Annex 2E Adjustments To Account For Burden Not Amenable To Surgical Care

In principle, the fatal burden for the hypothetical state of full access to high-quality surgical care was calculated by the following common equation:

\[
\text{Death}_{i,j,k} = \text{Incidence}_{i,j,k} \times \text{CFR}_{i,j,k} \quad (1)
\]

\[
YLL'_{i,j,k} = \text{Death}_{i,j,k} \times \text{StdLifeExpect}_{i} \quad (2)
\]

where \(\text{Death}_{i,j,k}\) is the age-specific (i) and sex-specific (j) number of deaths for the hypothetical state in each super region (k), \(\text{Incidence}_{i,j,k}\) is the age and sex-specific number of incident cases from GBD 2010 in each super region, \(\text{CFR}_{i,j,k}\) is the age and sex-specific case-fatality rates for the hypothetical state in each super region, \(YLL'_{i,j,k}\) is the fatal burden in case of the hypothetical state, and \(\text{StdLifeExpect}_{i}\) is the age-specific standard life expectancy used in GBD 2010. In order to estimate the \(\text{CFR}_{i,j,k}\), we assumed that the lowest age and sex-specific fatality rates among the 21 epidemiological regions from GBD 2010 reflect the hypothetical state (and hence the difference of those case-fatality rates reflecting the gap in surgical care).

The nonfatal burden for the hypothetical state was commonly estimated by the following equation:

\[
YLD'_{i,j,k} = (\text{Incidence}_{i,j,k} - \text{Death}_{i,j,k}) \times \text{Duration} \times \text{DW} \quad (3)
\]

where \(YLD'_{i,j,k}\) is the nonfatal burden in case of the hypothetical state, \(\text{Duration}\) is the duration of disease, and \(\text{DW}\) is the disability weight attached to each condition.

However, not all cases are amenable to surgical care for some of the investigated conditions: maternal haemorrhage, neonatal encephalopathy, and injury. These conditions required adjustments to account for those cases that were not avertable by surgical care.

Maternal haemorrhage

Johns et al. estimated the resources needed to achieve universal coverage of maternal and neonatal health in 75 countries, including for maternal haemorrhage (see Table A).\(^1\) Based on the findings of this study (although the authors did not provide detailed data sources for each procedure), we calculated that 36% of haemorrhage cases are amenable to surgical interventions:

\[
\text{SurgProp} = (\text{Caesarean}^{0.0011} + \text{RemovePlacenta}^{0.01} + \text{RepairTear}^{0.01} + \text{Hysterectomy}^{0.0013}) \div \text{HaemMgmtTotal}^{0.0622}
\]

\[
= 0.0224 \div 0.0622 \\
= 0.3601
\]

\(^1\) Adjustments To Account For Burden Not Amenable To Surgical Care
where \( SurgProp \) is the proportion of haemorrhagic cases amenable to surgical interventions, \( Caesarean^{0.0011} \), \( Remove\text{Placenta}^{0.01} \), \( Repair\text{Tear}^{0.01} \), \( Hysterectomy^{0.0013} \) denote the numbers per completed pregnancy or delivery that require each surgical care (i.e., caesarean section, manual removal of placenta, repair of vaginal, perineal or cervical tears, and hysterectomy, respectively), and \( HaemMgmt\text{Total}^{0.0622} \) the total number per completed pregnancy or delivery that require medical or surgical care due to maternal haemorrhage. With this proportion, we calculated the case fatality rates for each super region as follows:

\[
CFR_{i,j,k} = CFR_{i,j,k} \times (1 - SurgProp) + CFR_{i,j,k}^{\text{lowest}} \times SurgProp
\]  

(5)

For example, the \( CFR_{i,j,k} \) of maternal haemorrhage for women aged 35-39 in Sub-Saharan Africa was calculated as:

\[
CFR_{35,\text{ Sub-Saharan Africa}} = 0.01613 \times (1 - 0.3601) + 0.00015 \times 0.3601 = 0.010376
\]  

(5')

### Table A Interventions needed for maternal haemorrhage

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Per completed pregnancy or delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caesarean*</td>
<td>0.0011</td>
</tr>
<tr>
<td>Blood transfusion (antepartum)</td>
<td>0.0073</td>
</tr>
<tr>
<td>Blood transfusion (postpartum)</td>
<td>0.0125</td>
</tr>
<tr>
<td>Additional supplies</td>
<td>0.0125</td>
</tr>
<tr>
<td>Treatment of bleeding lasting &gt;24 hrs</td>
<td>0.0075</td>
</tr>
<tr>
<td>Manual removal of placenta*</td>
<td>0.0100</td>
</tr>
<tr>
<td>Repair of vaginal or perineal tear*</td>
<td>0.0050</td>
</tr>
<tr>
<td>Repair of cervical tears*</td>
<td>0.0050</td>
</tr>
<tr>
<td>Hysterectomy*</td>
<td>0.0013</td>
</tr>
<tr>
<td>Total</td>
<td>0.0622</td>
</tr>
</tbody>
</table>

Source: Johns et al.\(^1\)

