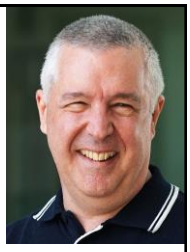
# Contemporary Infection Control

# 2022



**Emeritus Professor Laurence J. Walsh AO**

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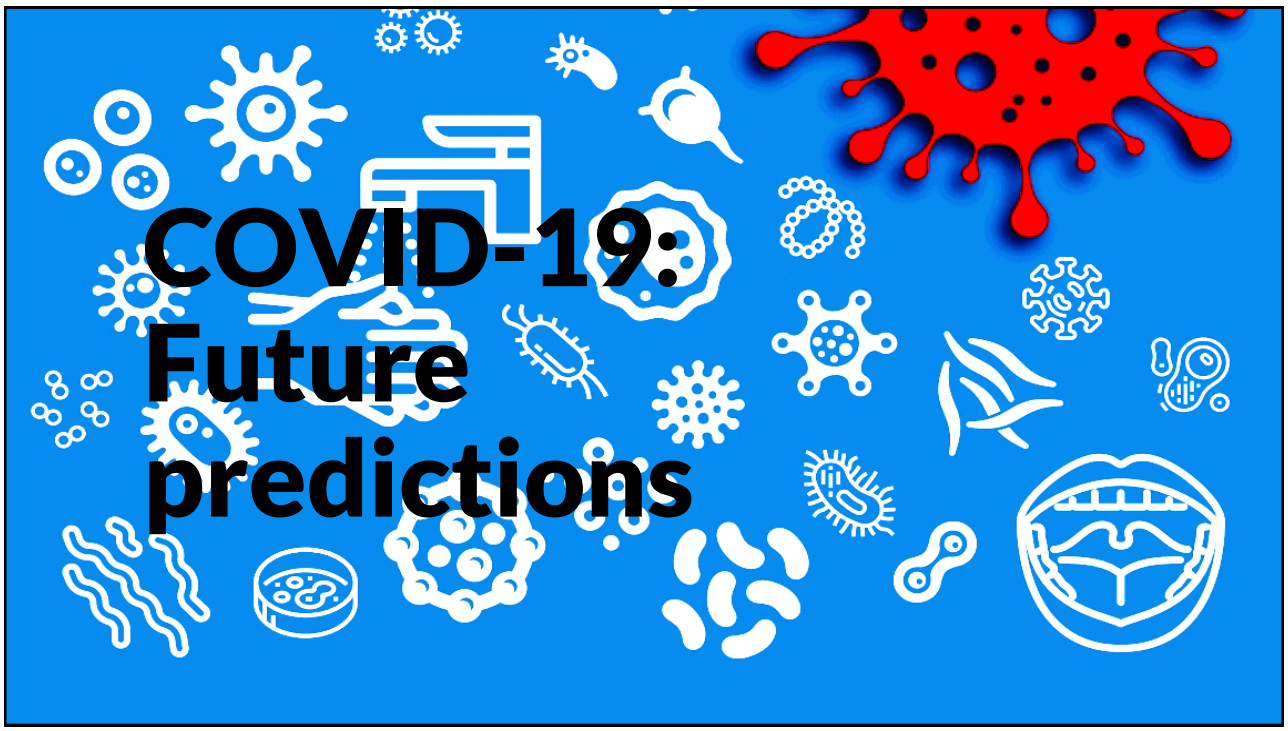
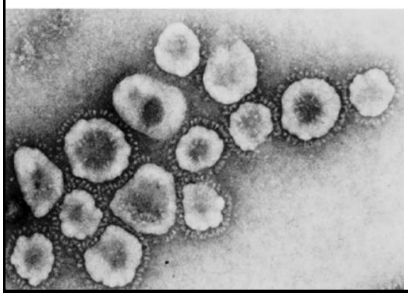


