Adoption and impact of non-pharmaceutical interventions for COVID-19

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Package

Extract variables of potential interest from linelist

```
extracted_linelist <- readr::read_csv("raw-data/linelist.csv") %>%
  dplyr::as_tibble() %>%
  dplyr::select(country, city, province, date_confirmation, travel_history_location) %>%
  dplyr::mutate(import_status = dplyr::if_else(is.na(travel_history_location) |
                                                 travel_history_location == "", "local", "imported"))
```

```
## Parsed with column specification:
## cols(
##   .default = col_character(),
##   ID = col_double(),
##   `wuhan(0)_not_wuhan(1)` = col_double(),
##   latitude = col_double(),
##   longitude = col_double(),
##   data_moderator_initials = col_logical(),
##   V34 = col_logical(),
##   V35 = col_logical(),
##   V36 = col_logical(),
##   V37 = col_logical(),
##   V38 = col_logical(),
##   V39 = col_logical(),
##   V40 = col_logical(),
##   V41 = col_logical()
## )
```

```
## See spec(...) for full column specifications.
```

```
## Warning: 656 parsing failures.
##  row                     col           expected actual                    file
## 5835 data_moderator_initials 1/0/T/F/TRUE/FALSE     SL 'raw-data/linelist.csv'
## 5836 data_moderator_initials 1/0/T/F/TRUE/FALSE     SL 'raw-data/linelist.csv'
## 5837 data_moderator_initials 1/0/T/F/TRUE/FALSE     SL 'raw-data/linelist.csv'
## 5838 data_moderator_initials 1/0/T/F/TRUE/FALSE     SL 'raw-data/linelist.csv'
## 5839 data_moderator_initials 1/0/T/F/TRUE/FALSE     SL 'raw-data/linelist.csv'
## .... ..................... .................. ...... ......................
## See problems(...) for more details.
```

Estimate fraction that are imported

- Based on linelist data alone. Only countries with at least 20 total cases present are shown.

```
## Based on linelist data
prop_cases_imported <- extracted_linelist %>%
  dplyr::count(country, import_status) %>%
  tidyr::spread(key = "import_status", value = "n") %>%
  dplyr::mutate_at(.vars = c("local", "imported"), ~ replace(., is.na(.), 0)) %>%
  dplyr::mutate(linelist_total = imported + local,
                frac_imported = round(imported / linelist_total, 2)) %>%
  dplyr::filter(linelist_total >= 15, !country %in% c("", "China")) %>%
  dplyr::arrange(desc(frac_imported))
```

- Based on linelist data and WH0 sit reps

```
countries <- prop_cases_imported$country
names(countries) <- prop_cases_imported$country

countries["South Korea"] <- "RepublicofKorea"
countries["United Arab Emirates"] <- "UnitedArabEmirates"
countries["United States"] <- "UnitedStatesofAmerica"
countries["Vietnam"] <- "VietNam"
countries["United Kingdom"] <- "UnitedKingdom"
countries <- countries[!is.na(countries)]

country_cases <- countries %>%
  purrr::map_dfr(~ get_who_cases(., daily = TRUE), .id = "country")

total_cases <- country_cases %>%
  dplyr::count(country, wt = cases) %>%
  dplyr::rename(who_total = n)

prop_cases_imported_who <- prop_cases_imported %>%
  dplyr::full_join(total_cases, by = "country") %>%
  dplyr::mutate(who_frac_imported = round(imported / who_total, 2)) %>%
  dplyr::arrange(desc(who_frac_imported)) %>%
  ## Drop USA and thailand
  dplyr::filter(!country %in% c("United States", "Thailand", "Iran"))
```

- Summarise and report

```
tab_cases_imported <- prop_cases_imported_who %>%
  dplyr::select(Country = country, Cases = who_total, `Fraction imported (linelist only)` = frac_importe
                `Fraction imported (WHO sit reps)` = who_frac_imported)

saveRDS(tab_cases_imported, "output-data/cases_imported.rds")

knitr::kable(tab_cases_imported)
```

Country	Cases	Fraction imported (linelist only)	Fraction imported (WHO sit reps)
Vietnam	17	0.69	0.65
Kuwait	58	1.00	0.64
Bahrain	49	1.00	0.41
Canada	51	0.75	0.29
Singapore	130	0.34	0.25