*These procedures were assumed surgical

### Neonatal encephalopathy

We limited the analysis to the burden of neonatal encephalopathy that can be averted by preventing obstructed labour cases; by caesarean section and instrumental delivery. The first step was to estimate the effect size in reducing the risk of fatal and nonfatal burden. We referred to the assumption of 40% risk reduction that was used in the World Health Organization Choosing Interventions that are Cost Effective (WHO CHOICE) project.\(^2\)\(^-\)\(^4\) However, applying this assumption uniformly to all regions leads to an overestimation of avertable burden for those regions that already have relatively high coverage of surgical care. Therefore we scaled the effect size according to the access to healthcare covariate used in modelling the nonfatal burden in GBD 2010.\(^5\) 0% risk reduction for the region with highest healthcare access; and 40% risk
reduction for that with lowest access (see Table B). Based on these assumptions, the YLLs and YLDs in case of the hypothetical state were calculated as follows:

\[
YLL'_{i,j,k} = Death_{i,j,k} \times (1 - RiskReduction_k) \times StdLifeExpect_i
\]

\[
YLD'_{i,j,k} = \text{PrevMild}_{i,j,k} \times DW_{mild} + \text{PrevSevere}_{i,j,k} \times DW_{severe} \times (1 - RiskReduction_k)
\]

where RiskReduction_k is the calculated reduction rate of mortality and morbidity risks for each super region, PrevMild_{i,j,k} is the prevalent mild cases in 2010, and PrevSevere_{i,j,k} the prevalent moderate to severe cases in 2010. For example, the YLL'_{i,j,k} of neonatal encephalopathy for male infants in North Africa & Middle East was calculated as:

\[
YLL'_{0,M,North \text{ Africa} \& \text{ Middle East}} = 8,844 \times (1 - 0.16) \times 86.4 = 641,862
\]

Table B Adjusted risk reduction

<table>
<thead>
<tr>
<th>East Europe &amp; Central Asia</th>
<th>Sub-Saharan Africa &amp; North Africa &amp; Middle East</th>
<th>Asia South</th>
<th>East Asia Pacific</th>
<th>Latin America &amp; Caribbean</th>
<th>High-income</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>39%</td>
<td>16%</td>
<td>40%</td>
<td>9%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Injury

In order to account for injury cases that result in deaths before reaching a hospital, we obtained information from survey literature\(^6\)\(^\text{--}^3\)\(^5\) and country-level hospital data (Brazil, USA, South Africa) from a total of 18 countries on the proportion of deaths that never make it to hospital, and pooled and extrapolated those data to regions where there was no information available by means of DisMod-MR (see Table C). With this proportion of fatal pre-hospital cases, we adjusted the case fatality rates for each super region as follows:

\[
CFR'_{i,j,k} = CFR_{i,j,k} \times NotReachProp_k + CFR_{i,j,k}^{\text{lowest}} \times (1 - NotReachProp_k)
\]

where NotReachProp_k is the proportion of fatal cases that take place before reaching hospitals in each region. For example, the CFR'_{i,j,k} of road injury for men aged 75-79 in Asia South was calculated as:

\[
CFR'_{75,M,Asia \text{ South}} = 0.04612 \times 0.46 + 0.01772 \times (1 - 0.46) = 0.03078
\]
Table C Average cause-specific proportions of fatal cases prior to reaching hospitals

<table>
<thead>
<tr>
<th></th>
<th>East Europe &amp; Central Asia</th>
<th>Sub-Saharan Africa</th>
<th>North Africa &amp; Middle East</th>
<th>Asia South</th>
<th>East Asia Pacific</th>
<th>Latin America &amp; Caribbean</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road injury</td>
<td>54%</td>
<td>60%</td>
<td>49%</td>
<td>46%</td>
<td>55%</td>
<td>51%</td>
<td>54%</td>
</tr>
<tr>
<td>Other transport injury</td>
<td>75%</td>
<td>72%</td>
<td>71%</td>
<td>60%</td>
<td>72%</td>
<td>71%</td>
<td>72%</td>
</tr>
<tr>
<td>Falls</td>
<td>26%</td>
<td>55%</td>
<td>36%</td>
<td>65%</td>
<td>34%</td>
<td>30%</td>
<td>38%</td>
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<td>Fire, heat and hot substances</td>
<td>47%</td>
<td>45%</td>
<td>33%</td>
<td>36%</td>
<td>43%</td>
<td>43%</td>
<td>43%</td>
</tr>
<tr>
<td>Unintentional injury others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure to mechanical forces</td>
<td>63%</td>
<td>72%</td>
<td>59%</td>
<td>59%</td>
<td>63%</td>
<td>57%</td>
<td>63%</td>
</tr>
<tr>
<td>Adverse effects of medical treatment</td>
<td>12%</td>
<td>16%</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
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<tr>
<td>Animal contact (non-venomous)</td>
<td>42%</td>
<td>73%</td>
<td>46%</td>
<td>75%</td>
<td>51%</td>
<td>43%</td>
<td>53%</td>
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<td>Unintentional injuries not classified elsewhere</td>
<td>51%</td>
<td>68%</td>
<td>49%</td>
<td>58%</td>
<td>54%</td>
<td>49%</td>
<td>55%</td>
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<tr>
<td>Interpersonal violence</td>
<td>66%</td>
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<td>65%</td>
<td>64%</td>
<td>66%</td>
<td>65%</td>
<td>67%</td>
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<tr>
<td><strong>Female</strong></td>
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</tr>
<tr>
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</tr>
<tr>
<td>Other transport injury</td>
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<td>73%</td>
<td>72%</td>
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<td>73%</td>
<td>72%</td>
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<tr>
<td>Falls</td>
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<td>32%</td>
<td>28%</td>
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</tr>
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<td>58%</td>
<td>53%</td>
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<tr>
<td>Adverse effects of medical treatment</td>
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<td>11%</td>
<td>11%</td>
<td>11%</td>
<td>8%</td>
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<td>42%</td>
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</table>
References


