# SOURCE FILES + NOTES ON DOCUMENTATION

## MISC/USER INPUT

**user\_input.R**

* User\_input
  + So far, this function is not in use at all ! It is supposed to represent the user\_input tab of the esft excel workbook, however is not actualized. It seems like any function provided by it could be superseded by base R subsetting functions. I might get rid of this entirely.

**utils.R**

* Approx\_sum
  + This is used by one function, the get\_country\_capacity function. It was initially written by giovanni, and is used to double check that some percentages input do not sum to zero. Can potentially be incorporated into more checks.

**esft.R**

* This does not contain any functions per say, but instead includes the rlang .data and %>% piping importation, in addition to some code that quiets some errors.

## DATA

**load\_imperial\_data.R**

* Read\_url
  + This is a function that comes from a stackoverflow response, it tests urls using the libcurl message to first see if its possible to access the url.
* Load\_imperial\_data
  + This calls the read url function - it takes as input a country code and scenario and then calls the requisite url to download that specific fit data.

**data.R**

* Contains data object descriptions - for all of the data input tabs/dataframes used in the package. Corresponds to a lot of subsets of the esft data sheet.
* Includes:
  + Who - HCW estimates, and bed estimates
  + Icl\_data - imperial model fits to excess death data
  + Wb\_beds - world bank estimates of number of hospital beds per country, by year
  + Bed\_nr\_proxy - income group averages of hospital beds per 1000 people
  + Bed\_perc\_crit\_proxy - income group averages of percentage of beds allocated to critical care
  + Hwfe - HWFE data - shows patient time per 24 hours by severity type and hcw cadre (need to double check if this is actually HWFE data, or if the HWFE estimates actually go into the who dataframe - since this isestimates of hours per patient)
    - This actually uses the “Staffing from HRH tool” tab
    - Note: HWFE tool methodology, combined with LMIC-specific inputs from consultations, e.g., with Ethiopian clinical leads
  + Diagnostics - estimates of diagnostic capacity per country (num machines)
  + Pharmaceuticals - types of drug per person per day
  + Equipment - equipment required per patient and HCW per day
  + Transmission\_scenarios - R numbers and labels of three different transmission scenarios
  + Population - UNDP population data
  + Hours\_per\_shift - hours per shift for diagnostic machines
  + Capacity\_perc - percent capacity dedicated to covid, diagnostic machines
  + Throughput - basically how much each machine can do for diagnostic processing per shift
  + Noncovid - equipment need estimates for noncovid healthcare capacity

## PARAMETERS

**scenario\_parameters.R**

* Set\_scenarios
  + This associates scenarios with the imperial labels/R numbers.
  + Maybe this can be combined with the load imperial data somehow?

**hcw\_caps.R**

* Hcw\_caps\_static
  + Updated - this gies static caps based on hcw capacity and parameters, just a list of the caps
  + Its the number of HCWs times the perc allocated
  + And capped lab staff, by percentage of the machine allocated to covid
* Hcw\_caps\_dynamic
  + Based on beds in use per week capped by bed cap, estimates HCW need
  + Theres a division of 8 here that is not obvious
  + First you get specific cleaner counts per severe/critical bed - get the hours per 24 hrs, divided by( 8 \* severe beds in use/total beds in use \*10)
    - Sum that up
  + Then HCWs per severe/crit bed - which is patient time per 24 hrs / (8 \* sum of sev beds in use/sum of total beds in use)
    - Then sum those
    - Maybe to allow for constant supply of HCWs???
  + Rest of the cadres are just total beds in use \* cadre per bed, from params

**parameters.R**

* Get\_parameters
  + List of parameters set in the inputs and user dashboard tabs

**diagnostic\_parameters.R**

* Set\_testing\_strategy
  + Almost unnecessarily long / fancy
  + But sets the different parameters with testing strategy
  + Althoug the only thing that chanes is the name of the strategy and the perc tested,
  + And theres a check for correctly setting percentages, but thats it
* Get\_diagnostic\_parameters
  + From user dashboard
  + These are preset parameters
* Get\_lab\_parameters
  + These are a collection of preset parameters, and a number which are implicitly assumed in the back calculations (percent wastage, num tests in manual test kits)
  + Could expand on these if we want to implement the same in the other types of test kits

## CAPACITY (COUNTRY-SPECIFIC)

**country\_capacity.R**

* Get\_country\_capacity
  + Reads in country capacity from WHO capacity estimate sheets - which comes from a miz of sources, including world bank, the UN population division, and others
  + Also double checks the percentage of beds adds up to bout 100%

