Context

- This document represents estimates as of 3/25/2020, based on BCG predictive modelling leveraging John Hopkins University data; full modelling constraints are detailed in the following pages

- We have deep dived on top 20 markets to project the evolution of two main variables[1] :
  - **# of daily new cases**
  - **Total 'active' infected patients** (excludes people infected and, either quarantined, recovered or dead)

- The current projected evolution of cases does not assume a second wave of infections vs. prior crises such as SARS or the Spanish flu – fuller confidence in this variable still TBD as data develops

- Where needed, we have leveraged this fact base to put a <u>draft</u> estimate of timing for the <u>start of a potential lockdown</u>, the <u>estimated peak</u> of infections, and the <u>end of a potential lockdown (short and long)</u>, leveraging:
  - Latest projected epidemic curves for that country
  - Analogs from countries further along in the infection curve
  - External press searches/reports on government activity
  - Quantitative ratings/factors that help triangulate efficacy of response (e.g., hospital infrastructure, regulatory quality indices, government effectiveness etc)

- To facilitate planning activities, we anchored each 'moment' of the epidemic on specific weeks – those weeks are not meant to predict the exact timing of each 'moment' and are subject to changes in external environment (e.g. new government measures)

> *Currently fine tuning epidemic curves of selected countries (e.g. Mexico)*

1. Includes asymptomatic cases which, depending on testing policy of each country, might result in higher numbers than reported

Legal context regarding our support

The situation surrounding COVID-19 is dynamic and rapidly evolving, on a daily basis. Although we have taken great care prior to producing this presentation, it represents BCG's view at a particular point in time.

This presentation is **not** intended to:
 (i) constitute medical or safety advice, nor be a substitute for the same; nor
 (ii) be seen as a formal endorsement or recommendation of a particular response.

As such you are advised to make your own assessment as to the appropriate course of action to take, use this presentation as guidance. Please carefully consider local laws and guidance in your area, particularly the most recent advice issued by your local (and national) health authorities, before making any decision.

Important caveats (at 25 March 2020)

The outputs of the modelling are not for publication or public dissemination

The model should be considered a 'beta' version: a more detailed model is under development

Much is still unknown or uncertain about the virus
- We have, where available, used assumptions from published academic sources. The lag time in research and publication of journals means that understanding of the virus is moving faster than refereed research
- This model is built using standard epidemiological modelling techniques, but given the relatively early stage of our understanding of this virus, it is possible that the virus does not behave in a way that makes such techniques applicable
- In particular, asymptomatic transmission is highly likely. The model seeks to account for this however the treatment of this may not be fully accurate. It is possible that asymptomatic carriers may remain infectious for an extended period of time
- The transmission of the virus and progress of the disease in people of different ages remains an area of emerging research. This version of the model does not yet incorporate an age stratification or other features that correct for differing demographics between geographies

There are very significant differences in access to testing and rates of testing and/or the timeliness and reliability of the reporting of infections across different geographies
- As with any model, the availability and quality of data will have a material impact on the quality and reliability of outputs

Government policy interventions have a significant lag time
- Given the time between infection, incubation, development of symptoms, access to testing and results, the impact of a particular government policy intervention taken today is unlikely to change the shape of the curve for at least 5-7 days, and possibly materially longer
- A future version of the model which will attempt to allow scenario modelling of different interventions is under development. This version does not attempt to do so

Scenario modelling disclaimer

"PREDICTING THINGS
IS VERY HARD...

...PARTICULARLY
ABOUT THE FUTURE"

- NIELS BOHR

This is a work-in-progress scenario model of a highly dynamic situation. The modelling depends on a number of assumptions, which may or may not be supported to varying extents in your geography. The results are scenarios for consideration, not BCG forecasts about the future. Please understand the assumptions, including the following:

'Reported cases' is a <u>lower bound</u> **on what the actual levels of COVID-19 may be**
- The modelling here is calibrated assuming that all cases are detected on average over time. This is unlikely to be true as many cases are currently going unreported and therefore do not flow through into the data that informs the modelling. The reported case limits set a lower bound on the true prevalence of COVID-19. The discrepancy may be worse in countries with less developed public health care systems or where inadequate testing has occurred

Government/personal <u>actions may drive further containment than what is modelled</u>
- This modelling includes an elasticity-like term that seeks to quantify the fact that increasingly large case counts typically drive progressively more aggressive containment strategies. The coefficient for this is calibrated automatically during the model fitting, and the resultant 'future reproduction number' modelled is shown in these pages, but its exact value is uncertain. We <u>do not</u> explicitly model the effect of specific government interactions in the future – for which the timing and efficacy is highly uncertain.

METHODOLOGY

Epidemic Curve

- Epidemic curve modelling is based on research by Lekone & Finkenstadt on "statistical inference in a stochastic epidemic SEIR model with control intervention: Ebola as a case study"

- Model assumes that the infection rate per person per unit time is dynamic to account for the fact that this empirically varies per person / country

- Model also includes a phenomenological term that models the fact that societies take increasingly aggressive measures as the number of cases rises

- Epidemic curves present a fitted line and an 80% confidence interval based on :
  - Viral parameters
  - Transmission rate
  - Evolution in the transmission rate over time (past and future)
  - Degree of response to date and statistically inferred future responses

Potential timing of a shutdown

- Lockdown start date set as either actual date of lockdown or estimated based on timing of cumulative 10th death, which has been a tipping point for many countries to establish lockdown (e.g. China, India, Belgium, Poland)

- Potential lockdown end date estimated based on two factors

  - (a) China: duration of Hubei / Wuhan lockdown, which are the only large scale lockdowns having being lifted

  - (b) Country-specific adjustment based on health system assessment and government effectiveness, includes
    - In-Patient Hospital Beds per Population (ability to receive and isolate infectious patients)
    - Deaths from Diseases of Respiratory System
    - Government Effectiveness
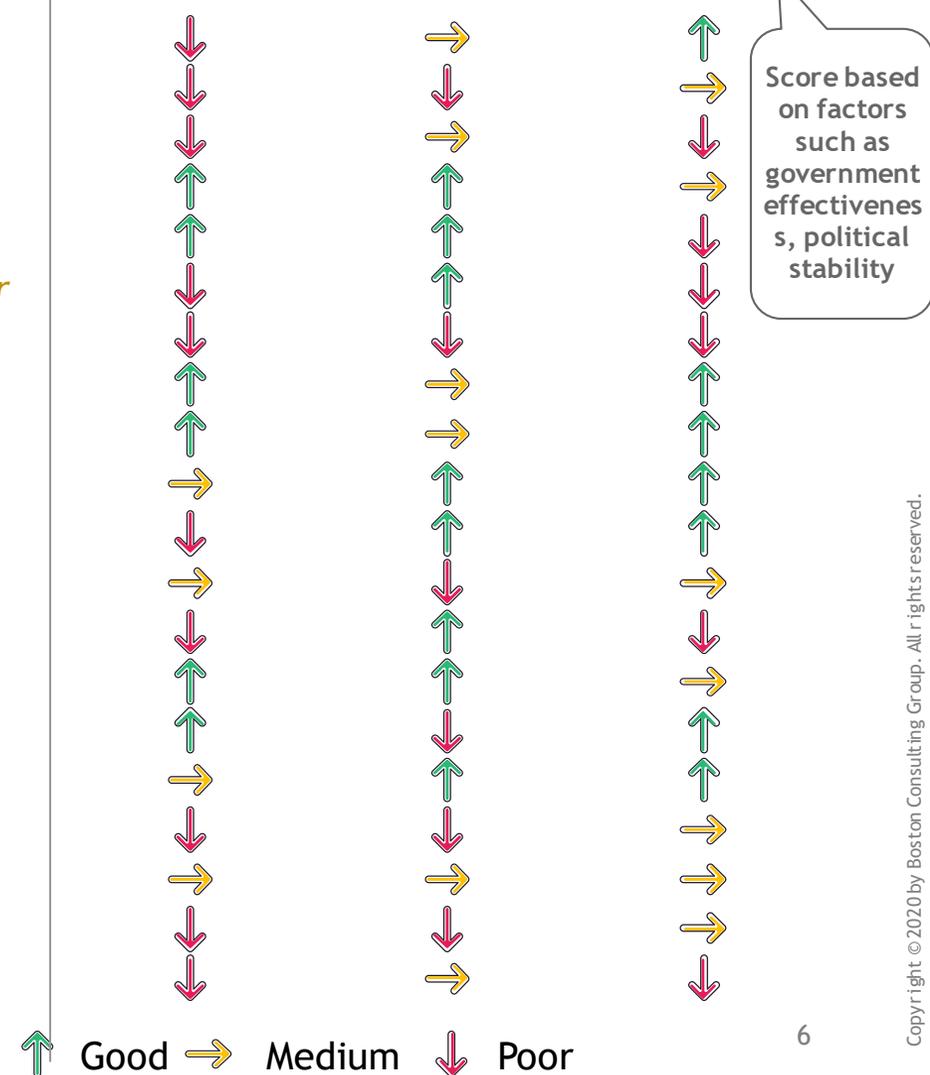   - Regulatory Quality

