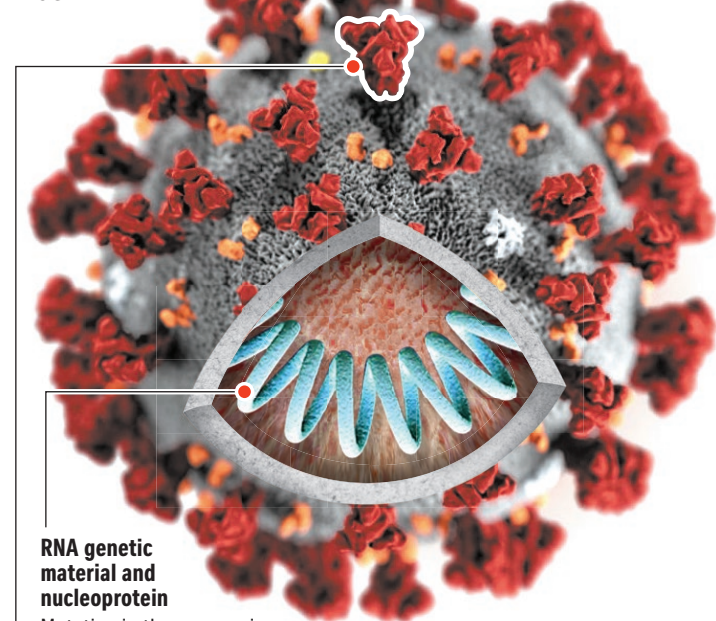


# Covid-19: How the virus has changed over a year

Since Sars-CoV-2 which causes Covid-19 emerged in December 2019, there have been more than 6,600 mutations of the spike protein of the virus. This is the part of the virus that allows it to invade the body. **Senior Health Correspondent Salma Khalik** and **Infographics Journalist Lim Yong** explain.

## WHY THE SPIKE PROTEIN IS IMPORTANT

Sars-CoV-2 virus



RNA genetic material and nucleoprotein

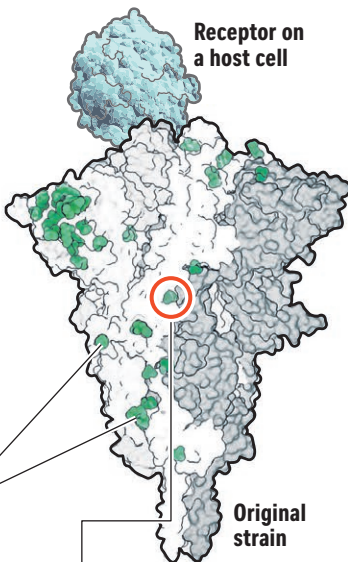
Mutation in the genome is transmitted to the spike proteins

Receptor on a host cell

### Sars-CoV-2 spike protein

- The spikes on the surface of the virus are the key that enables the virus to enter the human cell.
- This is why vaccine developers choose parts of these spike proteins to target.
- There is concern that should some of the chosen parts mutate, the vaccine might become less effective.
- Some parts of the virus are more prone to mutate.

These are the parts that have mutated in the current variants



Original strain

### D614G mutation

- A variant of Sars-CoV-2 with this mutation emerged in late January or early February last year.
- It is thought to **increase the coronavirus' infectivity** but does not seem to make the disease more severe or help the virus escape vaccines.
- The majority of currently circulating virus variants have this mutation.

## ABOUT MUTATIONS AND VARIANTS

Mutations occur when something changes, is added or deleted from the virus' proteins.

A variant is created by a combination of mutations – often between five and 15 mutations.

A variant becomes "of concern" (VOC) if it fulfils at least one of these criteria:

- 1 There is evidence that it transmits more easily
- 2 Causes more severe illness
- 3 Significantly reduces neutralisation by antibodies, or reduces the effectiveness of treatment, vaccines or diagnosis.

A variant is "of interest" if it might fulfil any of the criteria of a VOC, but there is insufficient evidence to declare it a VOC.

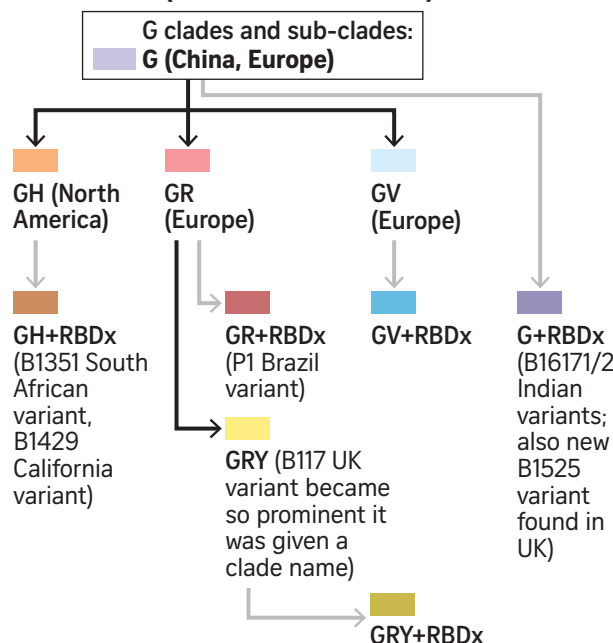
Mutations on the spike protein ● Key changes ● Other changes	VARIANTS OF CONCERN			VARIANTS OF INTEREST	
	UK B117	South Africa B1351	Brazil P1	India B16171	India B16172
<b>Earliest samples</b>	September 2020	August 2020	December 2020	October 2020	December 2020
<b>First detected</b>	United Kingdom	South Africa	Brazil and Japan	India	India
<b>Concerns</b>					
• Increased infectivity	✓	✓	✓	✓ Possible but not confirmed	
• Increased severity	✓ Possible	✓ Possible but not confirmed	✓ Possible but not confirmed		
• Reduction of vaccine effectiveness	✗	✓ Possible	✓ Possible		
<b>Number of locations now detected in</b>	142	97	56	At least 17	

NOTE: \*Accurate as at latest update by WHO on May 4.

## THE GLOBAL RISE AND FALL OF SARS-COV-2 VARIANTS

LEGEND: DIFFERENT CLADES

- L (Wuhan)
- V (China, Italy)
- S (Southern China)
- O (mix of all other strains)



- When a virus mutates significantly and becomes prominent, it creates an offshoot family called a clade.
- Since December 2019, the coronavirus that causes Covid-19 has formed several clades.

- Over the past year, the G clade that went from China to Europe has overwhelmed the rest.
- Today, almost all infections are from this clade and its sub-clades – GR, G, GV and GRY.

- Some clades have +RBDx (receptor-binding domain mutations) which means they may potentially be more infectious or less receptive to vaccines.

Started with S and L. S continued at moderate levels and L split into initially equal G and V versions with G reaching 50% in March 2020 and splitting further into GR and GH, and later also GV.

GR splintered into GRY from around September/October 2020.

