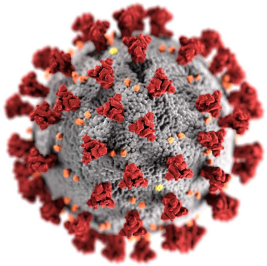
Bioanalytical solutions in support of the COVID-19 pandemic

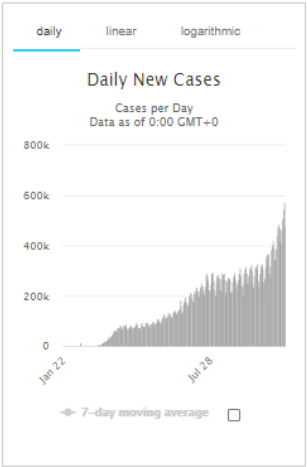
Presenter: Joanne Goodman
on behalf of EBF

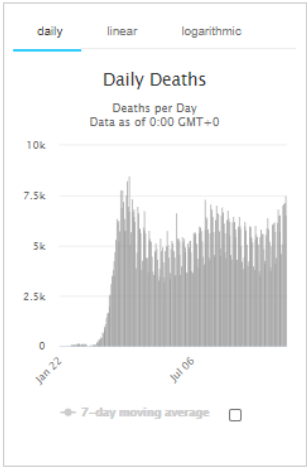
Open Symposium
November 2020

2020 the year that changed the world

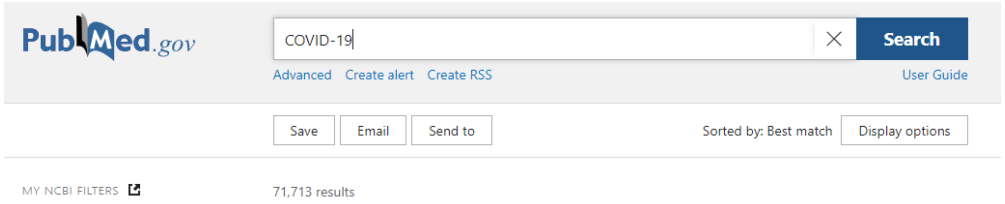


- Late December 2019 a novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first reported in Wuhan, China
- Classified as an epidemic and subsequently a pandemic by the WHO
- Currently affecting 216 countries and territories around the world and 2 international conveyances
- Scientific communities mobilised swiftly
- Urgent need for tests, effective drugs and vaccines

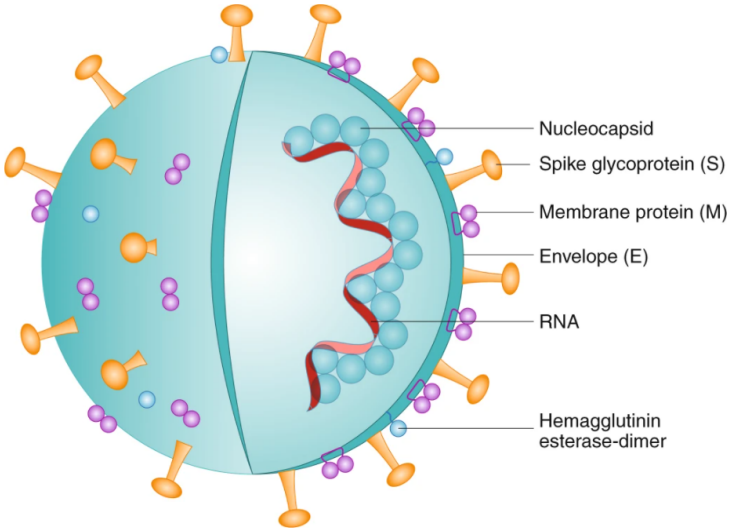




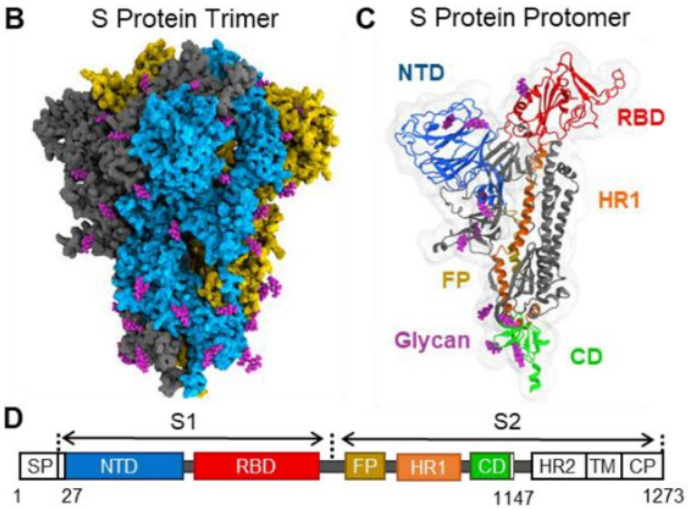
https://www.worldometers.info/coronavirus/