> *Additional detail in Appendix*

	Currently in full lock-down?	1 Potential lockdown start date	2 Peak new cases date	3 Short potential lockdown end date	4 Long potential lockdown end date		Factors influencing lockdown duration	
						In-patient beds per 100k pop.	Respiratory diseases per 100k pop.	Ability to manage epidemic
USA	✕	*W1 April (latest states)*	*W1 May*	*W2 June (earliest states)*	*W3 July (earliest states)*	↓	⇒	↑
UK	✓	March 24th	*W3 May*	*W3 June*	*W4 July*	↓	↓	⇒
Brazil	✕	*W4 March*	*W3 May*	*W1 July*	*W2 August*	↓	⇒	↓
France	✓	March 17th	*W3 May*	*W2 June*	*W4 July*	↑	↑	⇒
Russia	✕	*W4 March*	*W1 May*	*W4 June*	*W4 July*	↑	↑	↓
India	✓	March 24th	*W3 June*	*W4 June*	*W2 September*	↓	↑	↓
Argentina	✓	March 20th	*W4 May*	*W4 June*	*W4 August*	↓	↑	↓
China (Hubei)	✓	January 23rd	February 13th	March 25th	April 8th	↑	⇒	↑
Germany	✕	*W4 March*	*W1 May*	*W2 June*	*W1 July*	↑	⇒	↑
Australia	✕	*W1 April*	*W2 May*	*W4 June*	*W4 July*	⇒	↑	↑
Canada	✕	*W4 March*	*W1 May*	*W4 June*	*W3 July*	↓	↑	↑
Spain	✓	March 14th	*W4 April*	*W1 June*	*W3 July*	⇒	↓	⇒
Mexico	✕	*W1 April*	*W3 April*	*W1 July*	*W3 July*	↓	↑	↓
Poland	✓	March 24th	*W4 April*	*W3 June*	*W1 July*	↑	↑	⇒
Belgium	✓	March 17th	*W3 May*	*W2 June*	*W4 July*	↑	↓	↑
Norway	✓	March 12th	*W4 March*	*W1 June*	*W3 June*	⇒	↑	↑
South Africa	✓	March 26th	*W1 June*	*W4 June*	*W4 August*	↓	↓	⇒
Italy	✓	March 10th	*W3 April*	*W2 June*	*W1 July*	⇒	⇒	⇒
Sweden	✕	*W4 March*	*W4 March*	*W1 June*	*W3 June*	↓	↓	⇒
Colombia	✓	March 24th	*W1 May*	*W4 June*	*W4 July*	↓	⇒	↓

Potential | Actual

Score based on factors such as government effectiveness, political stability

↑ Good ⇒ Medium ↓ Poor

Source: John Hopkins University (Coronavirus Resource Center), Euromonitor, BCG Analysis

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Backup | Hubei containment of COVID-19 virus used as base case for timing of lockdown (before country specific factors)

New confirmed cases

1/20
Officially confirmed human to human transmission

1/23
Wuhan locked down;
Treat severe cases: Constructed specialty hospitals (e.g. Huoshenshan) for centralized treatment

1/24
Medical resources: 1st batch medical team arrived Hubei on CNY eve, 42k ppl by 2/29

1.27
Free treatment for all infected & suspected cases

2/3
Quarantine patients: Construct makeshift hospitals for mild patients

2.8
"leaving no household and no one behind": aim to quarantine all patients

Changed the caliber of statistics: counted clinically diagnosed cases as confirmed cases

2/15
Work resumption: gov. launched policy to encourage resume production

2/26
Oversea new confirmed case no. **exceeded China**

3/7
Sign of containment: No new confirmed cases reported outside Hubei in China

3/17
12 confirmed cases from oversea : the new risk 120K/day travelers back to China

3/26
Lockdowns being lifted this week & next across China & Hubei

Wuhan City
Hubei Province excl. Wuhan
China excl. Hubei

16,000
14,000
4,000
2,000
0

1/20 1/21 1/22 1/23 1/24 1/25 1/26 1/27 1/28 1/29 1/30 1/31 2/1 2/2 2/3 2/4 2/5 2/6 2/7 2/8 2/9 2/10 2/11 2/12 2/13 2/14 2/15 2/16 2/17 2/18 2/19 2/20 2/21 2/22 2/23 2/24 2/25 2/26 2/27 2/28 2/29 3/1 3/2 3/3 3/4 3/5 3/6 3/7 3/8 3/9 3/10 3/11 3/12 3/13 3/14 3/15 3/16 3/17

Sources: Official disclose & credible media reports; BCG analysis
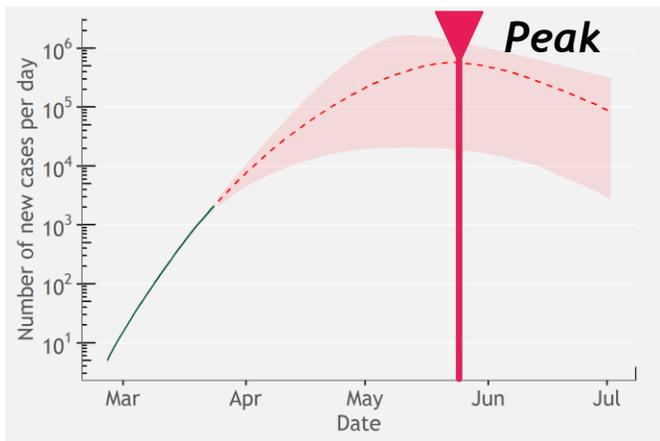
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Detail of epidemic scenarios by country

USA Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
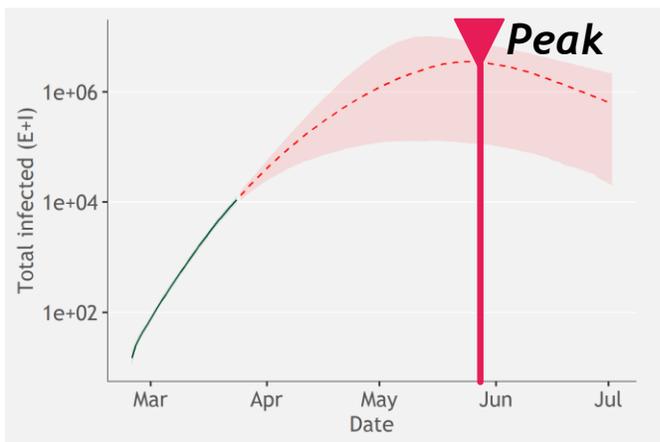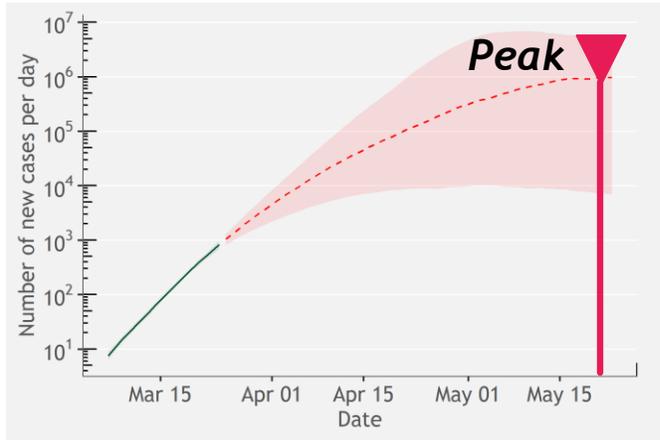
Current projections for **new cases** and **total infected patients**

