# Codebook for R Tool on Covid19 QALYS

- Tool by Prof Andrew Briggs developed in Excel information: https://www.lshtm.ac.uk/research/centres-projects-groups/chil#covid-19
- Based on v4.0 of Excel tool
- R code written by Nichola Naylor June 2020

## Inputs

- Excel file (inputs.xslx) with the following information:
  - Life table – probability of dying between ages $x$ and $x+1$
    - Note copied this for age=100 to age=120
  - $qol(x)$ = Population quality of life norms for different ages
  - Age distribution of deaths from covid19
- User defined inputs through the app interface:
  - Discount rate (r)
  - Standard mortality ratio (smr) - summarizes how a given comorbidity can increase the risk of dying. For example, an smr=1 shows no adjustment for comorbidities. [1]
  - qcm – comorbidity impacts on QALYs
  - Choice of country, current options are (see data dictionary for sources):
    - Canada
    - Israel
    - Norway
    - UK
    - USA
  - To add your country data – will include an option for this in next version.
  - Please note the current version does not contain error messages, therefore please ensure data are correct before entering new data (e.g. age distribution summation equaling 1).

## Outputs

- Mean life expectancy loss associated with Covid19 per 100,000 population
- Mean quality-adjusted life expectancy loss associated with Covid19 per 100,000 population
- Mean quality-adjusted life years lost associated with Covid19 per 100,000 population

## Functions

- $q(x)$ = probability of dying between x and x+1
- $d(x) = -ln(1-q(x))$
- $l(x)$ = number surviving to age $x \geq 1$ per 100,000= $l(x-1) * exp(-d(x) * SMR)$ , where l(0)=100,000
- $l(x)$ is estimated for females and males separately, and then averaged to get a "person" estimate using:
  - proportion female = $p(female) = \frac{l_{female}(x)}{l_{female}(x)+l_{male}(x)}$
  - $l_{person}(x) = p(f) * l_{female}(x) + \big(1-p(f)\big) * l_{male}(x)$
- $L(x) = (l(x)+l(x+1))/2$
- $T(x) = \sum_{u=x}^{\omega} L(u)$, $\omega$ is the upper bound of life-expectancy reported in the life table (e.g. 100 years old for the UK).
- $LE(x) = \frac{T(x)}{l(x)}$
- $z(x) = L(x) * qol(x) * qCM$
- $T_{adj}(x) = \sum_{u=x}^{\omega} Z(u)$

[1] Using life table methods to calculate QALY losses from deaths: with application to COVID-19, Andrew Briggs, LSHTM, May 13, 2020

- $QALE(x) = \frac{T_{adj}(x)}{l(x)}$
- $B(x) = \sum_{u=x}^{\omega} \frac{z(x)}{(1+r)^{(x-u)}}$
    - For example, if a person died at age 2 , for u=2,3…. $\omega$ :
    - $B(2) = \frac{z(2)}{(1+r)^{(2-2)}} + \frac{z(3)}{(1+r)^{(3-2)}} + \ldots + \frac{z(\omega)}{(1+r)^{(\omega-2)}}$
- $dQALY(x) = \frac{B(x)}{l(x)}$
- Weighted loss(LE) = $\sum_0^{\omega} pd(x) * LE(x)$ , where $pd(x)$ = proportion of covid19 deaths of age $x$ (for the purposes of this tool this is the mean age of the specified groupings).

## To update data for countries currently included:

- The input excel ("input.slxs") that is used has the following layout: (variable names and first values shown)
    - male_LT:

| Age | UK | US | Canada | Norway | Israel |
|---|---|---|---|---|---|
| 0 | 0.0042 | 0.006302 | 0.00477 | 0.002 | 0.003336 |

    - female_LT:

| Age | UK | US | Canada | Norway | Israel |
|---|---|---|---|---|---|
| 0 | 0.003548 | 0.005226 | 0.00427 | 0.002 | 0.002937 |

    - qol_norm:

| Age band | Low | high | UK | US | Canada | Norway | Israel |
|---|---|---|---|---|---|---|---|
| 0-17 | 0 | 17 | 1 | 1 | 1 | 0.89 | 0.985461 |

    - age_covid:

| Age band | low | high | UK | US | Canada | Norway | Israel |
|---|---|---|---|---|---|---|---|
| 0-9 | 0 | 9 | 0.00004 | 0.000222 | 0 | 0 | 0 |

- Data can be updated to match this formatting.
- Previously, for the excel model, downloaded/"copy and pasted" tables from the statistics websites were converted into these. This functionality is present in the excel file "LookupTables_converter_v1.0.xlsx". If data are downloaded or copied into similar tables this may then update the tab "LookUpTables" that can then be copied into "inputs.xlsx". Note the model does not directly use the lookuptables_coverter file.
- Once the new data in "inputs.xlsx" have been saved, the app can be rerun.

## To add data for new countries:

- Add in the data dictionary references for data on all inputs needed.
- For every single tab in "inputs.xslx" add a new column with the country name e.g.

| Age band | low | high | UK | US | Canada | Norway | Israel | **France** |
|---|---|---|---|---|---|---|---|---|
| 0-9 | 0 | 9 | 0.00004 | 0.000222 | 0 | 0 | 0 | 0 |

- Within the "app.R" RScript update the following code within the 'ui' section:

```
## nationality

        radioButtons(inputId="country", label="Country",

                     choices=c("UK", "US","Canada","Norway","Israel" ,"France" ), selected = "UK"),
```

- Rerun app accordingly.