Country	Cases	Fraction imported (linelist only)	Fraction imported (WHO sit reps)
Australia	62	0.88	0.24
Iraq	44	0.44	0.18
United Arab Emirates	45	0.35	0.16
Malaysia	83	0.65	0.13
India	31	0.14	0.13
Japan	408	0.07	0.13
Netherlands	128	0.67	0.09
United Kingdom	167	0.59	0.06
Spain	374	0.44	0.06
Norway	113	0.25	0.04
Germany	639	0.32	0.03
France	613	0.20	0.01
Italy	4636	0.02	0.00
South Korea	6767	0.02	0.00
Austria	66	0.00	0.00
NA	NA	0.58	NA

Plot cases over time

- Wrangle for countries of interest (with at least 40 cases)

```
cum_cases_in_countries <- readr::read_csv("raw-data/countries_of_interest_counts.csv") %>%
    dplyr::filter(!country %in% c("United States", "Thailand", "Iran"))
```

```
## Parsed with column specification:
## cols(
##   date = col_date(format = ""),
##   country = col_character(),
##   cases = col_double()
## )
```

- Get date of first report

```
cum_cases_in_countries %>%
  dplyr::group_by(country) %>%
  dplyr::filter(cases > 0) %>%
  dplyr::filter(cases == min(cases), date == min(date)) %>%
  dplyr::ungroup() %>%
  dplyr::arrange(date) %>%
  dplyr::select(Country = country, `Date of first case report` = date) %>%
  knitr::kable()
```

Country	Date of first case report
Wuhan	2020-01-15
Republic of Korea	2020-01-20
Japan	2020-01-20
Taiwan	2020-01-21
Hong Kong	2020-01-23
Singapore	2020-01-24
Italy	2020-01-31

- Get case counts

```
cases_in_countries <- cum_cases_in_countries %>%
  dplyr::group_by(country) %>%
  ## Cumulative?
  dplyr::mutate(cases = cases - dplyr::lag(cases)) %>%
  dplyr::ungroup()

cases_in_countries <- cases_in_countries %>%
  dplyr::filter(!country %in% "Taiwan") %>%
  dplyr::mutate(
    cases = ifelse(country %in% "Japan",
                   ifelse(date == "2020-02-05", 3,
                          ifelse(date == "2020-02-06", 2, cases)), cases)
  )
```

Get interventions

- Plot overall interventions

```
interventions <- readr::read_csv("raw-data/intervention_dates.csv") %>%
  dplyr::select(date = date_intervention, intervention, country, social_distancing) %>%
  dplyr::mutate(date = date %>%
                  stringr::str_replace_all("/", "-")) %>%
  dplyr::mutate(date = as.Date(date)) %>%
  dplyr::mutate(country = country %>%
                  stringr::str_replace_all("south korea", "Republic of Korea") %>%
                  stringr::str_replace_all("Usa", "United States") %>%
                  stringr::str_to_title() %>%
                  stringr::str_replace_all("Usa", "United States") %>%
                  stringr::str_replace_all("Republic Of Korea", "Republic of Korea")) %>%
  dplyr::mutate(intervention = intervention %>%
                  stringr::str_replace_all("_", " ") %>%
                  stringr::str_to_sentence() %>%
                  stringr::str_replace("School restictions", "School restrictions") %>%
                  stringr::str_replace("Communciation distancing", "Communication distancing"))
```

```
## Warning: Missing column names filled in: 'X8' [8]
```

```
## Parsed with column specification:
## cols(
##   date_intervention = col_date(format = ""),
##   intervention = col_character(),
##   social_distancing = col_character(),
##   country = col_character(),
##   notes = col_character(),
##   ref1 = col_character(),
##   ref2 = col_character(),
##   X8 = col_character()
## )
```

```
summarise_ints <- function(df) {
  df %>%
  dplyr::select(-date) %>%
  dplyr::group_by(country, intervention) %>%
  dplyr::slice(1) %>%
  dplyr::ungroup() %>%
```

```
  dplyr::count(intervention) %>%
  tidyr::drop_na(intervention) %>%
  dplyr::arrange(desc(n)) %>%
  dplyr::select(Intervention = intervention,
                `Countries that have implemented` = n)
}


summarise_interventions <- interventions %>%
  summarise_ints()



saveRDS(summarise_interventions, "output-data/intervention_freq.rds")

knitr::kable(summarise_interventions)
```