# of daily new cases
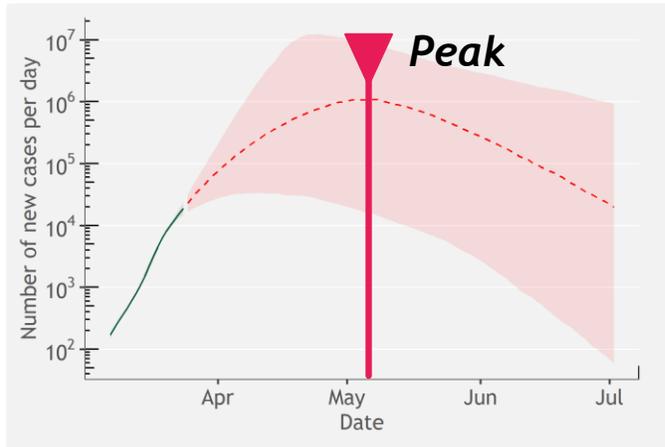
Total infected patients
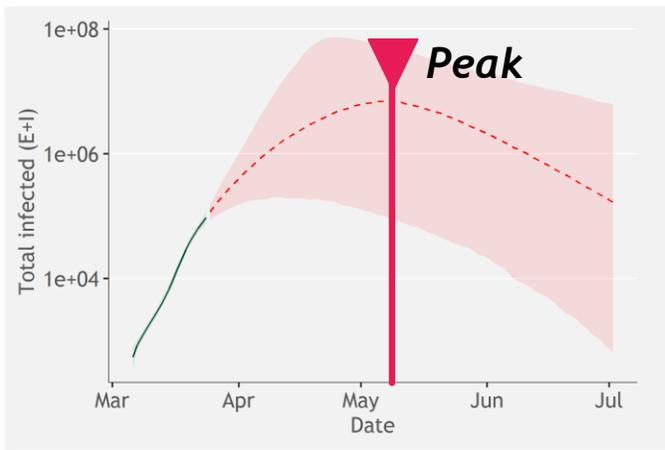
Estimated **key dates** of COVID-19 crisis

Lockdown start date *(actual or potential)*	• Several states already into lockdown, e.g.:
	– California since March 19th
	– Illinois since March 21st
	– New York since March 22nd
	• We expect **other states to follow in next weeks** as COVID-19 expands in the US

Peak date	• Peak of new cases expected in **W1 May**

Lockdown end date *(actual or potential)*	• We expect current lockdowns to be lifted **between W2 June and W3 July**, starting with states that were earlier in imposing lockdown (e.g. California)

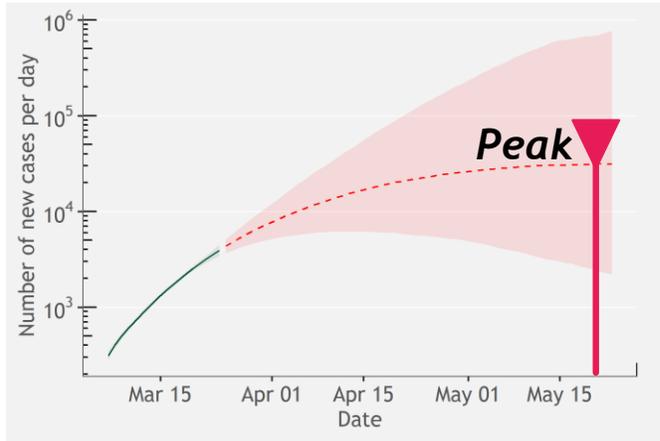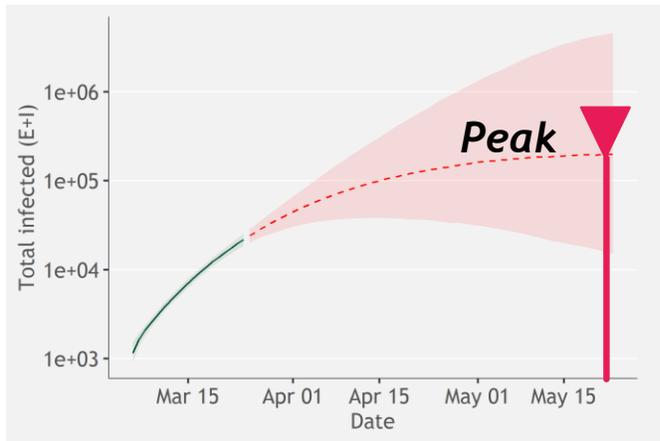Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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UK Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date *(actual or potential)*

- Country on lockdown since **March 24th**
- Lockdown started 10 days after 10th death was recorded (March 14th) – in line with other European countries

Peak date

- Peak of new cases expected in **W3 May**

Lockdown end date *(actual or potential)*

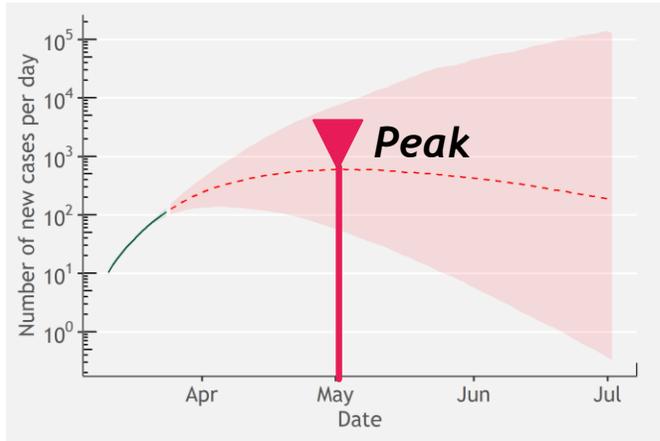- We expect lockdown to be lifted **between W3 June and W4 July**

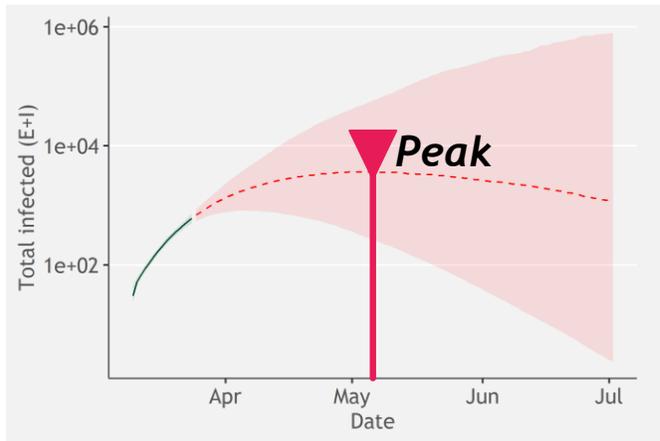# Brazil Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for __new cases__ and __total infected patients__

# of daily new cases

Total infected patients
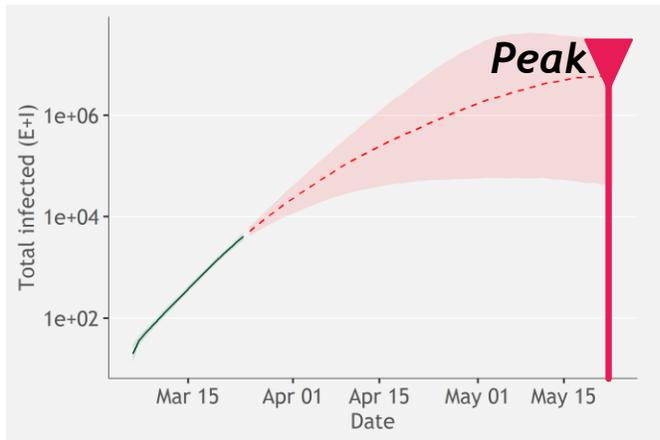
Estimated __key dates__ of COVID-19 crisis

Lockdown start date *(actual or potential)*	• Some cities and states have already gone into lockdown, including: – Sao Paulo since March 24th • Potential federal lockdown could start **as soon as __W4 March__**
Peak date	• Peak of new cases expected in __W3 May__
Lockdown end date *(actual or potential)*	• We expect potential lockdown to be lifted __between W1 July and W2 August__ – Longer range as a result of expected added challenge in Brazil due to history of less effective government policies

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

France Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
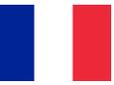
Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date *(actual or potential)*

- Country on lockdown since **March 17th**
- Lockdown started 10 days after 10th death was recorded (March 7th) – in line with other European countries

