Estimating vaccine impact with *vimpact* : : CHEAT SHEET

The package provides a set of functions to load datasets & quantify vaccination impact in terms of cases, deaths and DALYs averted

I. Installation

```
devtools::install_github("vimc/vimpact")
```

II. Reading burden estimates

ASSUMPTIONS FOR A THEORETICAL COUNTRY

1. Static model
2. Constant routine immunisation
3. One-off campaign

LOADING DATA: BASELINE vs FOCAL SCENARIO

No-immunisation (baseline)

```
example_novax <-
  read.csv(
    system.file("extdata/example_novax_burden.csv",
                package = "vimpact"))
```

Routine immunisation (focal)

```
example_routine <-
  read.csv(
    system.file("extdata/example_routine_burden.csv",
                package = "vimpact"))
```

Campaign immunisation

```
example_routine_campaign <-
  read.csv(
    system.file("extdata/example_routine_campaign_burden.csv",
                package = "vimpact"))
```

How does the data look ▶

```
str(example_novax)
#> 'data.frame':   10201 obs. of  6 variables:
#> $ country       : chr  "ABC" "ABC" "ABC" "ABC" ...
#> $ year          : int  2000 2000 2000 2000 2000 2000 2000 ...
#> $ age           : int  0 1 2 3 4 5 6 7 8 9 ...
#> $ value         : int  16 15 14 13 12 11 11 10 ...
#> $ activity_type : chr  "novax" "novax" "novax" "novax" ...
#> $ burden_outcome: chr  "deaths" "deaths" "deaths" "deaths" ...

str(example_routine)
#> 'data.frame':   10201 obs. of  6 variables:
#> $ country       : chr  "ABC" "ABC" "ABC" "ABC" ...
#> $ year          : int  2000 2000 2000 2000 2000 2000 2000 ...
#> $ age           : int  0 1 2 3 4 5 6 7 8 9 ...
#> $ value         : int  16 15 14 13 13 12 12 11 11 10 ...
#> $ activity_type : chr  "routine" "routine" "routine" "routine" ...
#> $ burden_outcome: chr  "deaths" "deaths" "deaths" "deaths" ...
```
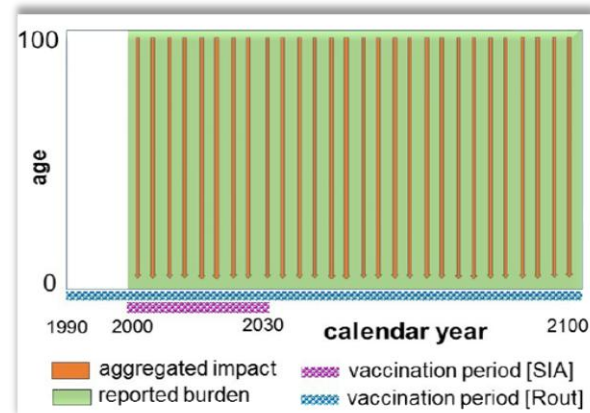
Burden outcomes observed: deaths/cases/DALYs ▶
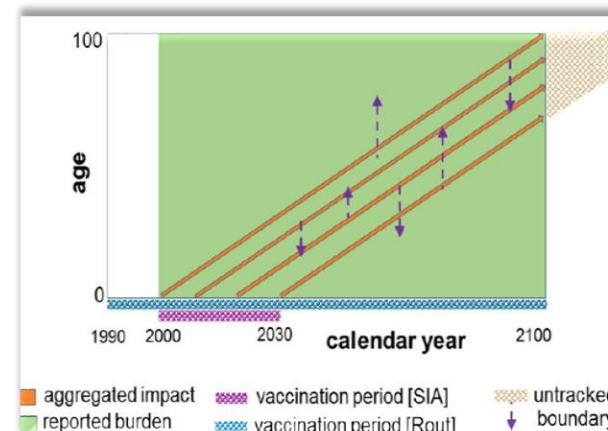
Year range: 2000-2100 ▶

III. Calculating impact estimates

By calendar year
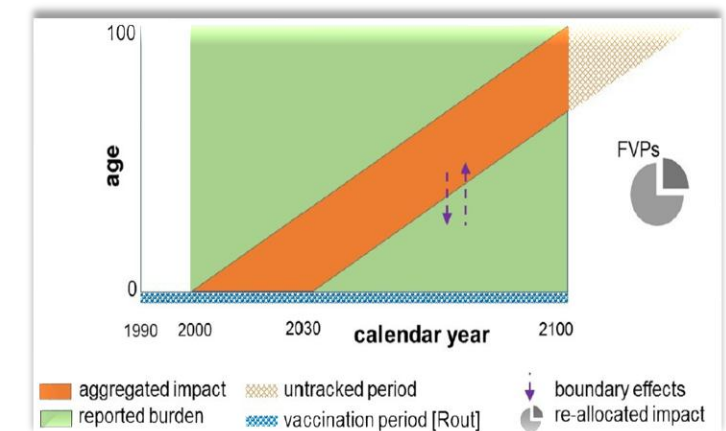
Impact accrual: All ages, specific year