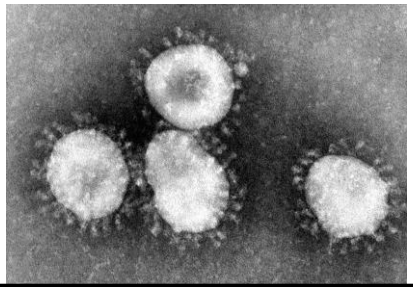
# Learning from the past

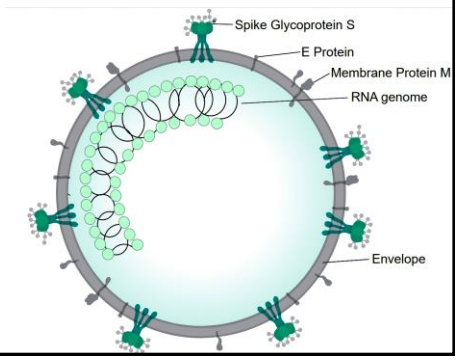
- Endemic CoV identified in 1960s.
- 4 major strains in circulation

HCoV-229E
HCoV-NL63

HCoV-OC43
HCoV-HKU1



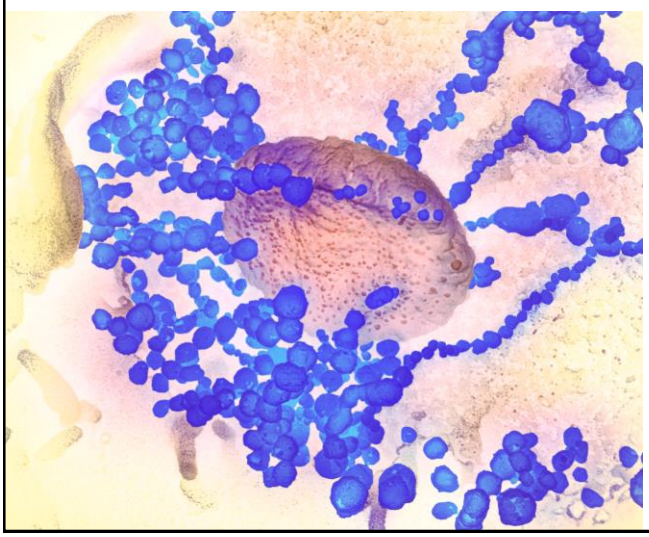


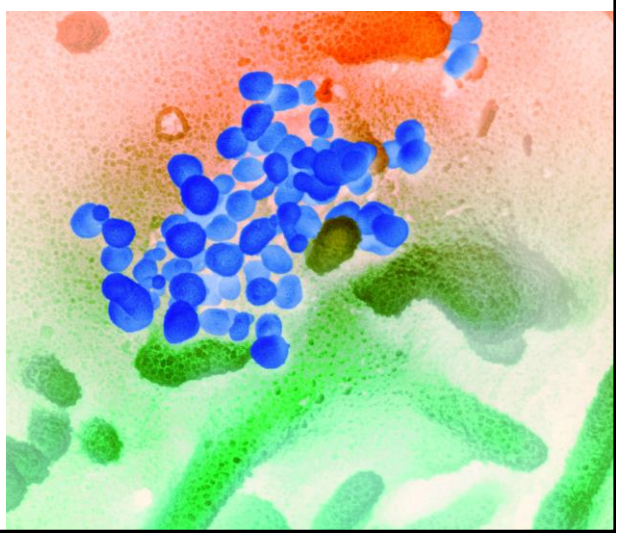



# Very small 0.1-0.14 microns – compared to RBC (L) and WBC (R)

8 microns

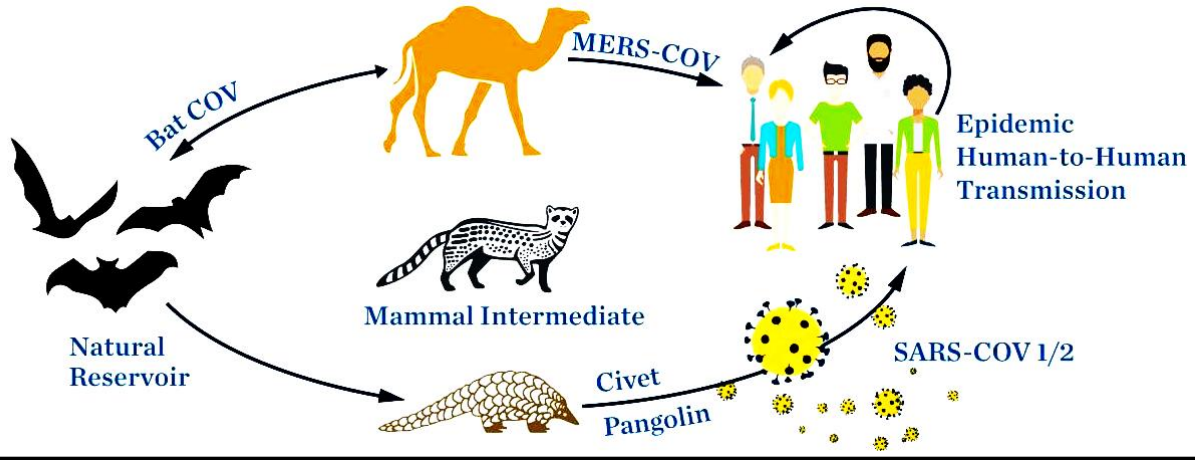
20 microns

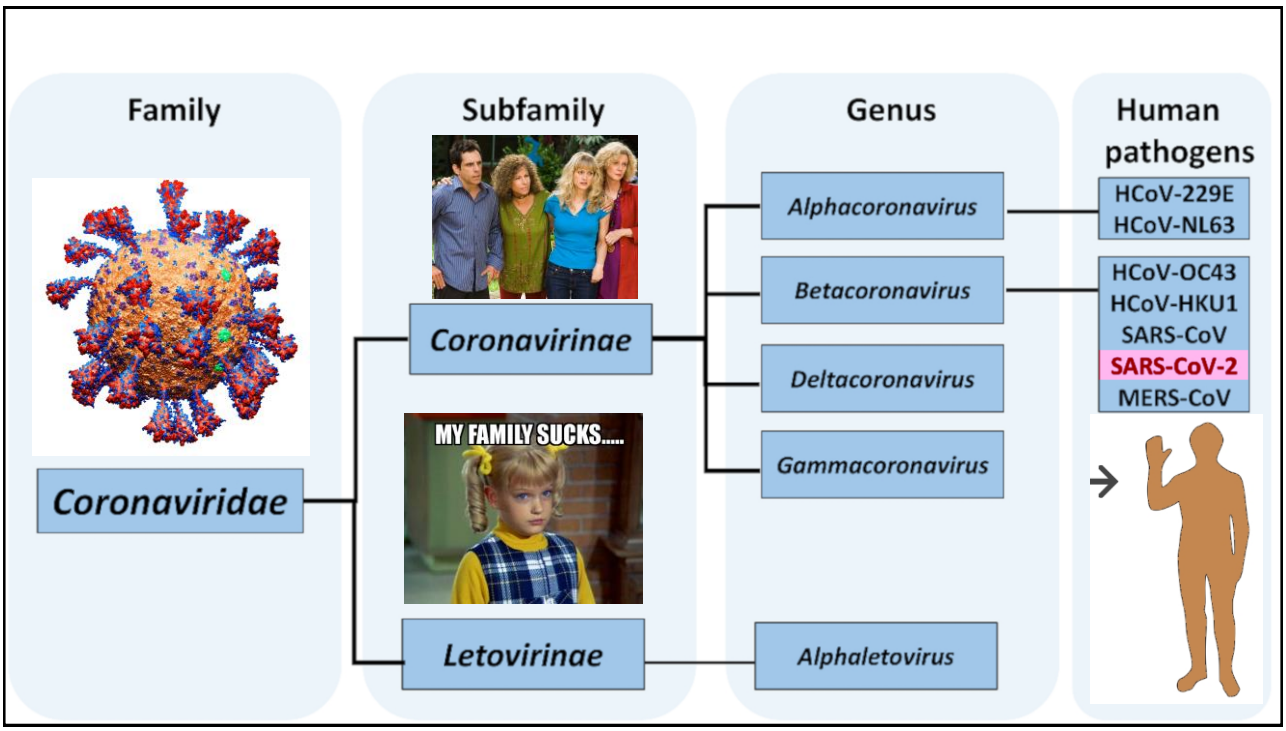


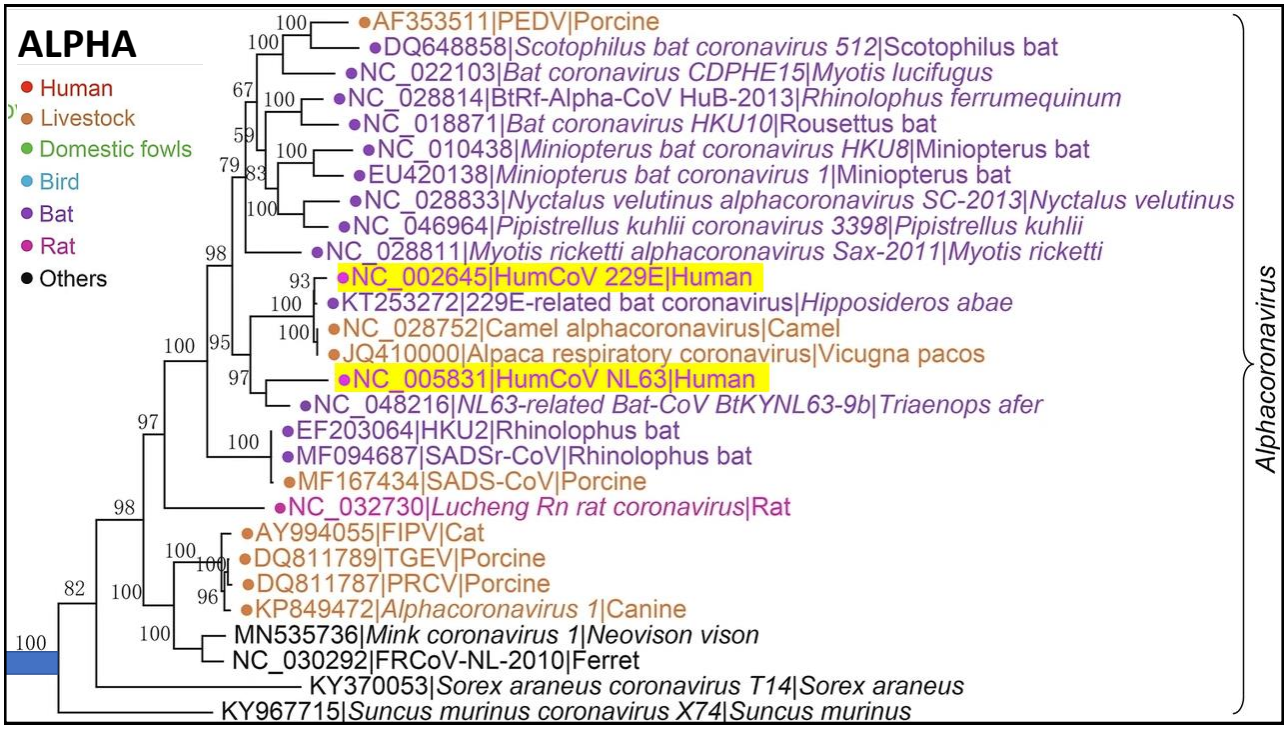


