

## Modelling the COVID-19 epidemic

Modelling of the course of the COVID-19 epidemic is critical in order to determine the impact of social distancing and other restrictions and to illustrate the importance of adherence to them. To support this work the Department of Health has established a modelling group chaired by the Chief Scientific Advisor. The group includes a number of external experts from the Public Health Agency, Trusts and local Universities. The group has access to a number of different models, including locally developed models and several different models developed by leading academic groups elsewhere in the UK. In addition, we liaise closely with the modelling group in ROI.

The purpose of this presentation is to illustrate the course of the epidemic to date, the impact of the introduction of social distancing, how we can assess public adherence to social distancing and the potential course of the epidemic if adherence to current measures declines.

Key to this is understanding the importance of the Reproduction Number ( $R$ ) – the number of other individuals who become infected as a result of contact with a single COVID-19 patient ( $R$ ). When  $R$  is less than one, the number of COVID-19 cases in the community decrease. When  $R$  is greater than one, the number of COVID-19 cases will increase, with the increase being more rapid as  $R$  becomes greater.

Before the introduction of social distancing almost three other people were infected by each COVID-19 patient in the community ( $R = 2.8$ ). As a result of social distancing and other restrictions, each COVID-19 patient now infects less than one other individual in the community ( $R=0.8$ ).

Hence, we are now seeing a slow decline in the number of community acquired COVID-19 cases, hospital admissions, ICU occupancy and deaths. The safest time to begin to release the current restrictions will be when  $R$  is well below 1 and there is a relatively low number of new COVID-19 cases each day.

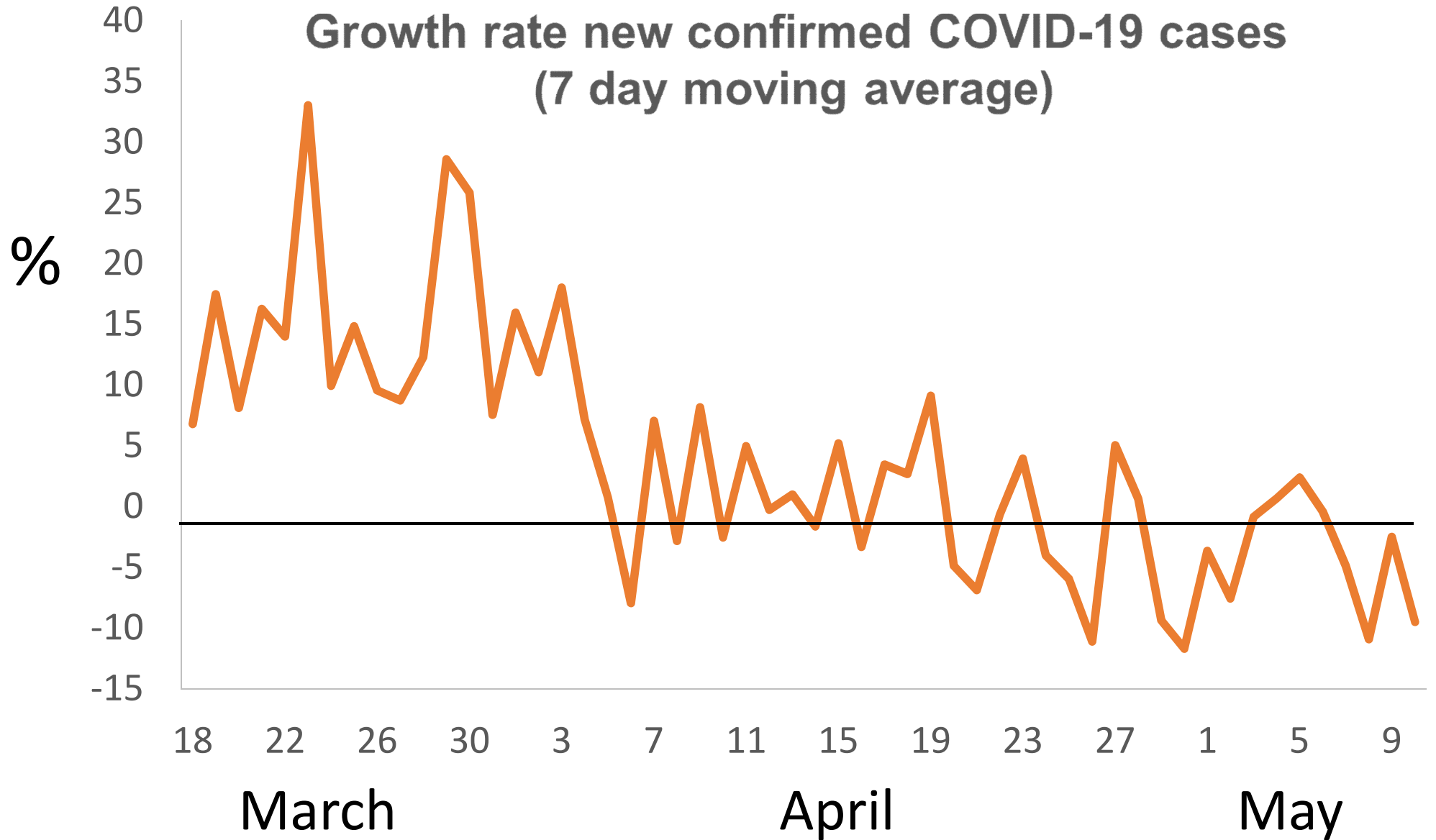
In order to ensure that the number of COVID-19 cases remains at the current level or less in the future, we need to ensure that  $R$  remains at or below 1. If  $R$  increases above one there will be an increase in COVID-19 cases and a risk of a second or subsequent waves of the epidemic.