Intervention	Countries that have implemented
Health screening	5
School closure	5
Remote working	4
Travel advisory	4
Government on alert	3
Lockdown	3
Quarantine	3
School closure (not related to outbreak)	3
Travel restriction	3
Isolation	2
Mandatory quarantine	2
Mass gathering advisory	2
Mass gathering cancellation	2
School restrictions	2
Social event cancellation	2
Suspending flights	2
Travel ban	2
University closure	2
Work closure (not related to outbreak)	2
[Extension] school and work closure	1
Border checks	1
Border control	1
Communication distancing	1
Communication general	1
Contact tracing	1
Containment to mitigation	1
Decontamination	1
Enhanced care	1
Entry ban	1
Government announcement	1
Healthcare restrictions	1
Mass gathering ban	1
Medical surveillance	1
Prevention measures school	1
Public information	1

Intervention	Countries that have implemented
Raise awareness flights	1
Raise awareness healthcare staff	1
Raise awareness public	1
Reduced shop hours	1
Resumption public services	1
Social distancing misc	1
Strengthening primary care response	1
Supply	1
Surveillance	1
Travel advice	1

- Social interventions only

```
social_interventions <- interventions %>%
  dplyr::filter(social_distancing %in% "yes") %>%
  summarise_ints()

saveRDS(social_interventions, "output-data/social_interventions.rds")

knitr::kable(social_interventions)
```

Intervention	Countries that have implemented
School closure	5
Remote working	4
Lockdown	3
Quarantine	3
School closure (not related to outbreak)	3
Isolation	2
Mandatory quarantine	2
Mass gathering advisory	2
Mass gathering cancellation	2
School restrictions	2
Social event cancellation	2
University closure	2
Work closure (not related to outbreak)	2
[Extension] school and work closure	1
Communication distancing	1
Contact tracing	1
Healthcare restrictions	1
Mass gathering ban	1
Prevention measures school	1
Reduced shop hours	1
Social distancing misc	1
Travel advice	1
Travel restriction	1

- Non-social interventions

```
non_social_interventions <- interventions %>%
  dplyr::filter(social_distancing %in% "no") %>%
  summarise_ints()
```

```r
saveRDS(non_social_interventions, "output-data/non_social_interventions.rds")

knitr::kable(non_social_interventions)
```

Intervention	Countries that have implemented
Health screening	5
Travel advisory	4
Government on alert	3
Travel restriction	3
Suspending flights	2
Travel ban	2
Border checks	1
Border control	1
Communication general	1
Containment to mitigation	1
Decontamination	1
Enhanced care	1
Entry ban	1
Government announcement	1
Medical surveillance	1
Public information	1
Raise awareness flights	1
Raise awareness healthcare staff	1
Raise awareness public	1
Resumption public services	1
Strengthening primary care response	1
Supply	1
Surveillance	1
Travel advice	1