Peak date

- Peak of new cases expected in **W3 May**

Lockdown end date *(actual or potential)*

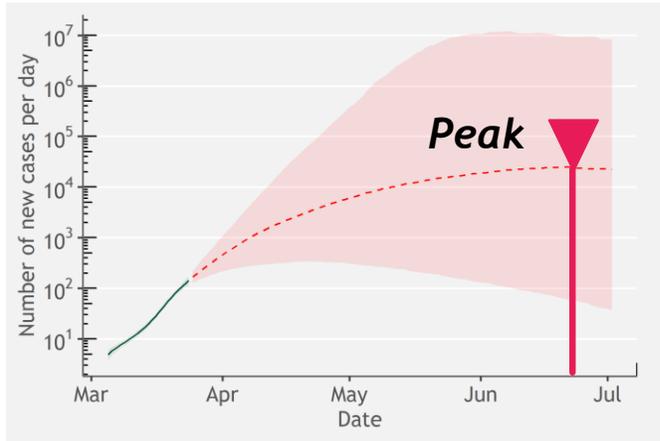- We expect lockdown to be lifted **between W2 June and W4 July**

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

Russia Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
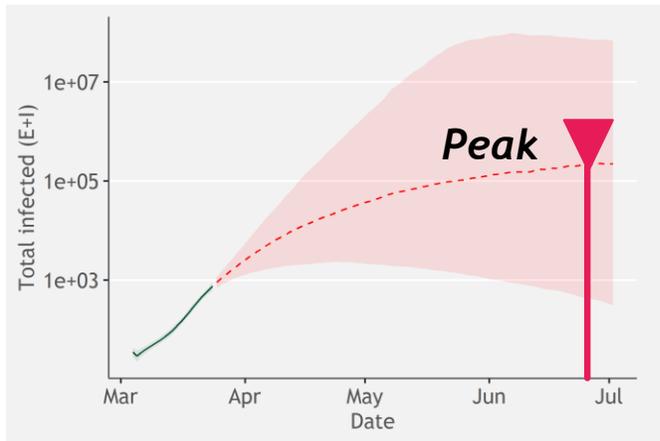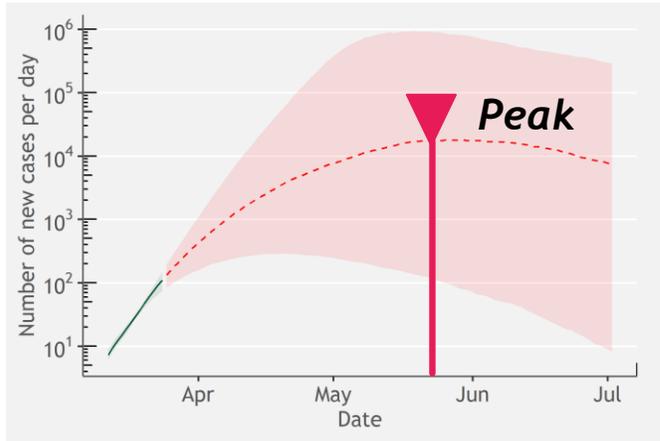
Current projections for **new cases** and **total infected patients**

# of daily new cases

Total infected patients

Estimated **key dates** of COVID-19 crisis

Lockdown start date *(actual or potential)*

- Expected 10th death for March 30th, based on current tally and ~33% estimated daily death growth (early phase)

- Potential lockdown could start **as soon as W4 March**

Peak date

- Peak of new cases expected in **W1 May**

Lockdown end date *(actual or potential)*

- We expect potential lockdown to be lifted **between W4 June and W4 July**

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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India Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date *(actual or potential)*
- Country on lockdown since **March 24th**
- Lockdown started the day of 10th death was recorded (March 25th) – in line with China's timing

Peak date
- Peak of new cases expected in **W3 June**

Lockdown end date *(actual or potential)*
- We expect lockdown to be lifted **between W4 June and W2 September**
  - Longer range as a result of expected added challenge in India due to health system preparedness and record of public policy effectiveness

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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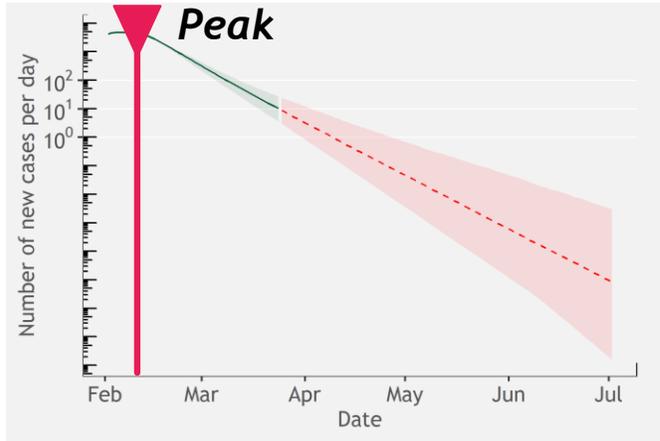# Argentina Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
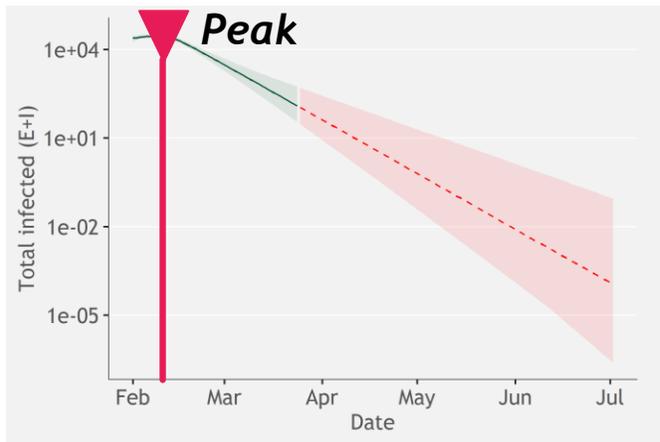
Current projections for **new cases** and **total infected patients**

# of daily new cases

Total infected patients
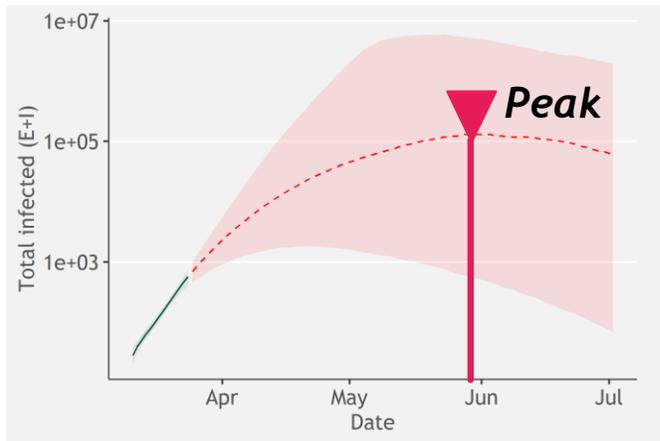
Estimated **key dates** of COVID-19 crisis

Lockdown start date *(actual or potential)*

- Country on lockdown since **March 20th**
- Lockdown started even before 10th death was recorded (tally of 4 by March 22nd), being ahead of the curve compared to China

Peak date

- Peak of new cases expected in **W4 May**

Lockdown end date *(actual or potential)*

- We expect lockdown to be lifted **between W4 June and W4 August**
  - Longer lockdown period reflects higher prevalence of population to health system preparedness / record of respiratory diseases

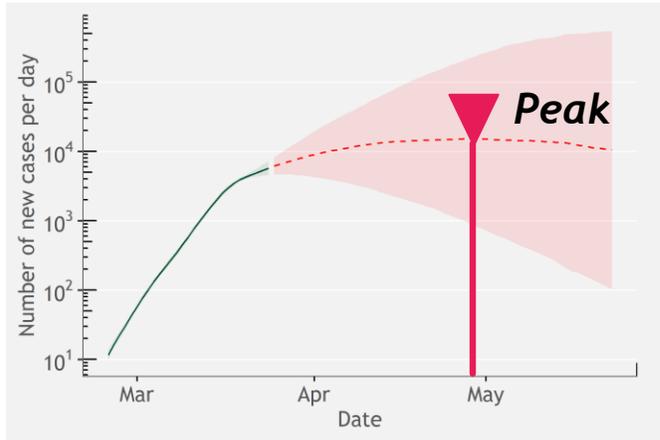Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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China Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
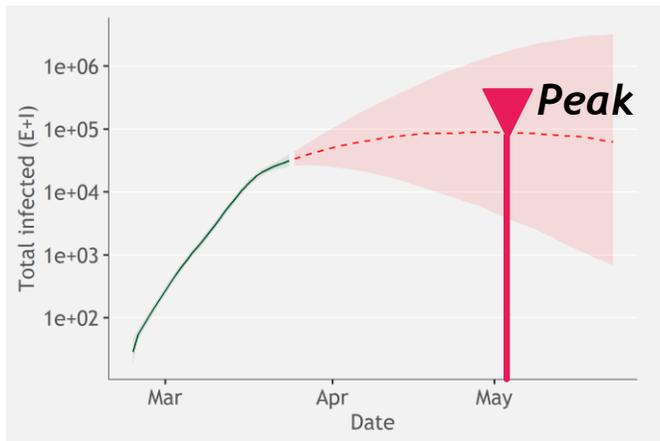
Current projections for new cases and total infected patients