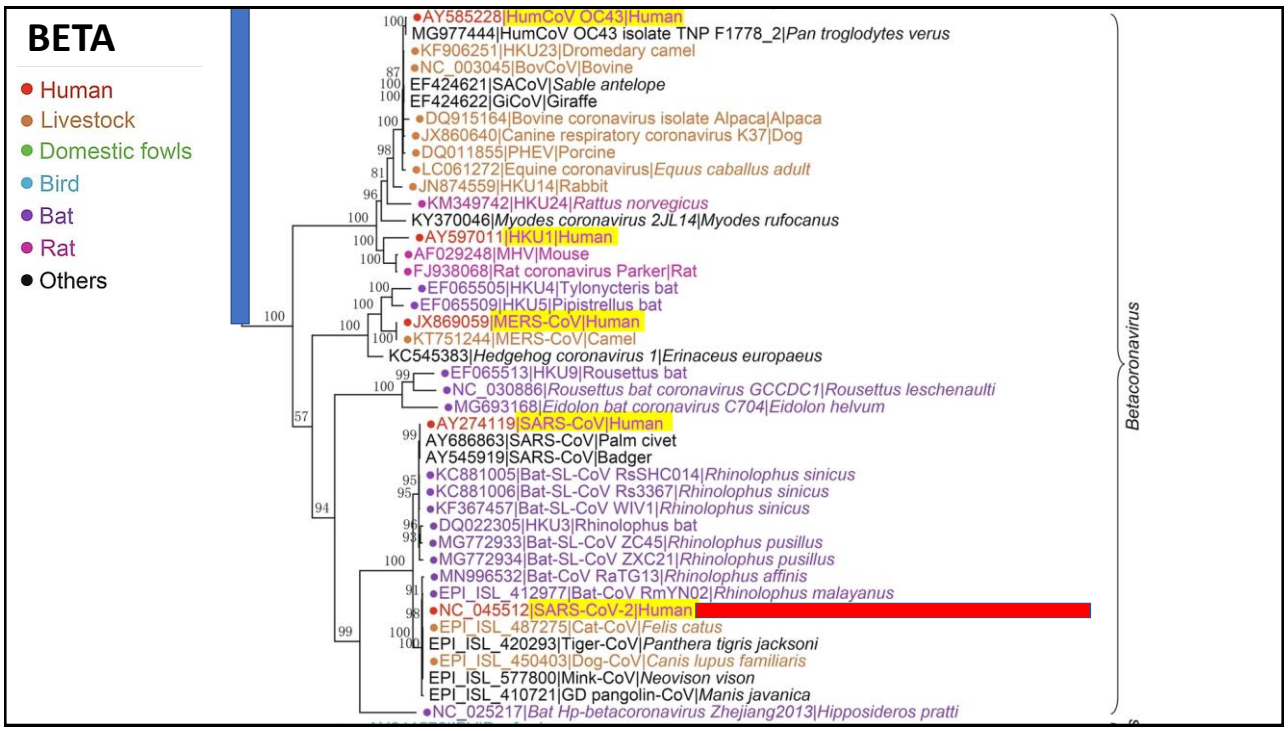
# Learning from the past

- Multiple known animal coronavirus reservoirs
- Zoonoses: SARS, MERS, COVID-19, ????