We do not expect  $R$  to fall to a much lower value than it is now until a high level of population immunity is achieved. Any relaxation of the current restrictions will tend to increase the value of  $R$  from its current value and it will be important to use every additional measure we can to keep  $R$  below one.

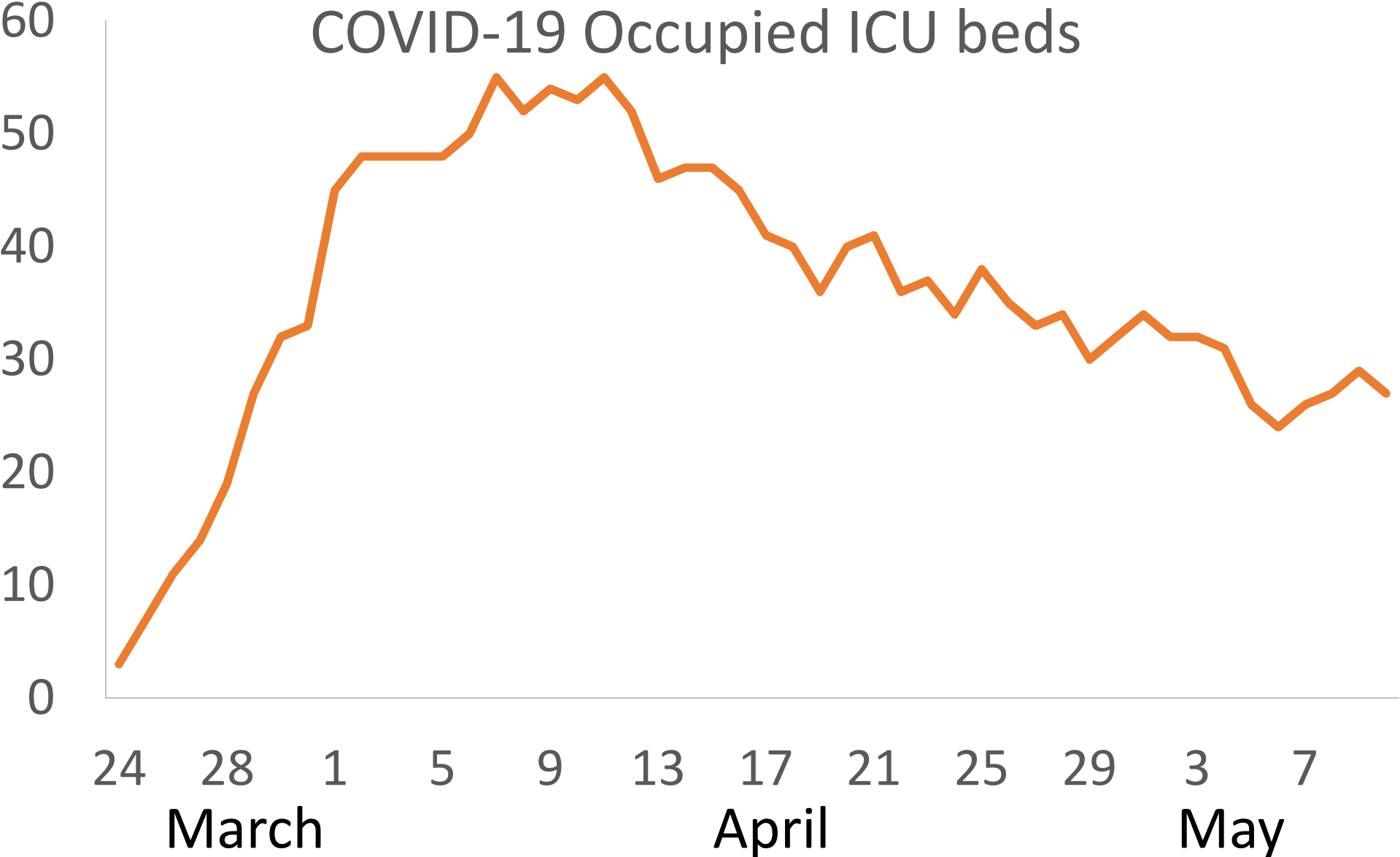
The most important strategy will be an extensive test/ trace /isolate programme which identifies contacts of every new case and makes sure that they self-isolate at home until we are sure that they do not have the infection.”