# of daily new cases

Total infected patients

Estimated key dates of COVID-19 crisis

Lockdown start date *(actual or potential)*
- Center of epidemic in China (city of Wuhan and province of Hubei) were placed on lockdown **January 23rd**
- Other major cities like Shanghai and Beijing were placed on partial lockdown with restrictions to movement

Peak date
- Peak of new cases occurred **February 13th**

Lockdown end date *(actual or potential)*
- Lockdown in the center of epidemic are currently being lifted, **~ 10 weeks after being enacted and ~8 weeks after peak of infections**
  - Hubei - March 25th
  - Wuhan - April 8th

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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Germany Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

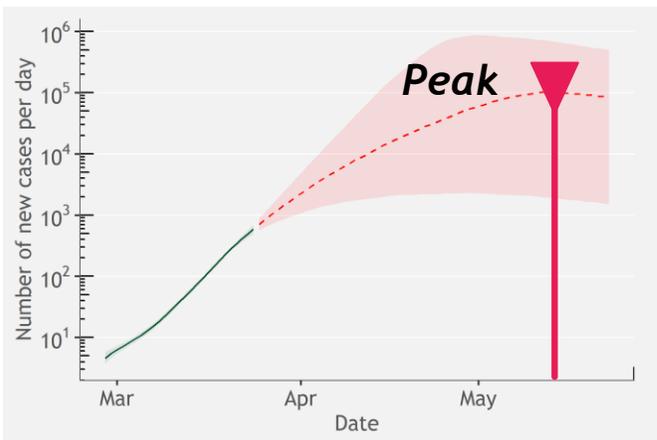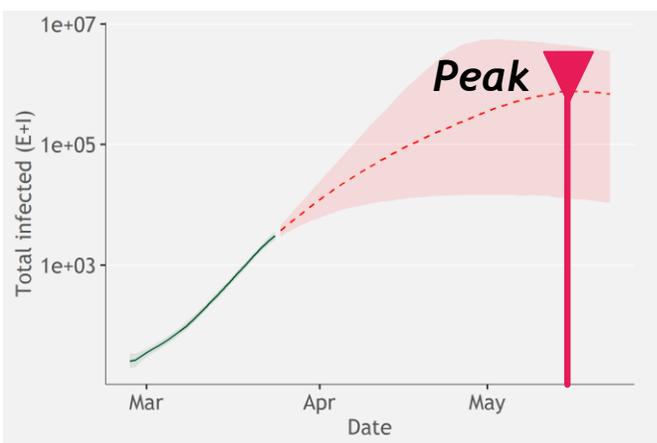| **Lockdown start date** *(actual or potential)*	• Some states have already gone into lockdown, including: – Bavaria, Saarland since March 25th • Potential federal lockdown could start **as soon as W4 March**
Peak date	• Peak of new cases expected in **W1 May**
Lockdown end date *(actual or potential)*	• We expect potential federal lockdown to be lifted **between W2 June and W1 July** – Germany likely to have one of the shortest lockdown as a result of high political and regulatory efficacy

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

As of March 25th

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date
(actual or potential)

- Only lighter containment measures implemented (e.g. selected venues such as bars and restaurants currently closed)

- Potential federal lockdown could start W1 April, given current death tally compared to other countries cases

Peak date

- Peak of new cases expected in W2 May

Lockdown end date
(actual or potential)

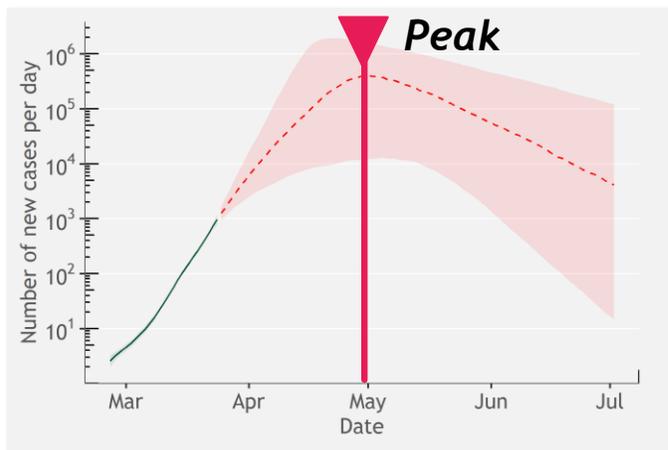- We expect potential lockdown to be lifted during between W4 June and W4 July

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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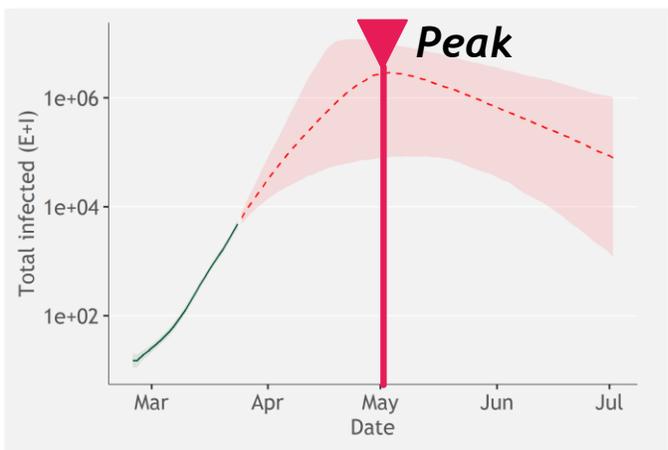# Canada Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date
(actual or potential)

- 10th death occurred on March 30th

- Potential lockdown could start **as soon as W4 March**
  - While national lockdown unlikely, many provinces have already begun restricting movement

Peak date

- Peak of new cases expected in **W1 May**

Lockdown end date
(actual or potential)

- We expect lockdown to be lifted **between W4 June and W3 July**

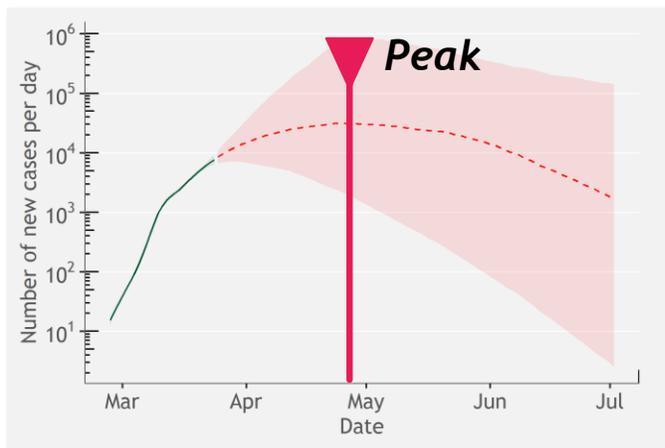Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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Spain Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

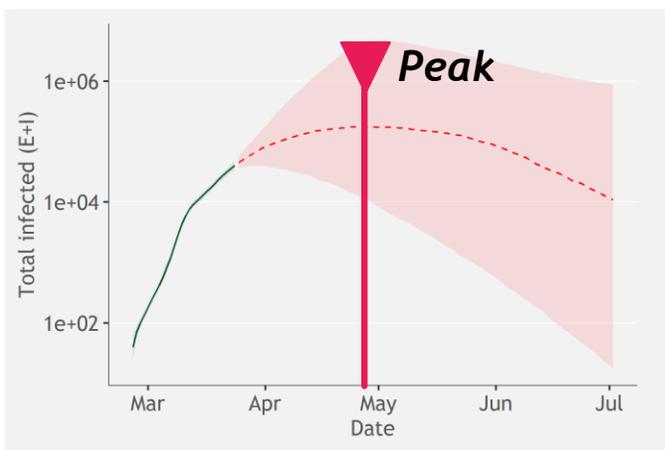## Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date
(actual or potential)