Structure of SARS-CoV-2 and Spike Protein Trimer



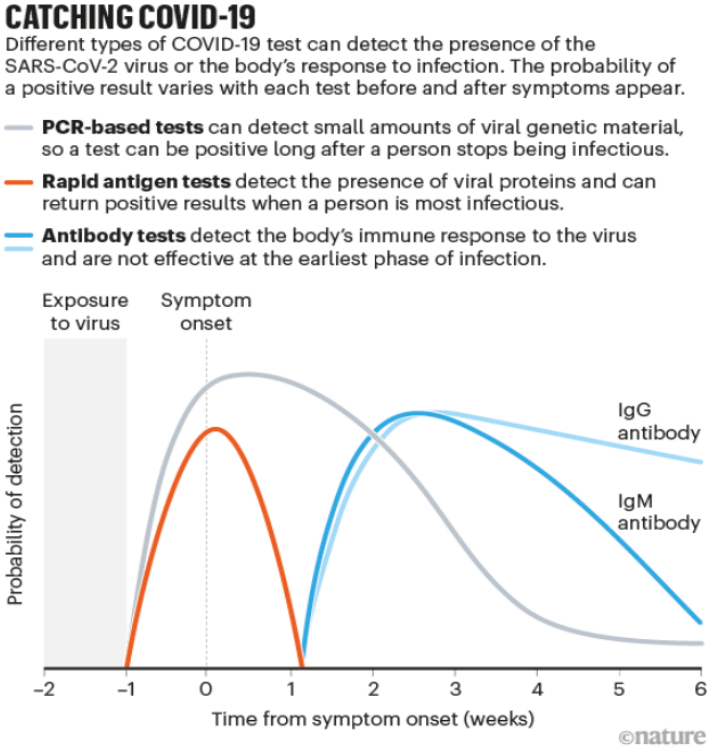
Schematic representation of SARS-CoV-2 structure. This is an enveloped, positive-sense RNA virus with four main structural proteins, including spike (S) and membrane (M) glycoproteins, as well as envelope (E) and nucleocapsid (N) proteins.

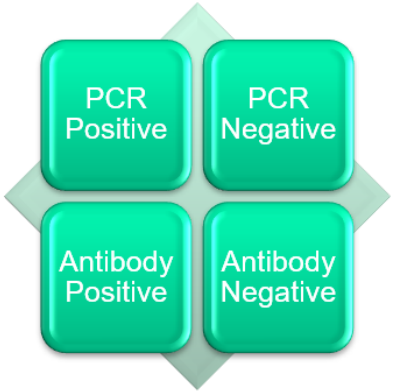


Florindo, H.F., Kleiner, R., Vaskovich-Koubi, D. *et al.* Immune-mediated approaches against COVID-19. *Nat. Nanotechnol.* **15,** 630–645 (2020). https://doi.org/10.1038/s41565-020-0732-3

Mert Gur, Elhan Taka, Sema Zeynep Yilmaz, Ceren Kilinc, Umut Aktas, Mert Golcuk bioRxiv 2020.04.17.047324; doi: https://doi.org/10.1101/2020.04.17.047324

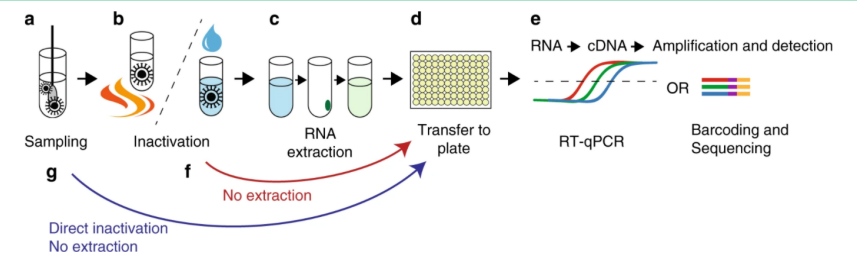
Detection of SARS-CoV-2 virus and antibody responses





Virus detection

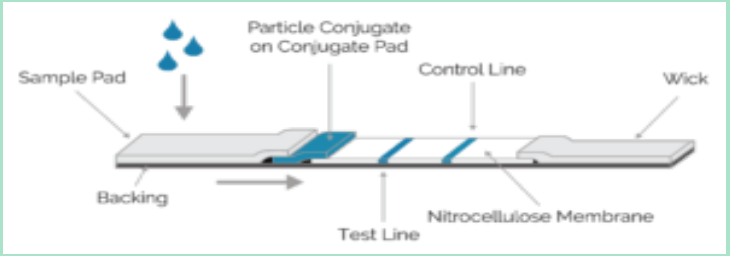
PCR methods



Nature Communications **volume 11**, Article number: 4812 (2020)