**diagnostic\_parameters.R**

* Total\_labs
  + Calculates total max labs that could be available for COVID, based on numbers of modules activated per machine - all have 3 modules per machine (I think thats what the number means - double check) except for genexpert, which has 4
  + Definitely needs num modules activated
* Get\_country\_test\_capacity
  + First one you need to do in this order
  + Basically queries the esft diagnostics R file, which is an internal reference sheet
  + You query based on iso3c code
  + With the potential to override if you have updated info
* Calc\_diagnostic\_capacity
  + Takes in the info fromthe country\_test\_capacity function - so num machines
  + Then also loads in the throughput data (estimates of test processed per shift per machine), also number of shifts per day and hours per shift
  + Uses this to calculate number of total tests can be performed per day
  + Throughput dataframe has the percentage allocated to covid - might want to change this to something the user can more easily access
* Test\_ratios
  + Using the calculated covid test capacity and preset percentage of tests that are antigen, back calculate what that means as actual number of antigen tests and percentage of total tests that are covid

## WEEKLY SUMMARY

**cases\_weekly.R**

* Cases\_weekly
  + Per week, calculates new and removed mild, moderate, severe, and critical cases
  + Severe: hospital incidence, capped by number of severe beds allocated to covid
  + Critical: ICU incidence, capped by critical beds allocated to COVID
  + mild/ moderate, two ways:
    - First: Sum of severe cases and critical caes \* (proportion mild/mod)/sum(proportion severe + critical)
    - Second: Infections \* proportion of severity
      * This is also the second method for severe and critical
  + Removed cases are the previous new cases shifted back the parameter for length of stay in weeks

**diagnostics\_weekly.R**

* Max\_tests\_per\_day
  + Uses diagnostic capacity from calc\_diagnostic\_capacity (so country specific) to calculate the max number of tests per day.
* Diagnostics\_weekly
  + Calculates tests per week, capped and uncapped, for diagnosis, release, for mild/moderate, and suspected cases
  + Uncapped sev/crit for diagnosis:
    - Number of new cases severe or critical per week \* number of tests for diagnosis
  + Capped sev/crit for diagnosis:
    - Admitted severe/critical cases with caps times tests for diagnosis
  + Uncapped sev/critical for release:
    - Removed patients severe \* (1-ifr severe) \* tests for release + removed patients critical \* (1-ifr critical) \* tests for release
  + Capped sev/crit for release:
    - Discharged patients severe \* (1-ifr severe) \* tests for release + discharged patients critical \* (1-ifr critical) \* tests for release
  + Mild/moderate cases (done separately, but same calculation):
    - new mild cases \* tests diagnosis (and if targeted strategy, \* perc tested of mild mod)
  + Suspected: suspected cases but negative \* tests diagnosis mild/mod \* perc tested of mild/mod

**hcw\_tests.R**

* Total\_tests
  + Calculates weekly total tests - sums up all the tests from diagnostics weekly, ten caps by the max number of tests can be done per week (from max tests per day - which is country specific and depends on diagnostic capacity)
* Additional\_testing
  + Calculates tests per HCW per week as well as tests for contacts, depending on testing strategy - needs hcws, tests\_weekly, parameters, screening HCWs, and testing strategy
* Screening\_hcw\_weekly
  + Calculates num HCWs required in order to do all the testing we estimate
  + So takes diagnostics weekly output, and then calculates it in capped and uncapped versions
  + = (tests suspected + tests mild + tests moderate)/(7\*num cases screened per HCW per day)
  + You cap this output by finding minimum of ^ the above and num hcws \* percent of hcws allocated to screening for covid

**patients\_weekly.R**

* Patients\_weekly
  + This one calculates beds and patients, and takes in capacity estimates, parameters, and cases from cases\_weekly to estimate bed usage
  + Mild\_patients\_nocap, mod\_patients\_nocap:
    - Cum mild/mod cases - cum removed mild/mod cases
  + sev\_patients\_nocap, crit\_patients\_nocap,
    - Hospital / ICU demand
  + Sev\_beds\_inuse, crit\_beds\_inuse,
    - crit/severe patients no cap, capped by critical or severe beds
  + Total\_beds\_inuse
    - sum of severe beds and critical beds in use
  + Hosp\_facilities\_inuse
    - Rounded up sum of beds in use / number of hospital beds per care unit
  + Rem\_mild\_patients, rem\_mod\_patients
    - Shifted new mild/moderate patients by the length of stay (parameter, in weeks)
  + rem\_sev\_patients, rem\_crit\_patients,
    - Cumulative removed sev/critical cases - cumulative removed cases shifted back by one week
  + Discharged\_sev\_patients, discharged\_crit\_patients
    - Admitted severe/critical cases, shifted back by stay in week