- Spain imposed a nationwide lockdown on **March 14th**
- Lockdown started 7 days after 10th death was recorded (March 7th) – in line with other European countries

Peak date

- Peak of new cases expected in **W4 April**

Lockdown end date
(actual or potential)

- We expect lockdown to be lifted **between W1 June and W3 July**

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis
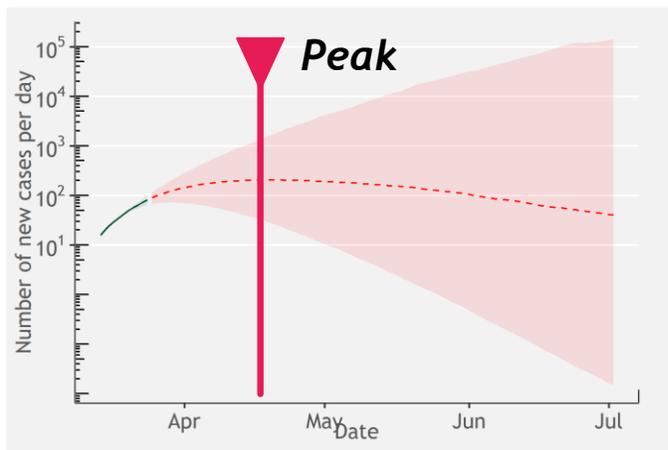
Mexico Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

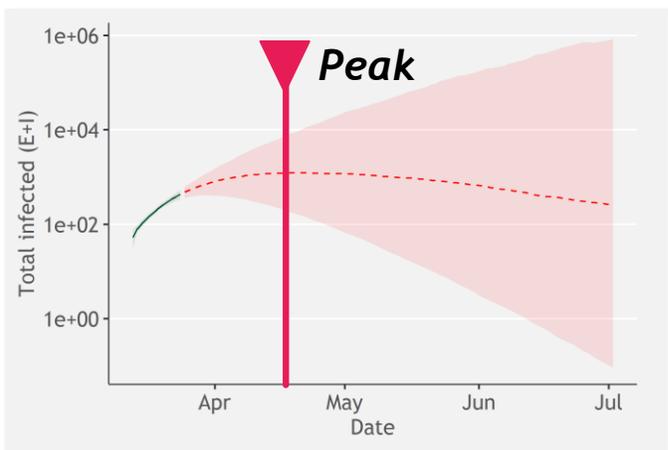## Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date *(actual or potential)*

- Only lighter containment measures currently implemented
- Potential federal lockdown could start **W1 April**, given current death tally compared to other countries cases

Peak date

- Peak of new cases expected in **W3 April**

Lockdown end date *(actual or potential)*

- We expect lockdown to be lifted **between W1 July and W3 July**

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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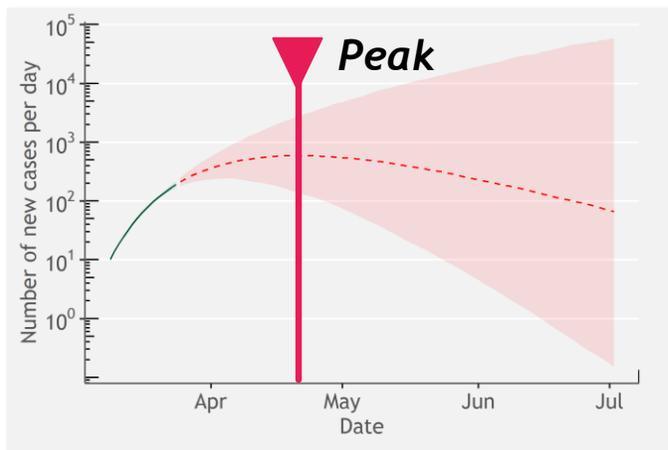
Poland Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

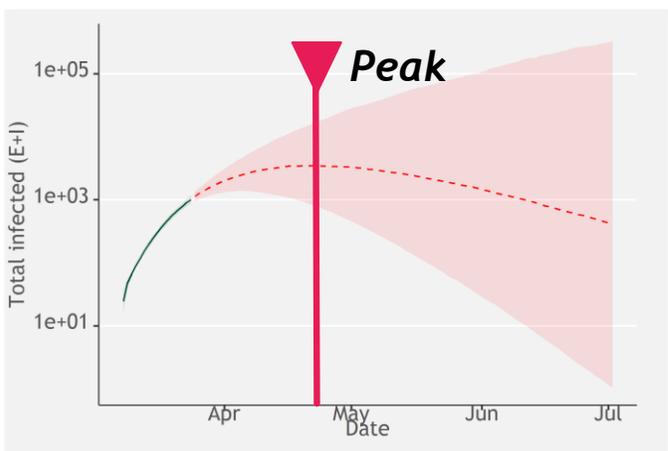## Current projections for **new cases** and **total infected patients**

# of daily new cases

Total infected patients

Estimated **key dates** of COVID-19 crisis

Lockdown start date
(actual or potential)

- Poland went into nationwide lockdown on **March 24th**, on the same day as the 10th death (similar to China)

Peak date

- Peak of new cases expected in **W4 April**

Lockdown end date
(actual or potential)
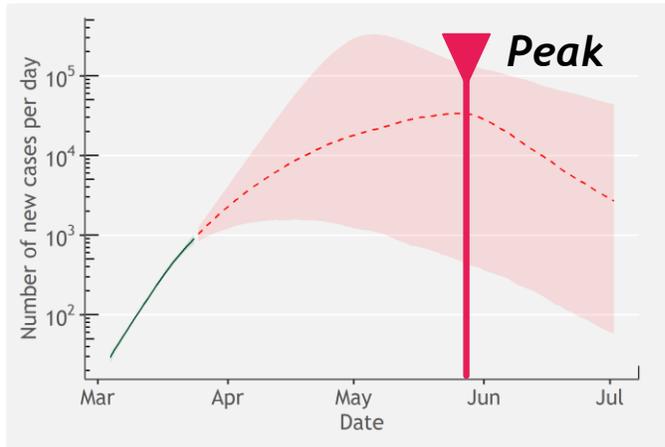
- We expect lockdown to be lifted **between W3 June and W1 July**

Belgium Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
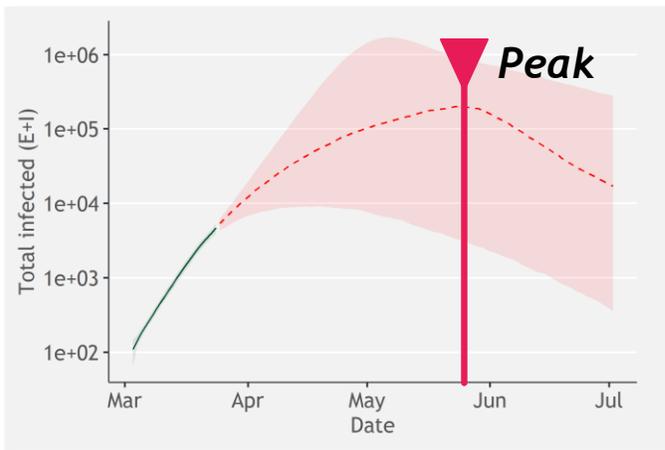
Current projections for **new cases** and **total infected patients**

# of daily new cases

Total infected patients

Estimated **key dates** of COVID-19 crisis

Lockdown start date *(actual or potential)*
- Belgium went into nationwide lockdown on **March 17th**, on the same day as the 10th death (similar to China)

Peak date
- Peak of new cases expected in **W3 May**

Lockdown end date *(actual or potential)*
- We expect lockdown to be lifted **between W2 June and W4 July**