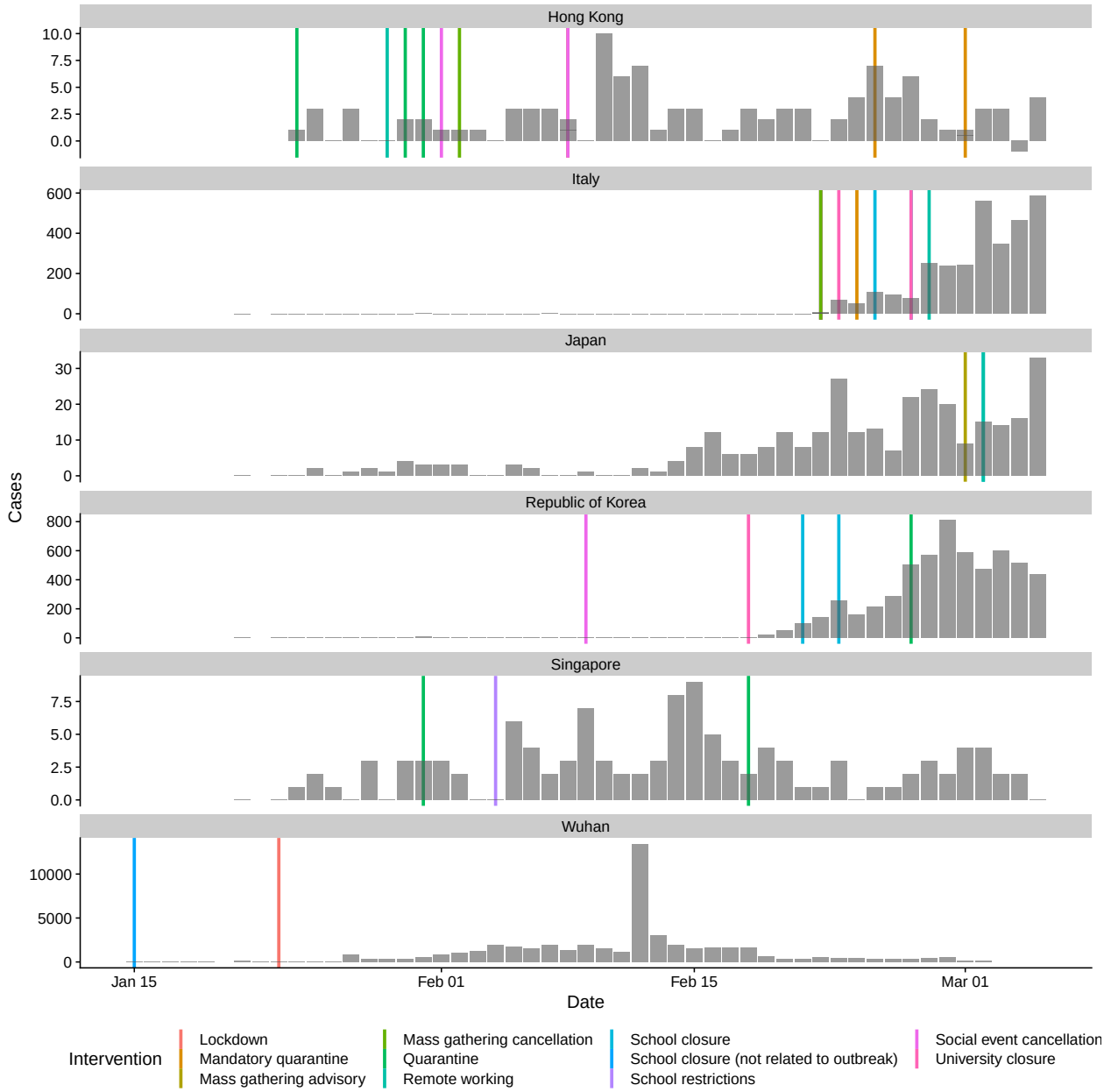
- Plot social interventions

```r
plot_interventions <- function(intervention_data , n = NULL, scales = "free_y") {
  plot_df <- cases_in_countries %>%
  dplyr::left_join(interventions %>%
                     dplyr::filter(intervention %in% intervention_data[1:n]),
                   by = c("date", "country")) %>%
  dplyr::group_by(country, date) %>%
  dplyr::mutate(cases = cases / dplyr::n())

  plot_df %>%
  ggplot2::ggplot(ggplot2::aes(x = date, y = cases, col= intervention)) +
  ggplot2::geom_vline(data = tidyr::drop_na(plot_df, intervention),
                      aes(xintercept = date, col = intervention), size = 1.2) +
  ggplot2::geom_col(col = NA, alpha = 0.6) +
  ggplot2::scale_fill_discrete(na.value = "grey") +
  ggplot2::facet_wrap(~ country, scales = scales, ncol = 1) +
  cowplot::theme_cowplot() +
  labs(x = "Date", y = "Cases") +
  theme(legend.position = "bottom") +
  labs(col = "Intervention", fill = NULL)
}
```