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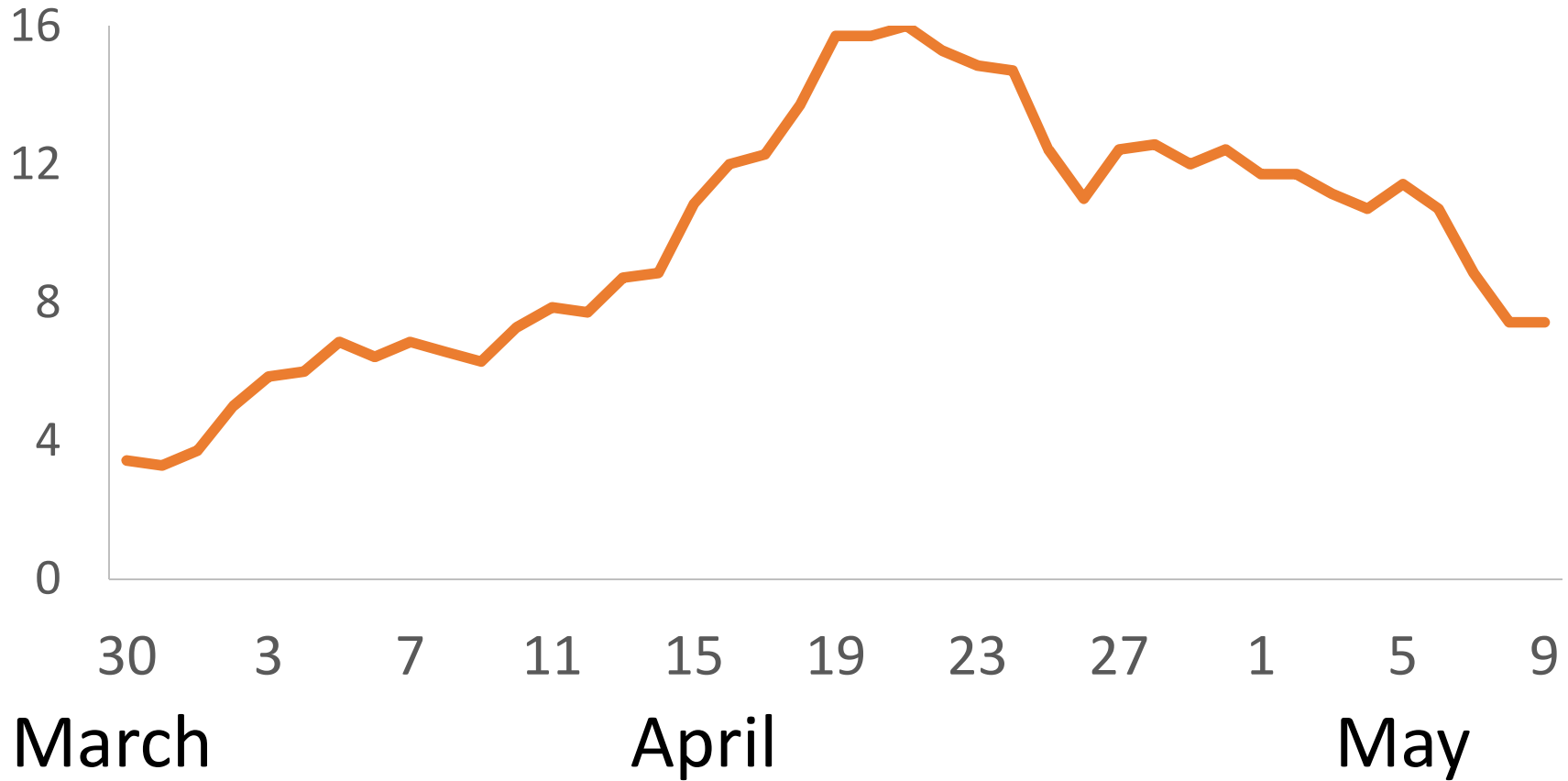
# Growth rate new confirmed COVID-19 cases (7 day moving average)