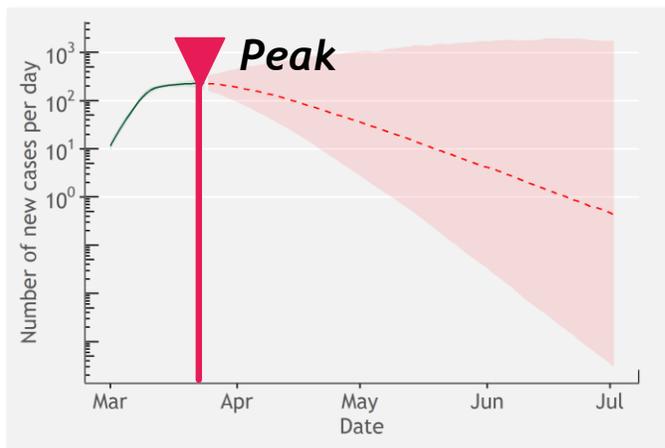Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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Norway Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients
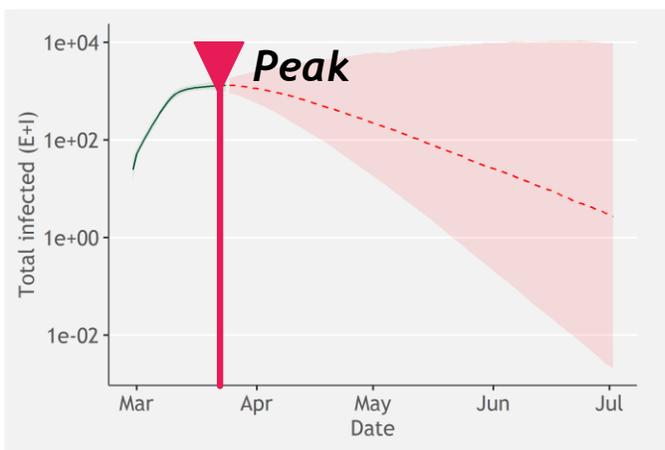
Lockdown start date *(actual or potential)*

- Norway went into nationwide lockdown on **March 12th**
- 10th death occurred 12 days later, on March 24th which makes it a faster lockdown than China

Peak date

- Peak of new cases expected in **W4 March**

Lockdown end date *(actual or potential)*

- We expect lockdown to be lifted **between W1 and W3 June**
  - Combination of early lockdown start plus political stability and government efficacy lead to Norway lifting lockdown sooner than many

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

S. Africa Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
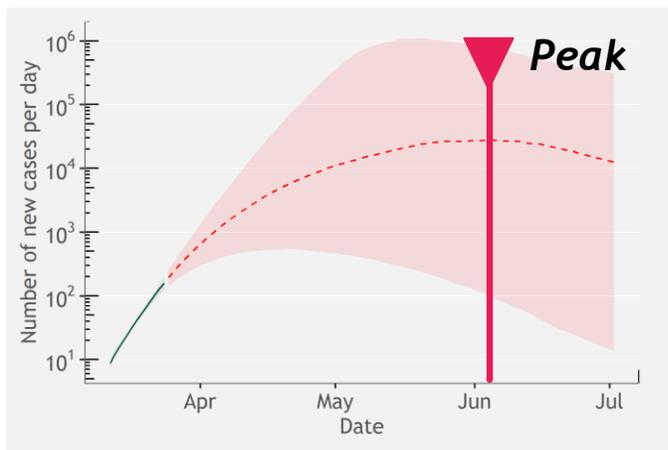
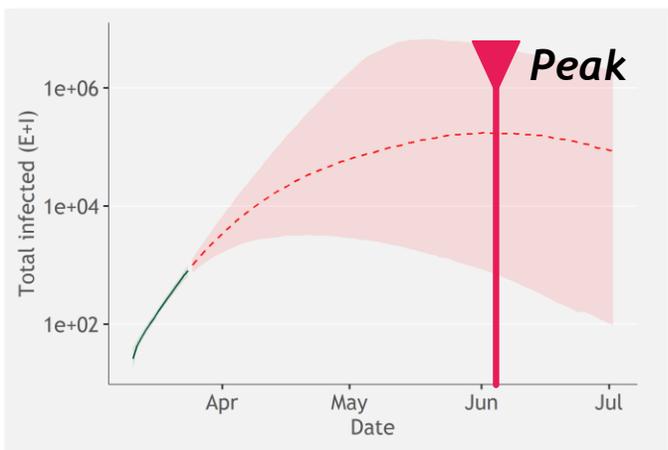## Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date *(actual or potential)*

- South Africa went into nationwide lockdown on **March 26th** a faster timing compared to China's lockdown vs. 10th death

Peak date

- Peak of new cases expected in **W1 June**

Lockdown end date *(actual or potential)*

- We expect lockdown to be lifted **between W4 June and W4 August**
  - South Africa will require a longer lockdown to manage epidemic due to lack of preparedness (e.g., low in-patient bed/population ratio)
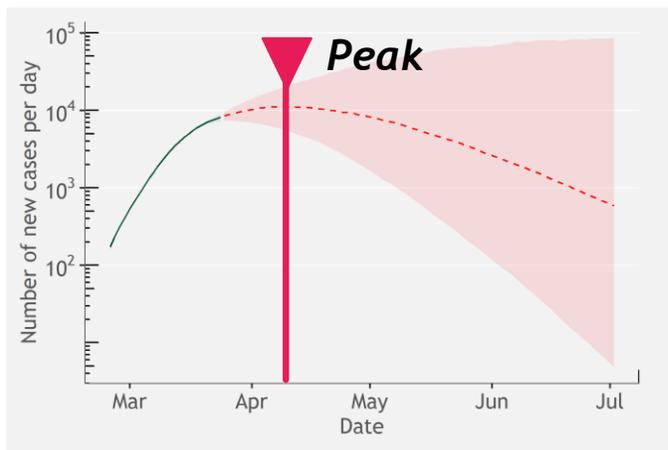
Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

Italy Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients

Lockdown start date *(actual or potential)*

- 10th death occurred on February 25th
- Italy went into a nationwide lockdown on **March 10th**, among longer timings

Peak date

- Peak of new cases expected in **W3 April**

Lockdown end date *(actual or potential)*

- We expect lockdown to be lifted **between W2 June and W1 July**

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

Sweden Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities
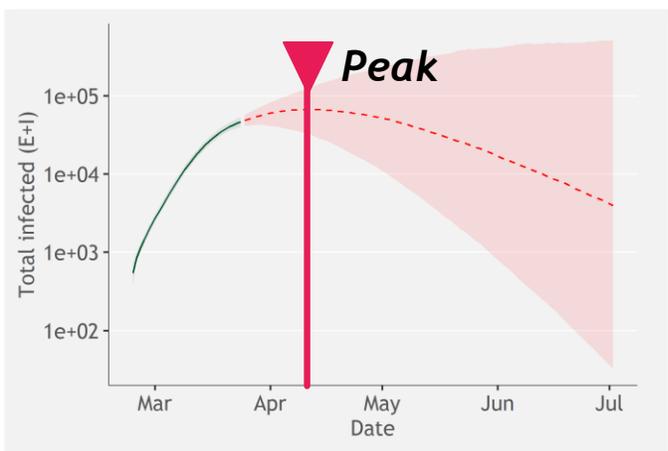
Current projections for new cases and total infected patients

# of daily new cases

Total infected patients

Estimated key dates of COVID-19 crisis

Lockdown start date *(actual or potential)*

- 10th death occurred on March 18th

- Potential lockdown could start **as soon as W4 March**, though government has imposed very few restrictions to date

Peak date

- Peak of new cases expected in **W4 March**

Lockdown end date *(actual or potential)*

- We expect lockdown to be lifted **between W1 June and W3 June**

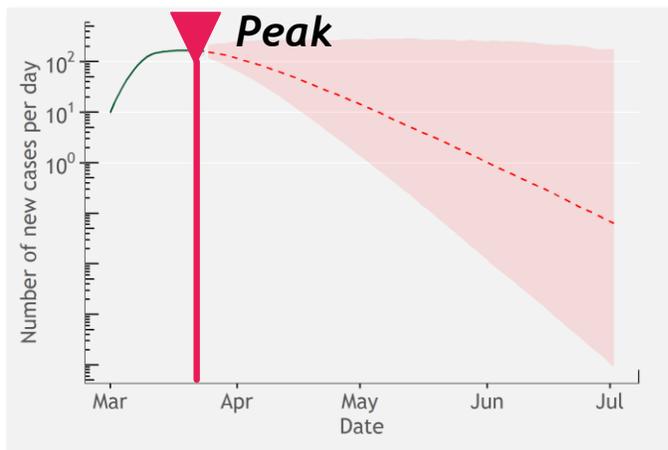Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

Colombia Epidemic scenarios | Current projection of cases and potential new measures to be taken by public authorities

