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

Sam Abbott

2020-02-02

## 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\_imported,  
 `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 |
| 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 |
| 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

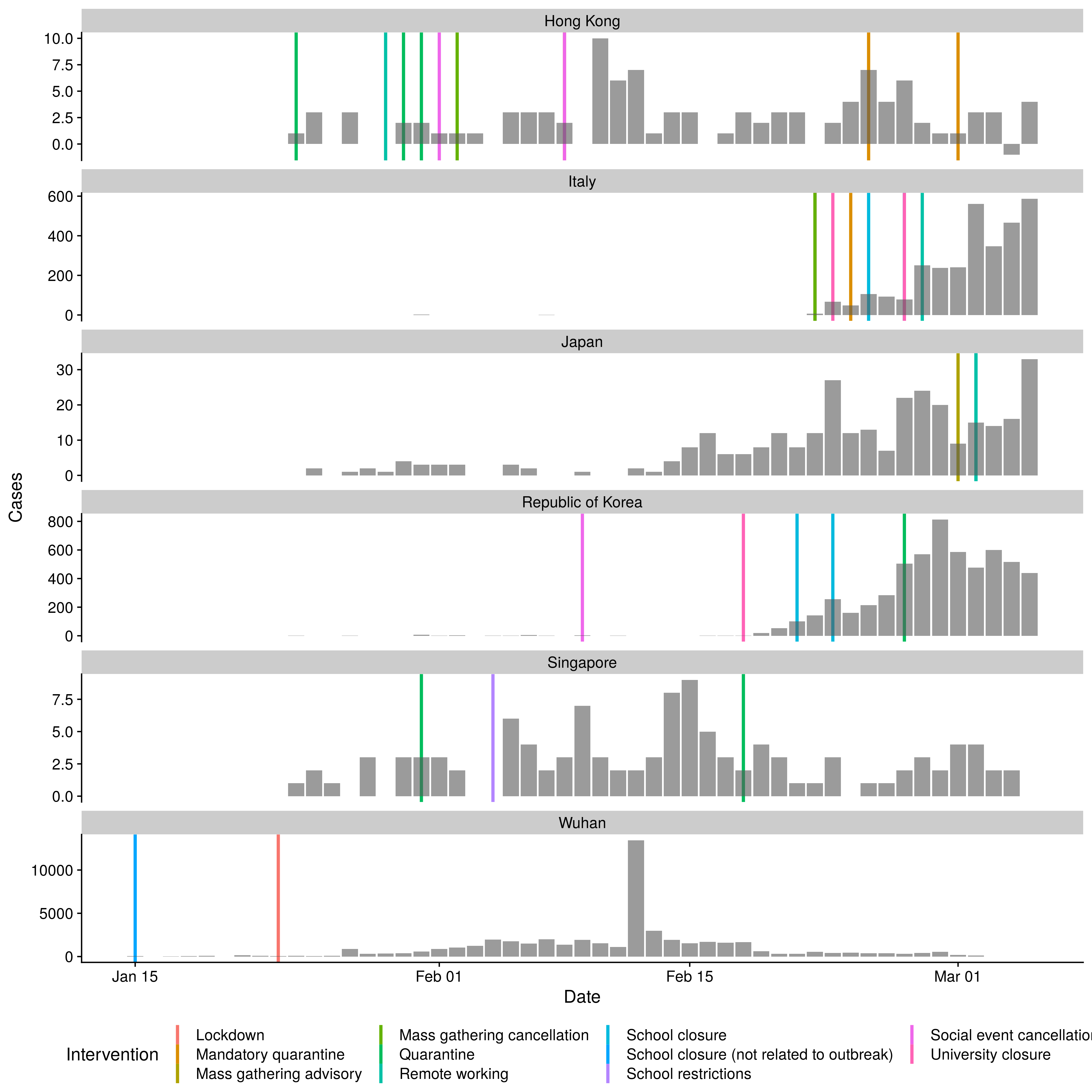
non\_social\_interventions <- interventions %>%   
 dplyr::filter(social\_distancing %in% "no") %>%   
 summarise\_ints()  
  