# COVID-19 Occupied ICU beds

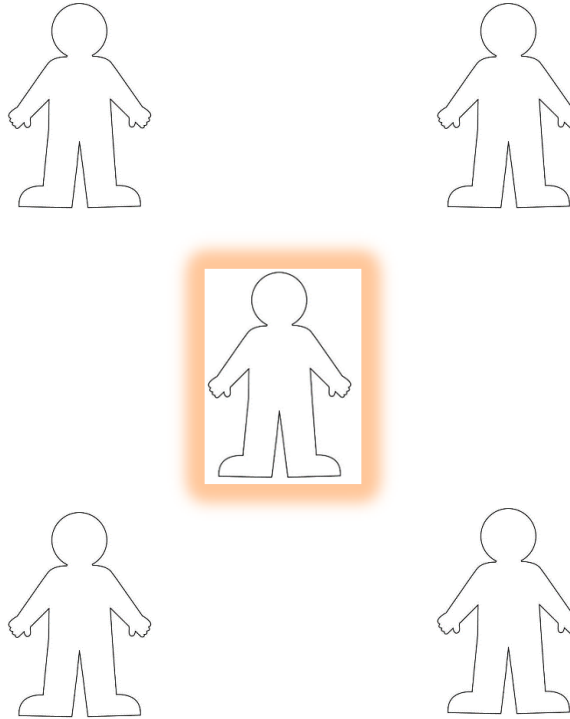


# Deaths by date reported (PHA) (7 day moving average)



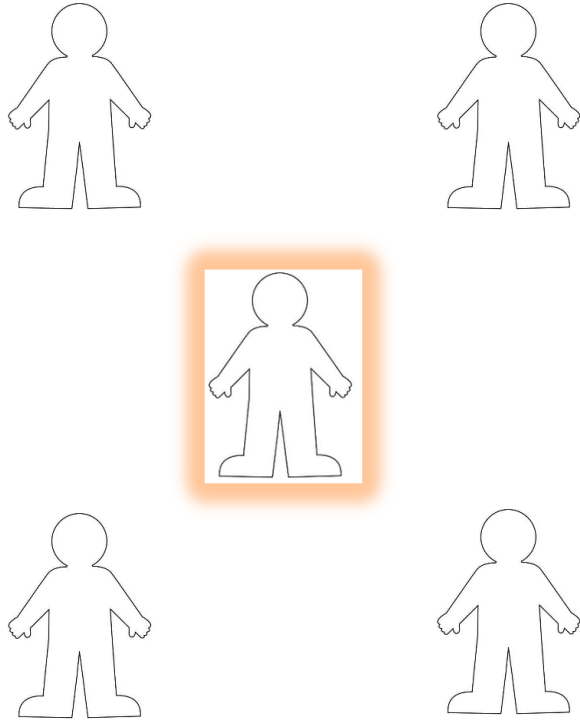
# The Basic Reproduction Number: R

- the number of individuals infected by one case



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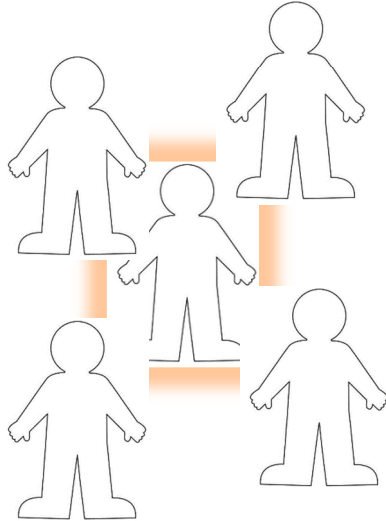


R less than 1  
– cases decrease

R greater than 1  
– cases increase

# What increases R?

- R is increased by close contacts between people or
- by shared contacts with hard surfaces



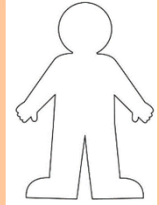
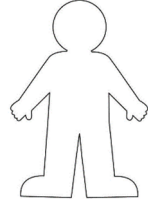
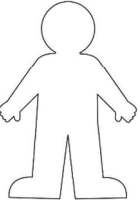
- Social distancing means
  - Fewer close contacts between people
