effectiveness values are updated, interventions are adopted and new features added.

Background

Human and financial resources for expansion of health services are limited. Therefore resources should be directed toward expanding availability and use of services that have the greatest health impact. Health policy makers and program managers require a tool that allows them to assess the differential mortality impact of a comprehensive set of maternal and child health interventions. Previously developed tools are either narrowly focused on a single set of interventions or calculate impacts without a rigorous demographic or epidemiological framework. LiST overcomes these limitations by allowing the simultaneous projection of health impacts for many maternal and child health interventions. This is primarily done by linking LiST as an additional module to the Spectrum suite of projection models that includes a demographic projection model, an HIV/AIDS projection model and a model for assessing the demographic impacts of family planning programs. Spectrum and the integration of LiST with other modules of SPECTRUM are described in Stover et al. [1]

LiST is a computer projection model used to estimate

coverage of intervention $(C_{,\,,\,t} - C_{,\,,\,0})$ and the affected fraction $(AF_{,\,,\,})$ adjusted for the unrealized potential impact $(1 - {}_{,\,,\,,0}\; C_{,\,,\,0})$.

$$R_{i,j,a,t} = [I_{i,j,a} \text{ x } (C_{i,a,t} - C_{i,a,0}) \,/\, (1 - I_{i,j,a,0} \text{ x } C_{i,a,0})] \text{ x } AF_{i,j,a} \quad (1)$$

For example, suppose that the coverage of ORS increased from 25 percent to 50 percent and that the effectiveness of ORS was 0.93 and the fraction of diarrhoea deaths that could be prevented by ORS was 0.95. If ORS were the only intervention then the percent reduction in mortality would be: [0.930 * (0.50 − 0.25)] / (1 − 0.93*0.25) * 0.95 = 0.288 or a 28.8 percent reduction in diarrhoea mortality.

When more than one intervention is scaled up LiST first calculates the mortality reduction for each intervention in isolation, as if it were the only intervention

$$hR_{i,j,a,t} = R_{i,j,a,t} + H_{i,j,a,t} \text{ x } (1 - R_{i,j,a,t}) \qquad (5)$$

percent of un-supplemented children who are stunted is 35.9.

If preventive zinc supplementation were the only intervention and the percent of children who are supplemented were to increase from 25 percent to 50 percent then the percent stunted would decline from 35 percent to 34.1 percent via equation 7 (0.50 x 0.322 + 0.50 x 0.359 = 0.341). And the percent decline in stunting would be 2.7 percent via equation 8 ((0.350 – 0.341)/ 0.350 = 0.027).

This process would be replicated for all statuses or behaviors impacting stunting status. The overall reduction in stunting is calculated similar to the process described above in equations (1) and (2).

In LiST there are five factors that influence stunting:

- For neonatal children the percent who were born with IUGR;
- For post-neonatal children the percent who were stunted at the previous age band;
- Complementary feeding;
- Episodes of diarrhoea per year; and
- Zinc supplementation.

LiST includes two interventions related to feeding children. Complementary feeding is an intervention designed to address stunting. Supplementary feeding is an intervention designed to address wasting. The percent of children born IUGR is impacted by improvements in coverage of pregnant women protected via Intermittent Prevention Therapy (IPT) or sleeping under a bednet, balanced energy supplementation or multiple micronutrient supplementations. The percent reduction in children born IUGR is calculated with the strategy described in equations (1) and (2) with the percentage reduction in mortality replaced by the percentage reduction in children born with IUGR.

The impact of complementary feeding is described by odds ratios associated with four different states:

- Food secure with promotion;
- Food secure without promotion;
- Food insecure with promotion and supplementation; and
- Food insecure without promotion and supplementation.

Food secure populations are defined as those living above the poverty line. The isolated impact of complementary feeding is calculated with the strategy described by equations (6) through (8). A major difference is that equation 6 is replaced with three equations corresponding to three odds ratios defined relative to the food secure population with promotion, the least risky group. Equation 7 is replaced with an equation that has four terms on the right hand side corresponding to the four bulleted populations listed above. These four equations (three equations replacing equation 6 and the new equation 7) lead to a quartic equation that is solved analytically to obtain the baseline stunting probabilities for the food secure population wi(co)-14(6)-38hai ln24eplaced of diarrhoea increases. The population averag odds ratio is the odds ratio of a single case raised to the power of the average number of cases of diarrhoea per year ( ).

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SD, -2 to -1 SDs and -1 - 0 SDs. Illustrations of these calculations can be found in figure 3.

Each of the height for age or weight for height statuses is associated with a risk of cause specific mortality relative to normal height for age and weight for height. For example children aged 1-5 months who are less than three standard deviations below the international norm for height for age are 4.6 times more likely to die of diarrhoea than are children who are greater than one standard deviation less than the international median norm.

Percent reductions in cause specific mortality are established by first calculating the average relative risk of mortality relative to the reference. "Reference" in the next few paragraphs refers to greater than one standard deviation less than the international median norm. The average relative risk (ARR) for a specific cause of death ( ) and a particular age ( ) at time t is the sum across all categories ( ) of height for age or weight for height of the percentage of children in that category (Z) multiplied by the relative risk (RR) of death for children in that category. The reference category (children of normal height for age or weight for height) has a relative risk of 1.00.

$$ARR_{a,ji,t} = \sum_s Z_{s,a,t} \times RR_{s,a,j,\ t} \qquad (11)$$

The percent reduction in mortality is then calculated as 1 minus the ratio of the average relative risk at time t to the average relative risk in the base year.

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including current intervention coverage for most countries. If the model is run without any changes the coverage of all interventions will remain constant at the current level and, as a result, mortality rates will also remain constant.

LiST can be used to explore the effects of alternate strategies by scaling up coverage of selected interventions over time. LiST will calculate the expected change in mortality as a result of the changes in coverage. The number of possible strategies that can be examined using LiST is quite large.

LiST is designed to encourage a strategic approach to strategy selection. The first step is to examine the mortality rates to see when most mortality happens. If mortality is concentrated in the neonatal period, then interventions that reduce neonatal mortality should be examined close. A second step is to examine the distribution of deaths by cause. If one or two causes of death are responsible for most deaths then, interventions that are effective against those causes of death are likely candidates. The most effective strategies will be those that scale up interventions that have large effects and those

The Lives Saved Tool, LiST, is intended to support national planning to improve maternal and child health. It summarizes a vast impact assessment literature by providing consensus estimates of the effectiveness of health interventions in a tool that facilitates the application of this information to any national context. LiST provides planners and policy makers with a tool to examine the potential impact of alternative strategies to reduce mortality. It is intended to support the strategic analysis of alternatives by displaying the cause of death structure and producing output showing not only the total impact on mortality but also the contribution of each intervention to the total impact.

There are limitations to LiST. It can be difficult to ensure that data on coverage of interventions refers to interventions that are similar to those in the impact literature. For some interventions estimates of effectiveness may rely on a small number of studies. The current version of LiST does not address these uncertainties although we expect to add this feature to future versions. The current version does not consider cost, but work is underway to add costing the model. Future versions will also include the ability to add interventions, for example a new vaccine, into the model.

LiST is readily available to anyone who wants to use it. It contains data bases to facilitate use. Most of the key assumptions in LiST are addressed in published articles in this supplement and earlier publications. [6] Uts