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Guidance

The R value and growth rate in England

The latest reproduction number (R) and growth rate of coronavirus (COVID-19) in England.

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Latest R and growth rate

No UK estimates for R and growth rate have been agreed by SAGE

The UK estimates of R and growth rate are averages over different epidemiological situations and should be regarded as a guide to the general trend rather than a description of the epidemic state.

Given the increasingly localised approach to managing the epidemic, particularly between nations, UK-level estimates are less meaningful than previously and may not accurately reflect the current picture of the epidemic.

The R value and growth rates for the 4 nations and NHS England regions are more robust and useful metrics than those for the whole UK. As a result, UK estimates of the R value and growth rate will no longer be produced.

Latest R range for England

0.8 to 1.0

Latest growth rate range for England

-4% to 0%

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per day

An R value between 0.8 and 1.0 means that, on average, every 10 people infected will infect between 8 and 10 other people.

A growth rate of between -4% and 0% means that the number of new infections is broadly flat or shrinking by up to 4% every day.

These estimates represent the transmission of COVID-19 over the past few weeks due to the time delay between someone being infected, developing symptoms, and needing healthcare.

Latest by NHS England regions

These are the latest R and growth rate estimates by NHS England regions.

Region	R	Growth rate % per day
England	0.8 to 1.0	-4 to 0
East of England*	0.7 to 1.0	-6 to -1
London*	0.8 to 1.0	-5 to 0
Midlands	0.7 to 1.0	-5 to -1
North East and Yorkshire	0.8 to 1.0	-4 to 0
North West	0.8 to 1.0	-4 to 0
South East*	0.7 to 0.9	-7 to -2
South West*	0.7 to 1.0	-6 to 0

* Particular care should be taken when interpreting these estimates, as they are based on low numbers of cases or deaths and/or dominated by clustered outbreaks. They should not be treated as robust enough to inform policy decisions alone.

When the numbers of cases or deaths are at low levels and/or there is a high degree of variability in transmission across a region, then care should be taken when interpreting estimates of R and the growth rate. For example, a significant amount of variability across a region due to a local outbreak may mean that a single average value does not accurately reflect the way infections are changing throughout that region.

Estimates for R and growth rates are shown as a range, and the true values are likely to lie within this range.

See a time series of published R and growth rate estimates (ODS, 23.7KB) from 29 May 2020 for:

- England
- the 7 NHS England regions

Historical UK estimates up to 26 March 2021 are also included. The time series document is updated regularly.

Latest for devolved administrations

The latest ranges for R values and growth rates in the devolved administrations are published on their respective websites:

- R value and growth rate for Wales (Cymraeg)
- R value and growth rate for Scotland
- R value for Northern Ireland

Other key statistics

The ONS Infection Survey provides information on:

- the number of new infections of the disease identified during a specified time period (incidence)
- the proportion of the population that test positive for the disease in the community at any given point in time (positivity rate or prevalence)

Other data on testing, cases, healthcare, and deaths is available at the Coronavirus (COVID-19) in the UK dashboard.

About R and growth rate

R

The reproduction number (R) is the average number of secondary infections produced by a single infected person.

An R value of 1 means that on average every person who is infected will infect 1 other person, meaning the total number of infections is stable. If R is 2, on average, each infected person infects 2 more people. If R is 0.5 then on average for each 2 infected people, there will be only 1 new infection. If R is greater than 1 the epidemic is growing, if R is less than 1 the epidemic is shrinking. The higher R is above 1, the more people 1 infected person infects and so the faster the epidemic grows.

R can change over time. For example, it falls when there is a reduction in the number of contacts between people, which reduces transmission. R increases when the numbers of contacts between people rise, leading to a rise in viral transmission.

Growth rate

The growth rate reflects how quickly the numbers of infections are changing day by day. It is an approximation of the percentage change in the number of infections each day. If the growth rate is greater than 0 (+ positive), then the epidemic is growing. If the growth rate is less than 0 (- negative) then the epidemic is shrinking.

The size of the growth rate indicates the speed of change. A growth rate of +5% indicates the epidemic is growing faster than a growth rate of +1%. Likewise, a growth rate of -4% indicates the epidemic is shrinking faster than a growth rate of -1%. Further technical information on growth rate can be found on Plus magazine.

How growth rates are different to R estimates

R alone does not tell us how quickly an epidemic is changing. Different diseases with the same R can generate epidemics that grow at very different speeds. For instance, 2 diseases, both with R=2, could have very different lengths of time for 1 infected individual to infect 2 other people; one disease might take years, while the other might take days.

The growth rate provides us with information on the size and speed of change, whereas the R value only gives us information on the direction of change.

To calculate R, information on the time taken between each generation of infections is needed. That is how long it takes for one set of people in an infected group to infect a new set of people in the next group. This can depend on several different biological, social, and behavioural factors. The growth rate does not depend on the ‘generation time’ and so requires fewer assumptions to estimate.

Neither one measure, R nor growth rate, is better than the other but each provide information that is useful in monitoring the spread of a disease.

Estimates of the R value and growth rates are updated on a regular basis.