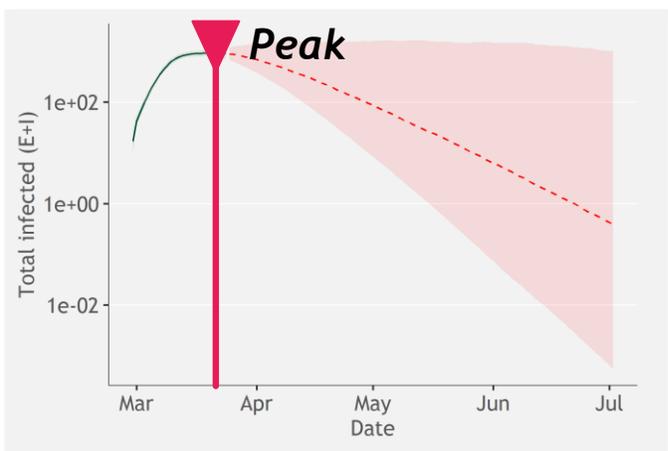## Current projections for **new cases** and **total infected patients**

Estimated **key dates** of COVID-19 crisis

# of daily new cases

Total infected patients
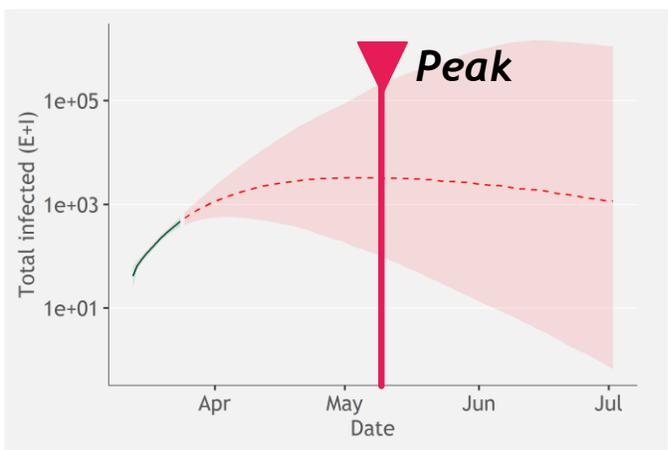
Lockdown start date *(actual or potential)*
- Colombia went into nationwide lockdown on **March 24th**, a faster timing compared to China's lockdown vs. 10th death

Peak date
- Peak of new cases expected in **W1 May**

Lockdown end date *(actual or potential)*
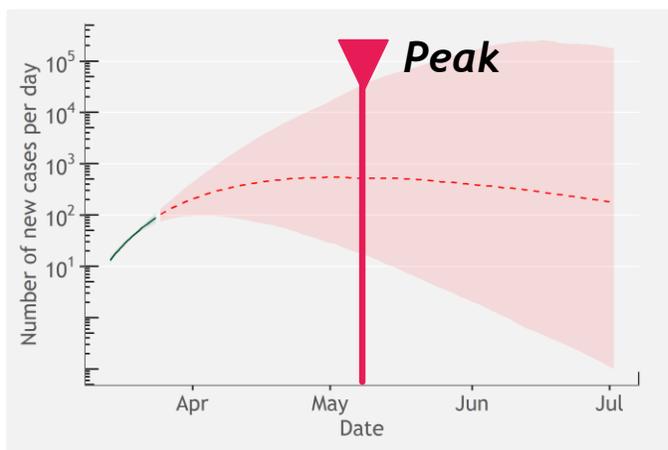- We expect lockdown to be lifted **between W4 June and W4 July**

Source: John Hopkins University (Coronavirus Resource Center), BCG Analysis

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METHODOLOGY | Detail on estimated timing of epidemic

Based on model projections

Estimated range for potential lockdown end date

1 **Lockdown begins or potential start**

2 **Peak of new daily cases reported**

3 **Short potential lockdown end date**

4 **Long potential lockdown end date**

+10-14 weeks

+8-12 weeks

Potential lockdown start date set as either actual date or estimated by the end of March – early April

Most of lockdowns (e.g. Hubei, France, UK, selected German states, Spain, India) went into lock down within 0-10 days after 10th cumulative death was announced
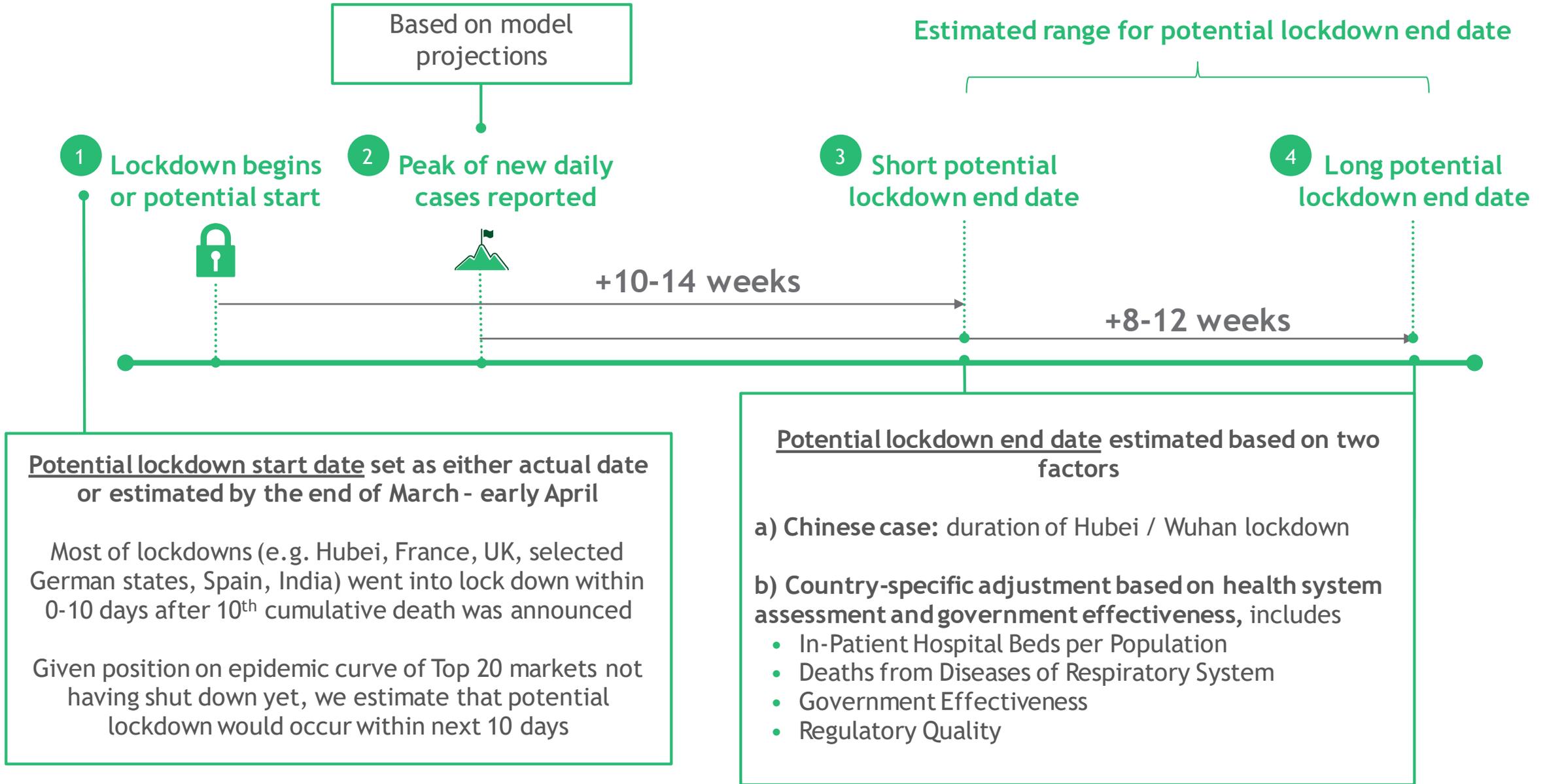
Given position on epidemic curve of Top 20 markets not having shut down yet, we estimate that potential lockdown would occur within next 10 days

Potential lockdown end date estimated based on two factors

a) Chinese case: duration of Hubei / Wuhan lockdown

b) Country-specific adjustment based on health system assessment and government effectiveness, includes
- In-Patient Hospital Beds per Population
- Deaths from Diseases of Respiratory System
- Government Effectiveness
- Regulatory Quality

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