- Results take a few hours
- Reporting make take a few days
- Result is only as good as the day that the test is taken

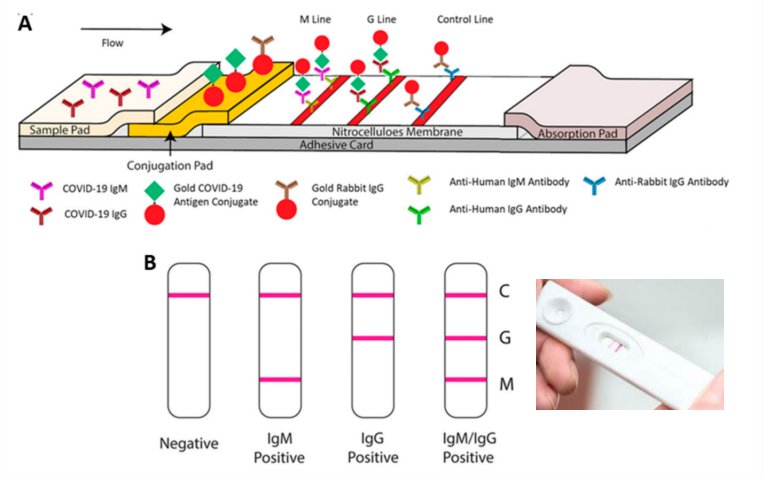
Rapid Antigen Tests (Point of Care Tests)



- Performed alongside the patient
- Results within 15-30 minutes
- Usually less sensitive than PCR
- Good for high viral loads
- Useful if no access to PCR methods

Antibody responses (serology)

Lateral flow assay (Point of Care Test)

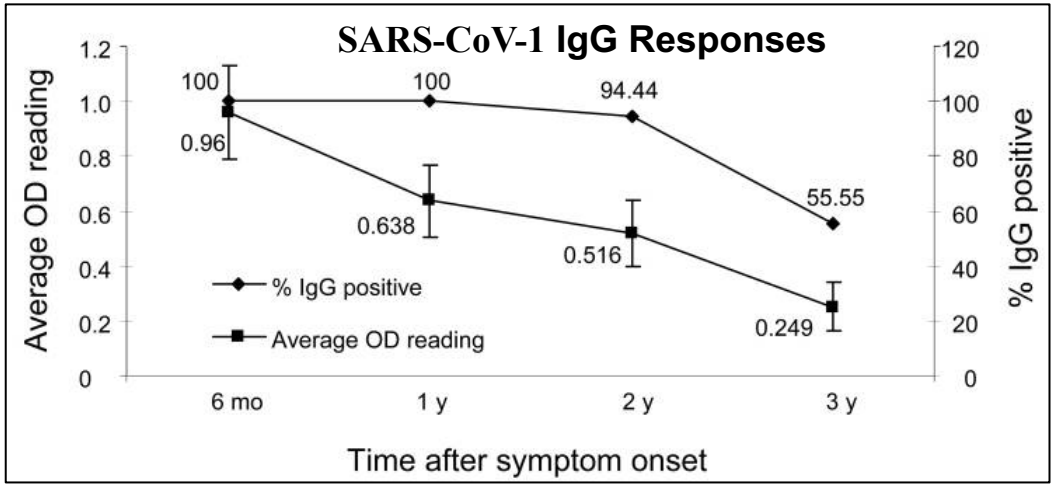


J. Clin. Med. **2020**, *9*(10), 3372; **https://doi.org/10.3390/jcm9103372**

Other methods:

- Immunoassay methods
  - May differ in the antigen used or the assay format (ELISA, ECL etc.)
- Flow based methods
  - Immunoglobulins
  - T cell responses
  - B cell responses

Still much to learn about immunity

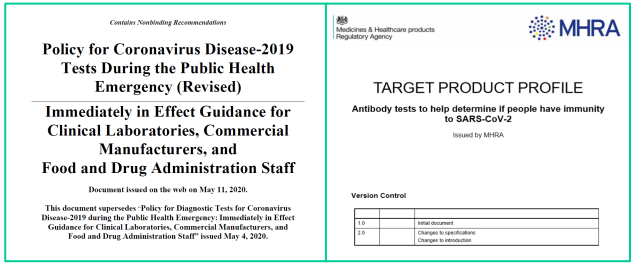


Li-Ping Wu *et al*. Emerg Infect Dis. 2007 Oct; 13(10): 1562–1564.