They are not, however, the only important measures of the epidemic. Both should be considered alongside other measures of the spread of disease, such as the number of new cases of the disease identified during a specified time period (incidence), and the proportion of the population with the disease at a given point in time (prevalence). If R equals 1 with 100,000 people currently infected, it is a very different situation to R equals 1 with 1,000 people currently infected. The number of people currently infected with coronavirus (COVID-19) – and so able to pass the virus on – is therefore very important.

How R and growth rates are estimated

Individual modelling groups use a range of data to estimate growth rates and R values, including but not limited to:

- epidemiological data such as testing data, hospital admissions, ICU admissions and deaths – it generally takes up to 3 weeks for changes in the spread of the disease to be reflected in the estimates due to the time delay between initial infection and the need for hospital care
- contact pattern surveys that gather information on behaviour – these can be quicker (with a lag of around a week) but can be open to bias as they often rely on self-reported behaviour and make assumptions about how the information collected relates to the spread of disease
- household infection surveys where swabs are performed on individuals – these can provide estimates of how many people are infected. Longitudinal surveys (where samples are repeatedly taken from the same people) allow a more direct estimate of the growth in infection rates

Different modelling groups use different data sources to estimate these values using mathematical models that simulate the spread of infections. Some may even use all these sources of information to adjust their models to better reflect the real-world situation. There is uncertainty in all these data sources so estimates can vary between different models, so we do not rely on just one model. Evidence from several models is considered, discussed, combined, and the growth rate and R value are then presented as ranges. The most likely true values are somewhere within the ranges.

Rounding and differences between the data streams used in these individual model outputs that are combined account for differences between estimates of R and estimated growth rates.

As of 26 March 2021, the approach to combining the R values and growth rates has been normalised, so that modelling groups submit time series of estimates and a given date across all models is used, rather than their most recent estimates. This makes the estimation more consistent and robust, with little to no difference to the range.

Who estimates R and growth rates

The R value and growth rates are estimated by several independent modelling groups based in universities and Public Health England (PHE). The modelling groups discuss their individual R estimates at the Science Pandemic Influenza Modelling group (SPI-M) – a subgroup of SAGE.

Not all groups submit model estimates for all geographical areas considered. For example, some groups may submit national but not UK estimates.

Time delay of the estimates

SPI-M use several models, each using data from a variety of sources in their estimates of R and growth rate. Epidemiological data, such as hospital admissions, ICU admissions and deaths, usually takes up to 3 weeks to reflect changes in the spread of disease.

This is due to the time delay between initial infection, developing symptoms and the need for hospital care. As a result, the latest published figures represent the situation over the past few weeks rather than today. These estimates do not yet fully reflect any very recent changes in transmission due

estimates do not yet fully reflect any very recent changes in transmission due to, for example, recent policy changes in the UK.

Limitations of R

R is an average value that can vary in different parts of the country, communities, and subsections of the population. It cannot be measured directly so there is always uncertainty around its exact value. This becomes even more of a problem when calculating R using small numbers of cases, either due to lower infection rates or smaller geographical areas. This uncertainty may be due to variability in the underlying data, leading to a wider range for R and more frequent changes in the estimates.

Even when the national R estimate is below 1, some regions may have R estimates that include ranges that exceed 1, for example from 0.7 to 1.1; this does not necessarily mean the epidemic is increasing in that region, just that the uncertainty means it cannot be ruled out. It is also possible that an outbreak in one specific place could result in an R above 1 for the whole region.

The UK estimates of R and growth rate are averages over different epidemiological situations and should be regarded as a guide to the general trend rather than a description of the epidemic state. Given the increasingly localised approach to managing the epidemic, particularly between nations, UK-level estimates are less meaningful than previously and are more easily biased by the models combined in their calculation.

SPI-M considers estimates of R and growth rates for the 4 nations and NHS England regions to be more robust and useful metrics than those for the whole UK.

Limitations of growth rates

The growth rate is an average value that can vary. When case numbers are low, uncertainty increases. This could happen when only a very small proportion of people are infected, or the geographical area considered has a very small population. A smaller number of cases means that variability in the underlying data makes it difficult to estimate the growth rate; there will be a wider range given for growth rate and frequent changes in the estimates. This will happen for both R and the growth rate. However, estimation of the growth rate requires fewer assumptions about the disease than R.

Even when the England growth rate estimate is negative (below 0), some regions may have growth rate estimates that include ranges that are positive (above 0), for example from -4% to +1%. This does not necessarily mean the epidemic is increasing in that region, just that the uncertainty means it cannot be ruled out. It is also possible that an outbreak in one specific place could result in a positive (above 0) growth rate for the whole region.

As for the R value, UK-level estimates of the growth rate are less meaningful than previously given the increasingly localised approach to managing the epidemic, particularly between nations.

SPI-M considers estimates of R and growth rates for the 4 nations and NHS England regions to be more robust and useful metrics than those for the whole UK.

Estimates of growth rate for geographies smaller than regional level are less reliable and it is more appropriate to identify local hotspots through, for example, monitoring numbers of cases, hospitalisations, and deaths.

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