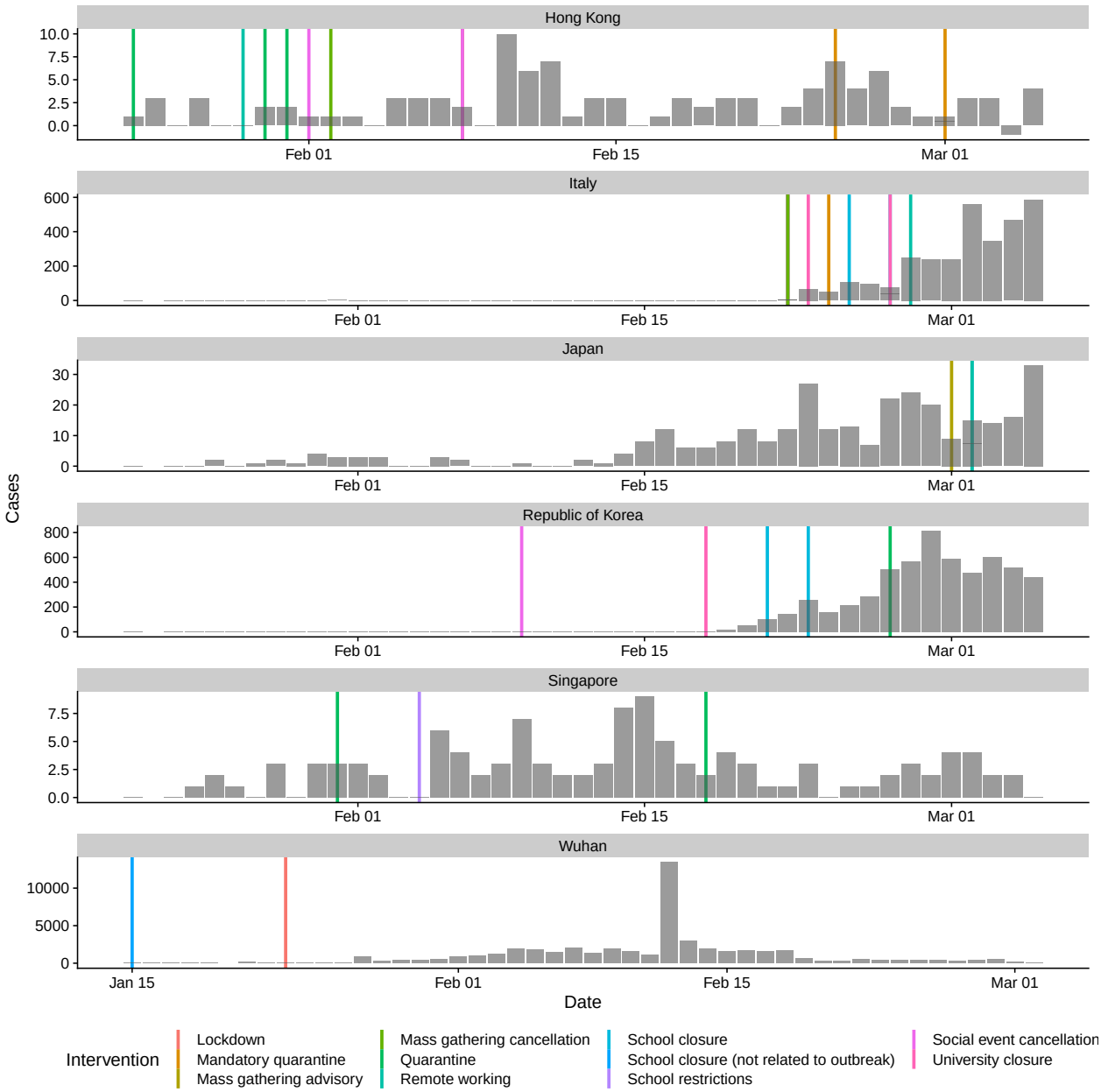
```
plot_interventions(social_interventions$Intervention, 12, scales = "free_y")
```

```
## Warning: Removed 8 rows containing missing values (position_stack).
```




```
plot_interventions(social_interventions$Intervention, 12, scales = "free")
```