- Which antigen is the best for neutralising responses?
- Will a vaccine confer long-term immunity?
- Will COVID passports become reality?

Such assays are diagnostic tests

- Diagnostic tests and therefore validation looks different from typical BMV
  - For serology assays assay thresholds are not set in the same way as immunogenicity cut points
- Sensitivity (% true positives) and specificity (% true negatives) using blinded sample sets
- Serlogy:
  - ≥98% sensitivity ≥20 days post symptoms
  - ≥98% specificity >6 months before the pandemic
- Concordance of data between testing labs



Contains Nonbinding Recommendations

Policy for Coronavirus Disease-2019 Tests During the Public Health Emergency (Revised)

Immediately in Effect Guidance for Clinical Laboratories, Commercial Manufacturers, and Food and Drug Administration Staff

Document issued on the web on May 11, 2020.

This document supersedes "Policy for Diagnostic Tests for Coronavirus Disease-2019 during the Public Health Emergency: Immediately in Effect Guidance for Clinical Laboratories, Commercial Manufacturers, and Food and Drug Administration Staff" issued May 4, 2020.

Medicines & Healthcare products Regulatory Agency

MHRA

TARGET PRODUCT PROFILE

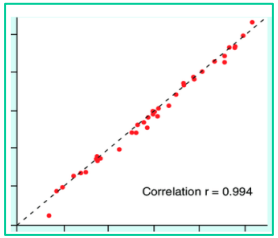
Antibody tests to help determine if people have immunity to SARS-CoV-2

Issued by MHRA

Version Control

1.0		Initial document
2.0		Changes to specifications Changes to introduction

		Sample type	
		Positive	**Negative**
Immunoassay test result	**Positive**	True positive (TP)	False positive (FP)
	Negative	False negative (FN)	True negative (TN)
	Sensitivity	=TP/(TP + FN) * 100%	
	Specificity		=TN/(TN + FP) * 100%



PHE evaluation of serological assays show potential of false positives/cross reactivity

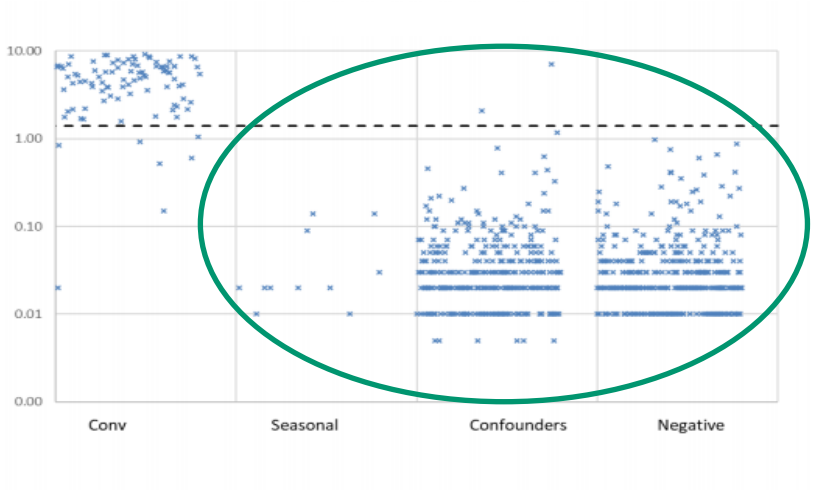


Figure 3: Scatterplot of all samples according to sample group.

Test	Specificity	Sensitivity >21 days	Antigen
Ortho	99.5%	93.5%	Spike
EuroImmune	99.0%	74.7%	Spike
Diasorin	97.7%	71.4%	S1, S2
Beckman Coulter	99.3%	79.2%	RBD
Siemens	100%	92.4%	RBD
Abbott	100%	93.5%	NP
Roche	100%	86.7%	NP

RBD: receptor binding domain
NP: nucleocapsid protein

Data compiled from: https://www.gov.uk/government/publications/covid-19-laboratory-evaluations-of-serological-assays

https://www.gov.uk/government/publications/covid-19-laboratory-evaluations-of-serological-assays

Looking to the future ….

- Better access to testing
  - Such tools may be useful to allow “COVID secure” workplaces when combined with measures such as regular hand washing, physical distancing, wearing of masks and temperature monitoring
- Better understanding of immune responses
- Assessment of mutations in the virus and infectivity
- Repurposing and novel drugs to improve clinical outcomes
- The availability of one or even multiple vaccines
  - Logistical issues in vaccination of 8 billion people
  - Willingness of the population to be vaccinated

European Bioanalysis Forum vzw
Email: info@e-b-f.eu
Website: www.e-b-f.eu