  - Contacts which are as short as possible
  - Frequent hand washing

**Social distancing = lower R**

**We need to keep R less than 1 to avoid an increase in COVID-19 cases**



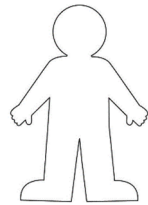
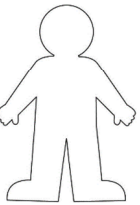
# What decreases R?



- R is decreased when there are few close contacts between people and
- a reduction in shared contacts with hard surfaces
  
- Social distancing for all
- Frequent hand washing
- Tracing, isolating and testing contacts of confirmed cases
- Shielding the vulnerable

**Social distancing = lower R**

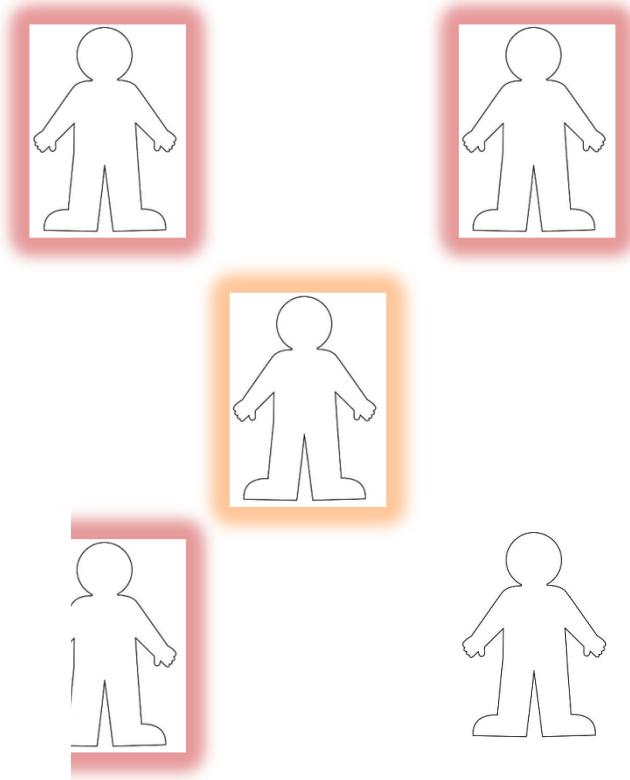
**We need to keep R less than 1 to avoid an increase in COVID-19 cases**