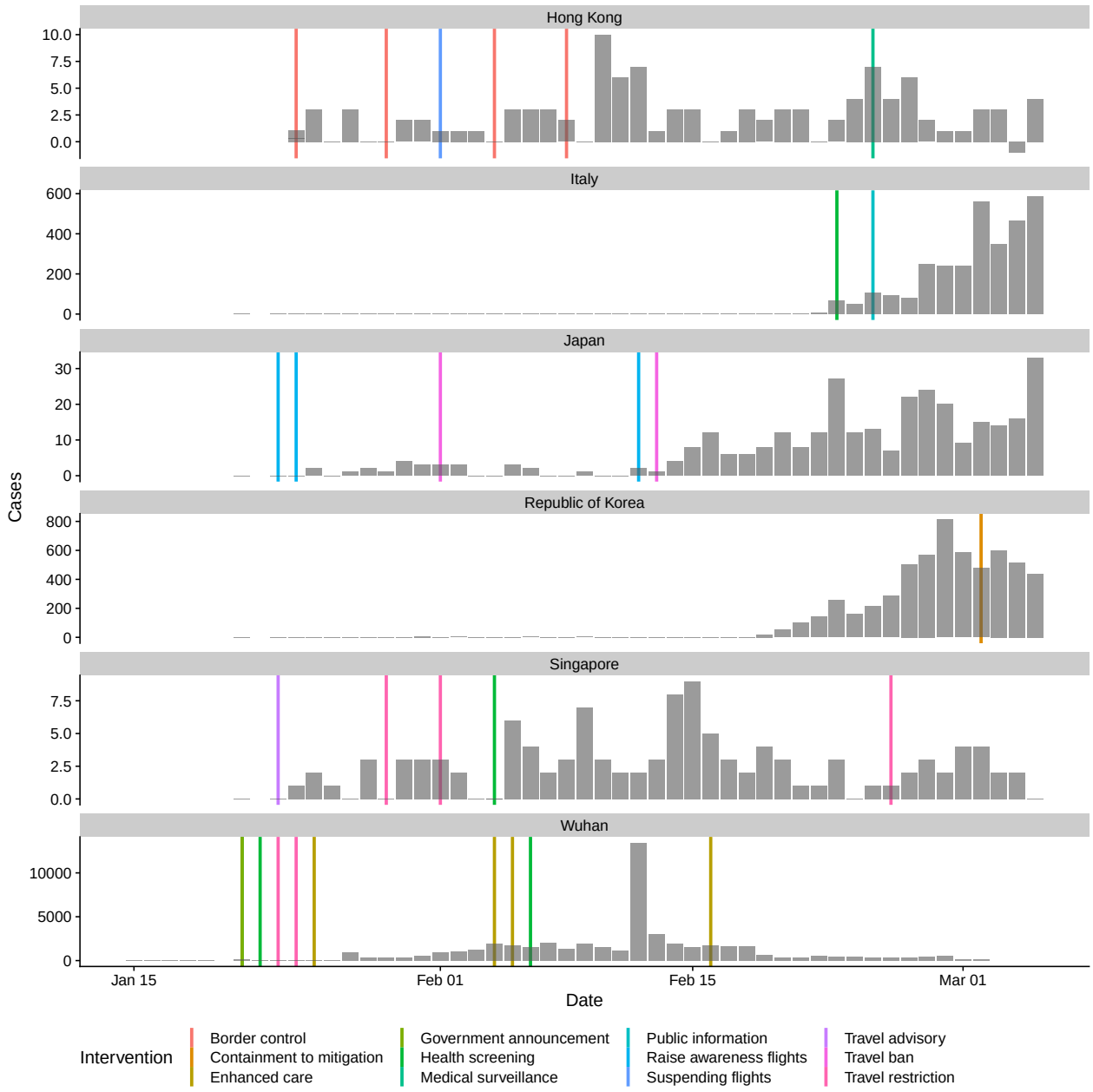
```
## Warning: Removed 8 rows containing missing values (position_stack).
```