- aggregated impact
- reported burden
- vaccination period [SIA]
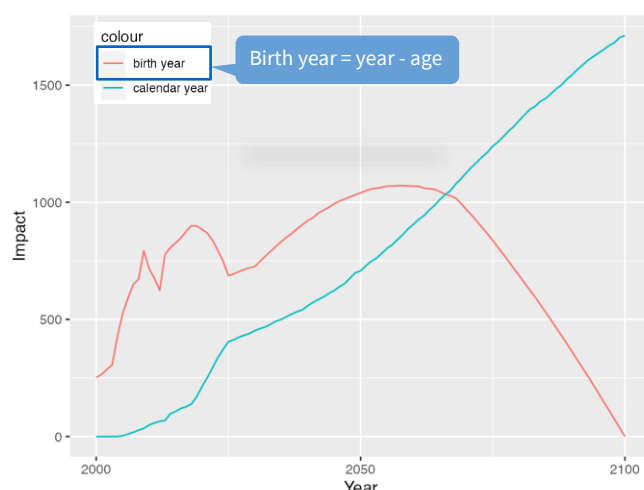- vaccination period [Rout]

GENERATE ESTIMATES

```
calendar_year <-
  vimpact::impact_by_calendar_year(
    baseline_burden = example_novax,
    focal_burden = example_routine_campaign)
```

Impact estimates only for common groups in focal & baseline dataset

How does the data look? ▶

```
str(calendar_year)
#> tibble [101 × 4] (S3: tbl_df/tbl/data.frame)
#> $ country       : chr [1:101] "ABC" "ABC" "ABC" "ABC" ...
#> $ burden_outcome: chr [1:101] "deaths" "deaths" "deaths" "deaths" ...
#> $ year          : int [1:101] 2000 2001 2002 2003 2004 2005 2006 ...
#> $ impact        : int [1:101] 0 0 0 0 3 11 18 27 35 ...
```


Birth year = year - age

By birth/cohort year

Impact accrual: vaccinated birth cohorts

- aggregated impact
- reported burden
- vaccination period [SIA]
- vaccination period [Rout]
- untracked
- boundary

GENERATE ESTIMATES

```
birth_year <-
  vimpact::impact_by_birth_year(
    baseline_burden = example_novax,
    focal_burden = example_routine_campaign)
```

How does the data look? ▶

```
str(birth_year)
#> tibble [201 × 4] (S3: tbl_df/tbl/data.frame)
#> $ country       : chr [1:201] "ABC" "ABC" "ABC" "ABC" ...
#> $ burden_outcome: chr [1:201] "deaths" "deaths" "deaths" "deaths" ...
#> $ birth_cohort  : int [1:201] 1900 1901 1902 1903 1904 1905 1906 ...
#> $ impact        : int [1:201] 0 0 0 0 0 0 0 0 0 0 ...
```

How do the two compare? ▶

```
birth_year$year <- birth_year$birth_cohort
birth_year$impact_birth_year <- birth_year$impact
calendar_year$impact_calendar_year <- calendar_year$impact
plot_data <- merge(birth_year, calendar_year,
                   by = c("country", "burden_outcome", "year"))
plot_data$year <- as.Date(paste(plot_data$year, "01", "01", sep = "-"))
ggplot2::ggplot(plot_data, ggplot2::aes(x = year)) +
  ggplot2::geom_line(ggplot2::aes(
    y = impact_birth_year, colour = "birth year")) +
  ggplot2::geom_line(ggplot2::aes(
    y = impact_calendar_year, colour = "calendar year")) +
  ggplot2::expand_limits(y = 0) +
  ggplot2::ylab("Impact") +
  ggplot2::xlab("Year")
```

By year of vaccination

Impact accrual: all vaccination activities in a year

- aggregated impact
- reported burden
- untracked period
- vaccination period [Rout]
- boundary effects
- re-allocated impact

LOAD DATA ON FVPS (Fully Vaccinated Persons)

FVP = Cohort size * Coverage

```
example_fvps <-
  read.csv(system.file("extdata/example_fvps.csv",
                       package = "vimpact"))
```

GENERATE IMPACT STRATIFIED BY ACTIVITY TYPE

```
routine <-
  vimpact::impact_by_year_of_vaccination_activity_type(
    baseline_burden = example_novax,
    focal_burden = example_routine,
    fvps = example_fvps[example_fvps$activity_type == "routine",],
    2000:2030)

campaign <-
  vimpact::impact_by_year_of_vaccination_activity_type(
    baseline_burden = example_routine,
    focal_burden = example_routine_campaign,
    fvps = example_fvps[example_fvps$activity_type == "campaign",],
    2000:2030)

activity_type <- rbind(routine, campaign)
```

How does the data look? ▶

```
str(activity_type)
#> tibble [35 × 8] (S3: tbl_df/tbl/data.frame)
#> $ country       : chr [1:35] "ABC" "ABC" "ABC" "ABC" ...
#> $ vaccine       : chr [1:35] "YF" "YF" "YF" "YF" ...
#> $ activity_type : chr [1:35] "routine" "routine" "routine" "routine" ...
#> $ year          : int [1:35] 2004 2005 2006 2007 2008 2009 2010 2011 ...
#> $ burden_outcome: chr [1:35] "deaths" "deaths" "deaths" "deaths" ...
#> $ impact        : num [1:35] 184 323 404 478 479 ...
#> $ impact_ratio  : num [1:35] 0.168 0.168 0.168 0.168 0.168 ...
#> $ fvps          : int [1:35] 1090 1919 2397 2838 2842 4008 2971 2310 ...
```

Impact Ratio = impact / fvps
(impact attributable per fully vaccinated person) ▶

VACCINE IMPACT MODELLING CONSORTIUM