# What do we expect to happen to R?

- The higher R is above 1 the faster cases will rise
- The lower R is below 1 the faster cases will fall
- We do not expect R to keep falling lower and lower
  
- **R some way below 1 and a relatively small number of cases is the least dangerous time to relax restrictions**

# Before social distancing.....



$R = 2.8$

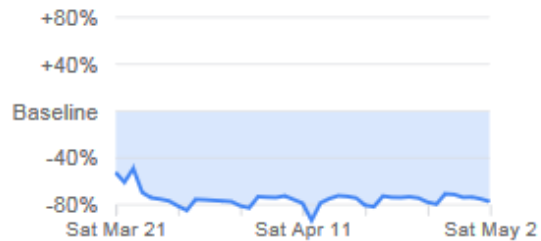
- Almost three other people infected by each case
- COVID-19 increasing rapidly
- Cases double every 3 – 4 days

# Effect of social distancing on behaviours.....

## Belfast

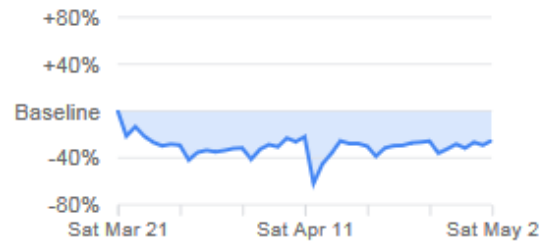