**hcws\_weekly.R**

* Hcws\_weekly
  + Hcws\_inpatient\_capped = total beds in use \* hcws per bed
  + hcws\_inpatient\_uncapped = min of calc above^ and the cap for inpatient hcws
  + Inf\_caregivers\_hosp\_uncapped = total beds in use \* number of informal caregivers in hospital
  + Cleaners\_inpatient\_capped = minimu of total beds in use \* hygienists per bed, and the inpatient cleaners cap
  + Amb\_personnel\_inpatient\_capped = cap of ambulance personnel inpatient
  + Bio\_eng\_inpatient\_capped = cap of biological engineer inpatient
  + Inf\_caregivers\_isol\_uncapped = (tests mild + tests moderate)/num informal caregivers isolation
  + Lab\_staff\_capped = minimum total labs from total labs function \* lab staff per lab, and the number of labs from params
  + Cleaners\_lab = total labs (from total labs function)\* hygienists per lab (from parameters)

## COMMODITY FORECASTS

**commodities\_forecast.R**

* Commodities\_weekly
  + Wrapper function for all of them
  + Idk if this is super useful/what we would actually like to do tbh
* Hygiene\_forecast
  + Amount\_inpatient\_hcw = hcws\_inpatient\_capped \*amount\_per\_inpatient\_hcw\_per\_day + cleaners\_inpatient\_capped \* amount\_per\_inpatient\_cleaner\_per\_day + inf\_caregivers\_hosp\_uncapped \* amount\_per\_inpatient\_inf\_caregiver\_per\_day + amb\_personnel\_inpatient\_capped \* amount\_per\_inpatient\_ambworker\_per\_day + bio\_eng\_inpatient\_capped \* amount\_per\_inpatient\_biomed\_eng\_per\_day
  + amount\_inpatient\_patient = total\_beds\_inuse \* amount\_per\_inpatient\_sev\_crit\_patient\_per\_day + sev\_beds\_inuse \* amount\_per\_inpatient\_sev\_patient\_per\_day + crit\_beds\_inuse \* amount\_per\_inpatient\_crit\_patient\_per\_day
  + amount\_isolation =
    - if reusable:

inf\_caregivers\_isol\_uncapped \* params$stay\_mild + tests\_mild \* params$stay\_mild + tests\_mod \* params$stay\_mod

* If not:

inf\_caregivers\_isol\_uncapped \*amount\_per\_isolation\_inf\_caregiver\_per\_day \* params$stay\_mild + tests\_mild \* params$stay\_mild \* amount\_per\_isolation\_patient\_per\_day + tests\_mod \* params$stay\_mod \* amount\_per\_isolation\_patient\_per\_day

* + Amount\_screening\_hcw
    - If reusable:

If amount\_per screening hcw per day > 0, number of screening hcw capped, else 0 +

If amount per screening patient per day >0, tests mild + tests moderate

* If not:

screening\_hcw\_capped \* amount\_per\_screening\_hcw\_per\_day + tests\_mod \* amount\_per\_screening\_patient\_per\_day \* params$stay\_mod +tests\_mild \* amount\_per\_screening\_patient\_per\_day \* params$stay\_mild

* + Amount\_lab
    - If reusable:

If amount\_per lab tech per day > 0, lab staff capped, else 0 +

If amount per lab cleaner per day >0, cleaners in a lab, else 0

* + - If not:

lab\_staff\_capped \* amount\_per\_lab\_tech\_per\_day + cleaners\_lab \* amount\_per\_lab\_cleaner\_per\_day