saveRDS(non\_social\_interventions, "output-data/non\_social\_interventions.rds")  
  
knitr::kable(non\_social\_interventions)

|  |  |
| --- | --- |
| 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

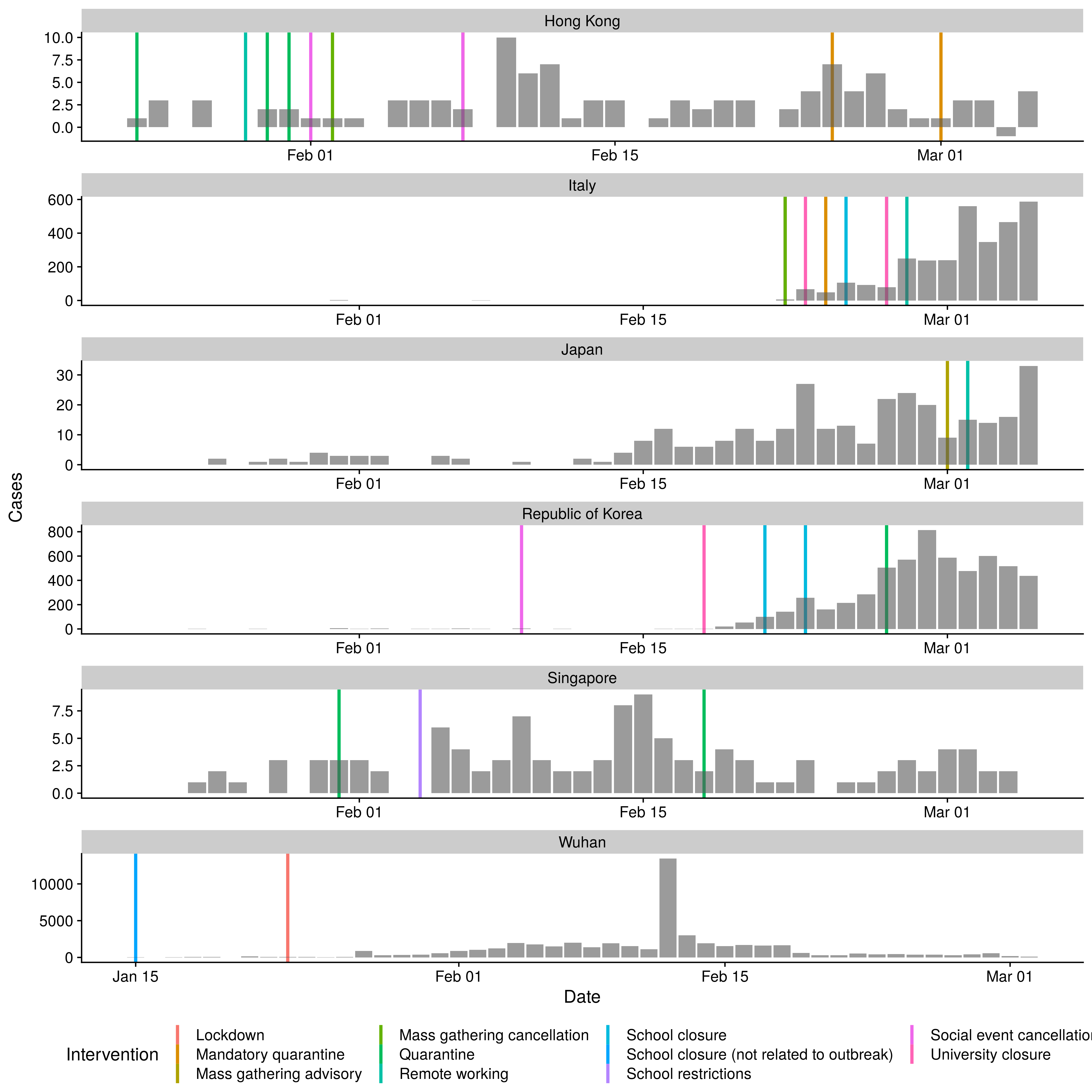
plot\_interventions <- function(intervention\_data , n = NULL, scales = "free\_y") {  
 plot\_df <- cases\_in\_countries %>%   
 dplyr::left\_join(interventions %>%   
 dplyr::filter(intervention %in% intervention\_data[1:n]),  
 by = c("date", "country")) %>%   
 dplyr::group\_by(country, date) %>%   
 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")