### Retail & recreation

**-77%** compared to baseline



### Grocery & pharmacy

**-25%** compared to baseline



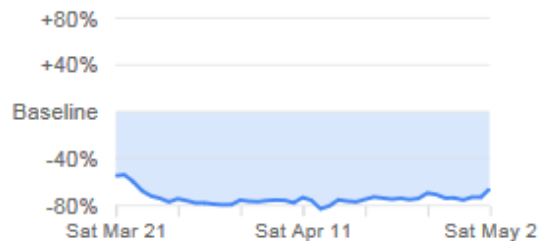
### Parks

**-33%** compared to baseline



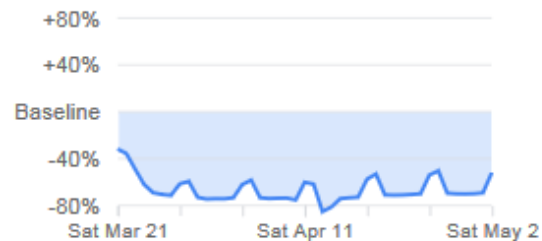
### Transit stations

**-66%** compared to baseline



### Workplace

**-52%** compared to baseline



### Residential

**+18%** compared to baseline

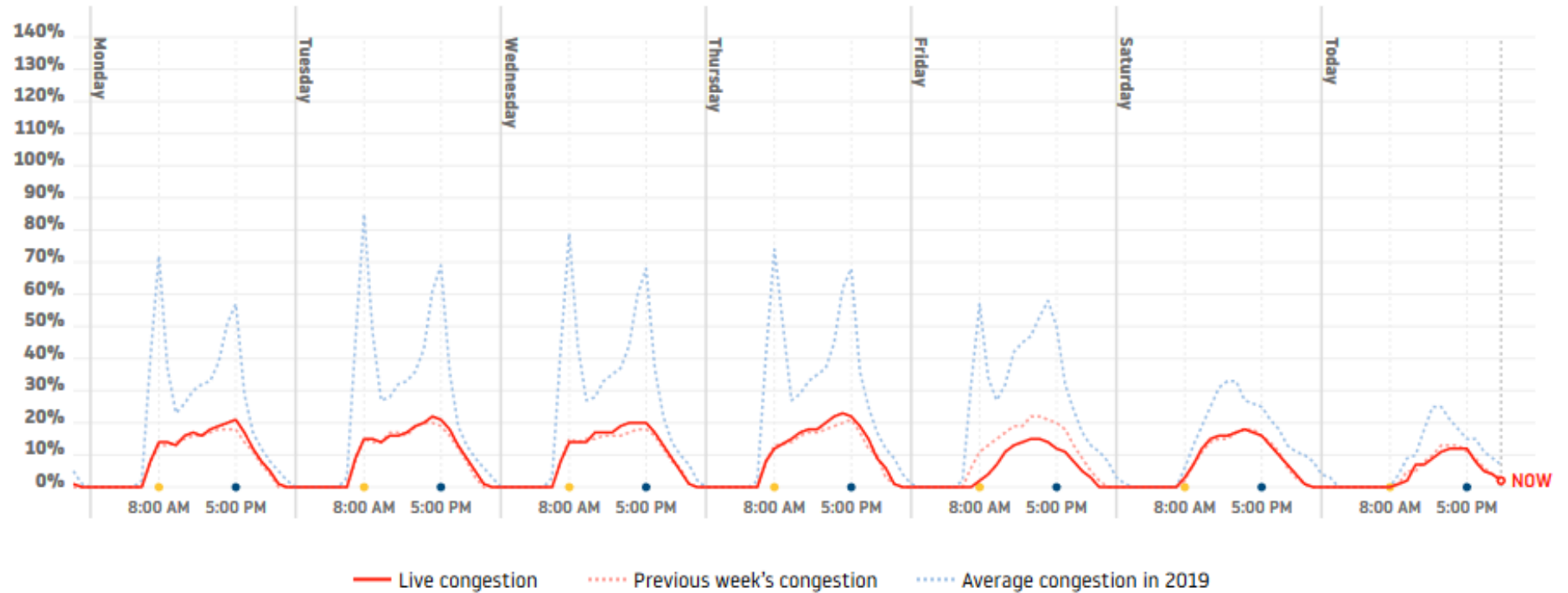


# Traffic Congestion

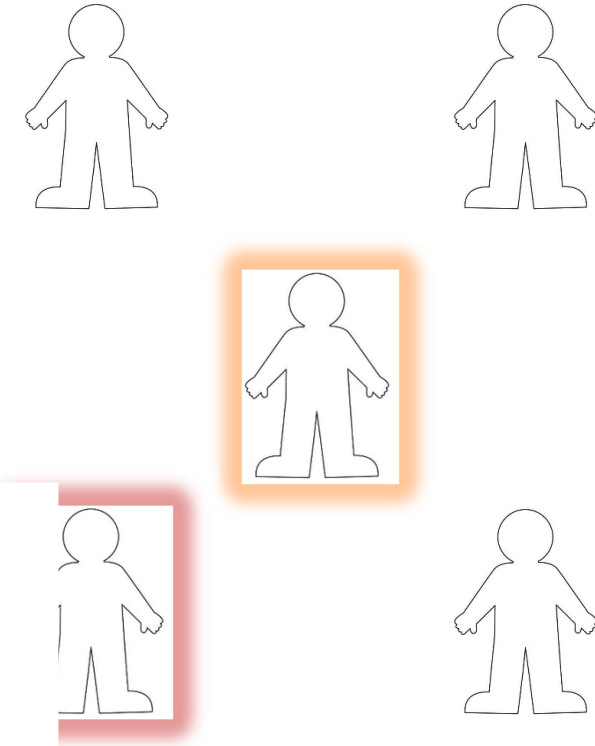
## CONGESTION LEVEL

LAST 48 HOURS

LAST 7 DAYS



# After social distancing.....



$$R = 0.8$$

- Less than one other person infected by each case
- COVID-19 decreasing slowly

# What happens if R increases? Patients in ICU.....