* Case\_management\_forecast
  + First you create a reusable multiplier:
    - it is 7 if the item is not reusable, 1 if it is
    - You times the amount needed per patient, hcw, whatever by the reusable multiplier
  + Then you calculate the demand for severe patients, critical patients, and both (sum):
    - Sev beds in use\*amount per inpatient severe patient per day + severe beds in use\*amount per inpatient severe bed per day
    - Only one of these amounts is nonzero, so avoids double counting
  + First amounts are calculated by taking the first week fo the forecast, and rounding up the demand
  + Then for the rest of the forecast, the amount is calculated by:
    - If the item is reusable:
      * Take the cumulative sum of what has been previously donated/forecasted
      * Find the maximum of the difference between current demand and this cumulative sum (demand - sum) and 0
      * If current demand>cumulative sum, demand-sum, else 0
    - If not reusable, just say the amount is the demand
  + Amount\_sev\_patient, crit patient, and sev\_crit\_patient (sum for both)
* Ppe\_forecast
  + First you create a reusable multiplier:
    - it is 7 if the item is not reusable, 1 if it is
    - You times the amount needed per patient, hcw, whatever by the reusable multiplier - this gets used in the following calculations:
  + Amount\_inpatient\_hcw = hcws\_inpatient\_capped \* amount\_per\_inpatient\_hcw\_per\_day + cleaners\_inpatient\_capped \* amount\_per\_inpatient\_cleaner\_per\_day + inf\_caregivers\_hosp\_uncapped \* amount\_per\_inpatient\_inf\_caregiver\_per\_day + amb\_personnel\_inpatient\_capped \*amount\_per\_inpatient\_ambworker\_per\_day +bio\_eng\_inpatient\_capped \* amount\_per\_inpatient\_biomed\_eng\_per\_day
  + amount\_inpatient\_patient = total\_beds\_inuse \* amount\_per\_inpatient\_sev\_crit\_patient\_per\_day + sev\_beds\_inuse \* amount\_per\_inpatient\_sev\_patient\_per\_day + crit\_beds\_inuse \* amount\_per\_inpatient\_crit\_patient\_per\_day
  + amount\_isolation
    - If reusable: inf\_caregivers\_isol\_uncapped \* params$stay\_mild + tests\_mild \* params$stay\_mild + tests\_mod \* params$stay\_mod
    - Else : inf\_caregivers\_isol\_uncapped \* amount\_per\_isolation\_inf\_caregiver\_per\_day \* params$stay\_mild + tests\_mild \* params$stay\_mild \* amount\_per\_isolation\_patient\_per\_day +

tests\_mod \* params$stay\_mod \* amount\_per\_isolation\_patient\_per\_day

* + Amount\_screening\_hcw
    - If reusable:
      * If amount per screening hcw per day >0, screening hcws, else 0 +
      * If amount per screening patient per day > 0, tests mild + tests mod
    - Else: screening\_hcw\_capped \* amount\_per\_screening\_hcw\_per\_day + tests\_mod \* amount\_per\_screening\_patient\_per\_day \* params$stay\_mod + tests\_mild \* amount\_per\_screening\_patient\_per\_day \*params$stay\_mild
  + Amount\_lab
  + If reusable:

If amount\_per lab tech per day > 0, lab staff capped, else 0 +

If amount per lab cleaner per day >0, cleaners in a lab, else 0

* + If not:

lab\_staff\_capped \* amount\_per\_lab\_tech\_per\_day + cleaners\_lab \* amount\_per\_lab\_cleaner\_per\_day

* Diagnostic\_forecast
  + Calculations per item (grep/string match following terms)
    - Manual PCR = total tests capped \* ratio of manual tests / (percentage wastage of manual test kits \* number of tests per manual test kit)
    - Triple packaging = hospital facilities in use \* number of triple packaging per hospital unit
    - Swab and viral = total tests capped
    - High-throughput = total tests capped\*ratio of high throughput tests
    - RT-PCR cartridge = total tests capped \* ratio of near patient tests
    - Antigen rapid diagnostic tests = total tests capped \* ratio of antigen tests

**noncovid\_essentials.R**

* Reference\_hcw
  + Either loads presets or WHO estimates of hcw (<https://apps.who.int/gho/data/node.main.HWFGRP?lang=en>)
  + Num doctors = doctors\*perc not covid
  + Nurses = nurses\*perc hcws not covid
  + Labs = labs \* (1-mean covid capacity of throughput machines)
  + Rest are just number of HCWs of different cadres, since they dont segregate by covid status
* Noncovid\_essentials:
  + Amount per hcw, by cadre:
  + If reusable: ref\_hcws$n\_nurses
  + Else: ref\_hcws$n\_nurses \* amount\_per\_noncovid\_nurse\_per\_day \* days\_week \* forecast\_length

**pharma\_forecast.R**

* Pharma\_forecast:
  + Not a weekly calculation, is total, this can be changed
  + total\_drug\_form\_all\_mild\_treated = sums$new\_mild\_cases\*form\_per\_mild\_course\*perc\_mild\_treated,