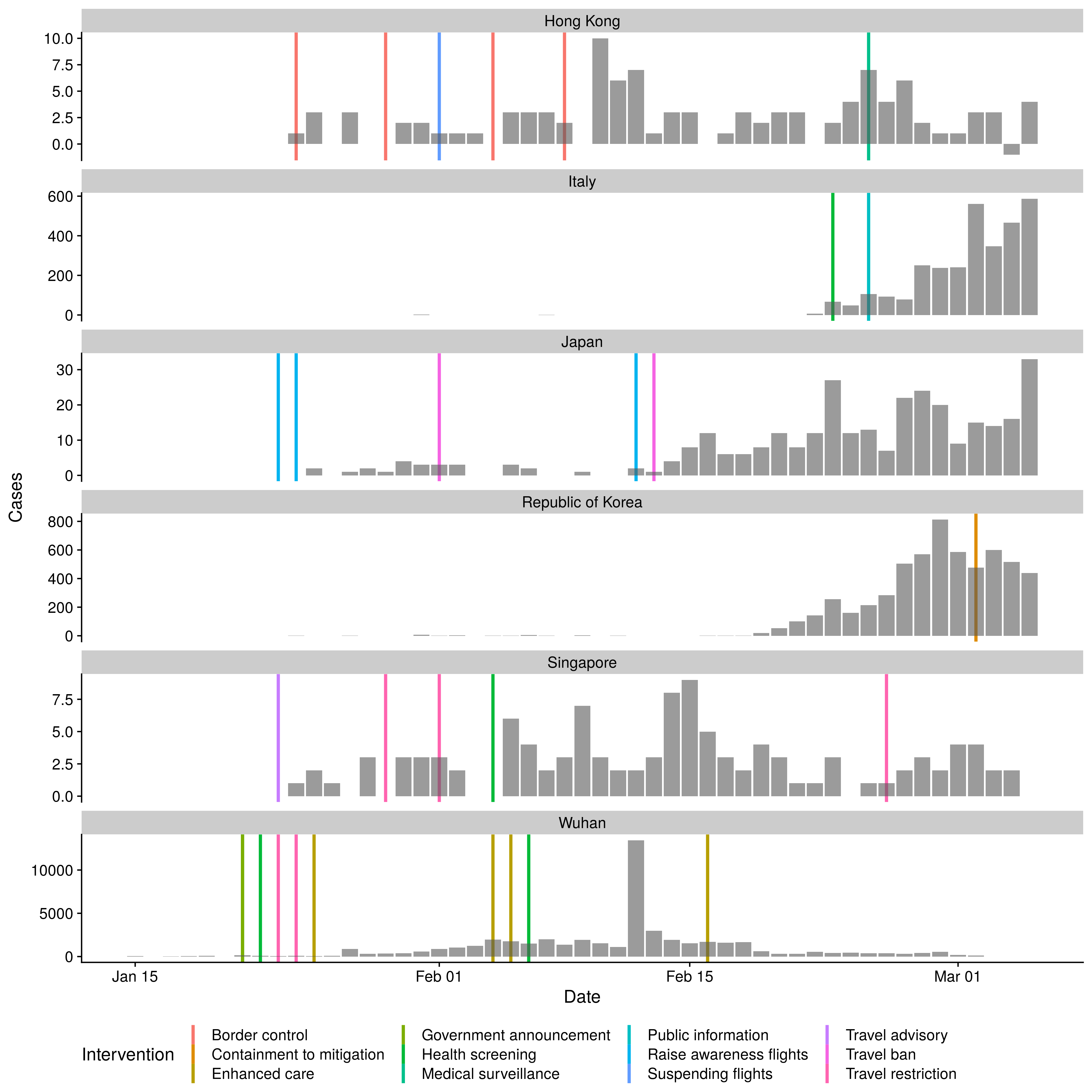
## Warning: Removed 8 rows containing missing values (position\_stack).



* 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).