- Plot non-social interventions

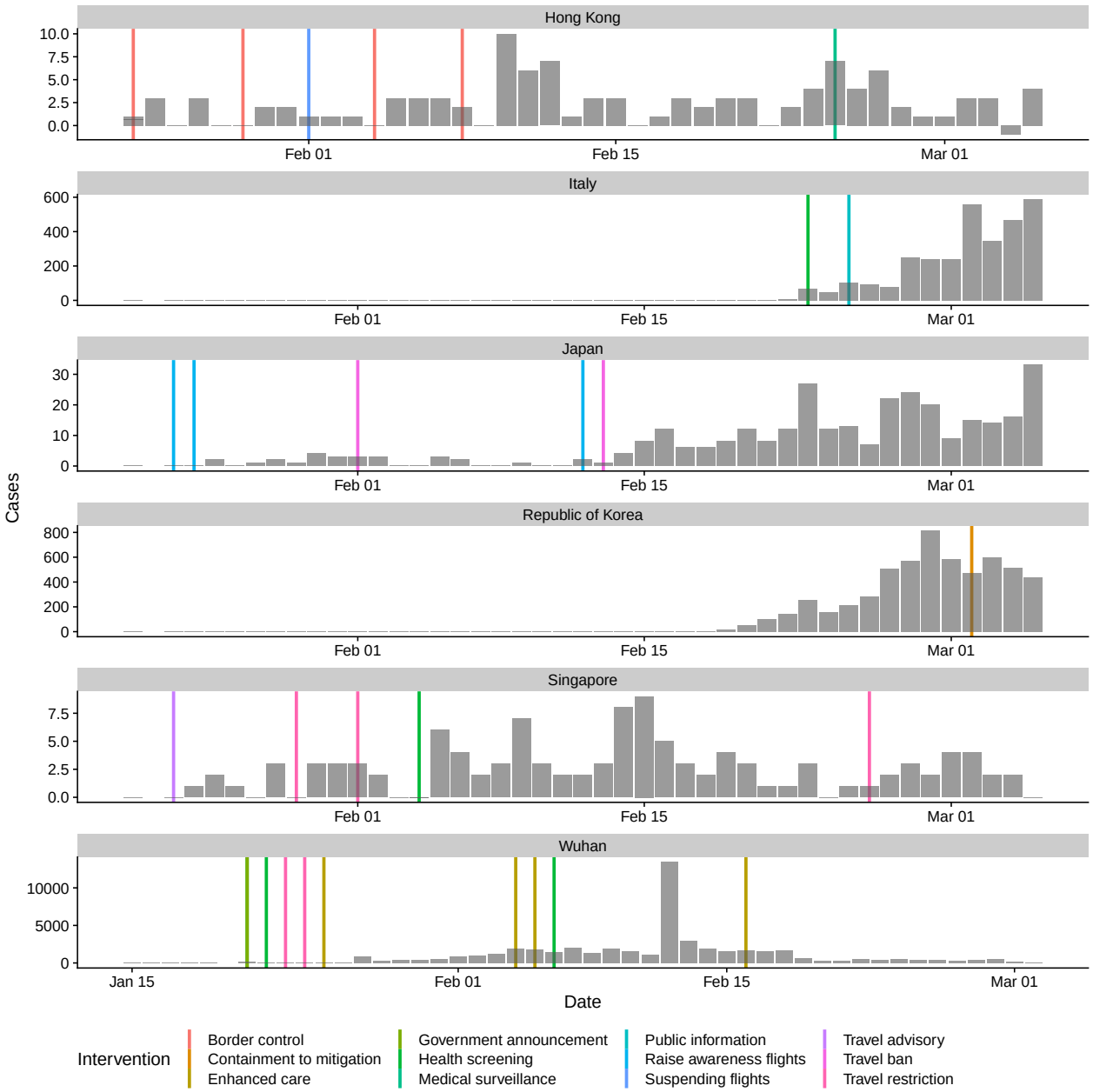
```
plot_interventions(non_social_interventions$Intervention, 17, scales = "free_y")
```

```
## Warning: Removed 8 rows containing missing values (position_stack).
```




```
plot_interventions(non_social_interventions$Intervention, 17, scales = "free")
```

```
## Warning: Removed 8 rows containing missing values (position_stack).
```


Hong Kong
Italy
Japan
Republic of Korea
Singapore
Wuhan
Cases
Date
Jan 15
Feb 01
Feb 15
Mar 01
Intervention
Border control
Containment to mitigation
Enhanced care
Government announcement
Health screening
Medical surveillance
Public information
Raise awareness flights
Suspending flights
Travel advisory
Travel ban
Travel restriction