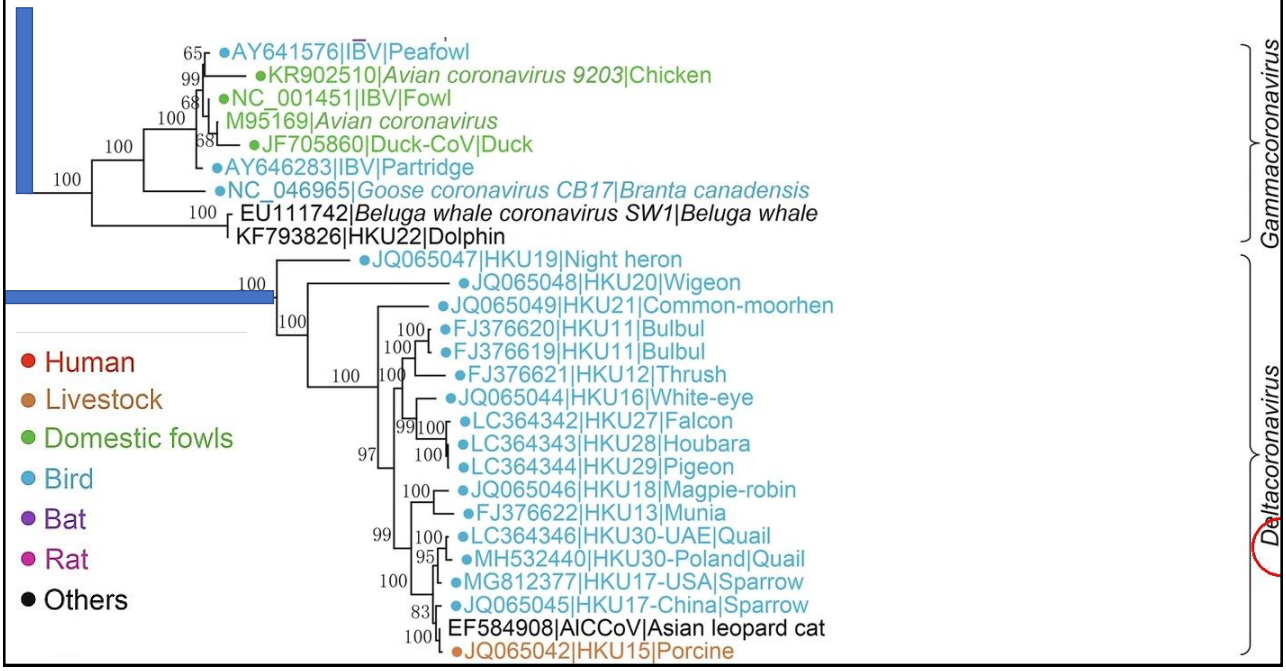



ALPHA
Human
Livestock
Domestic fowls
Bird
Bat
Rat
Others
AF353511|PEDV|Porcine
DQ648858|Scotophilus bat coronavirus 512|Scotophilus bat
NC_022103|Bat coronavirus CDPHE15|Myotis lucifugus
NC_028814|BtRf-Alpha-CoV HuB-2013|Rhinolophus ferrumequinum
NC_018871|Bat coronavirus HKU10|Rousettus bat
NC_010438|Miniopterus bat coronavirus HKU8|Miniopterus bat
EU420138|Miniopterus bat coronavirus 1|Miniopterus bat
NC_028833|Nyctalus velutinus alphacoronavirus SC-2013|Nyctalus velutinus
NC_046964|Pipistrellus kuhlii coronavirus 3398|Pipistrellus kuhlii
NC_028811|Myotis ricketti alphacoronavirus Sax-2011|Myotis ricketti
NC_002645|HumCoV 229E|Human
KT253272|229E-related bat coronavirus|Hipposideros abae
NC_028752|Camel alphacoronavirus|Camel
JQ410000|Alpaca respiratory coronavirus|Vicugna pacos
NC_005831|HumCoV NL63|Human
NC_048216|NL63-related Bat-CoV BtKYNL63-9b|Triaenops afer
EF203064|HKU2|Rhinolophus bat
MF094687|SADSr-CoV|Rhinolophus bat
MF167434|SADS-CoV|Porcine
NC_032730|Lucheng Rn rat coronavirus|Rat
AY994055|FIPV|Cat
DQ811789|TGEV|Porcine
DQ811787|PRCV|Porcine
KP849472|Alphacoronavirus 1|Canine
MN535736|Mink coronavirus 1|Neovison vison
NC_030292|FRCoV-NL-2010|Ferret
KY370053|Sorex araneus coronavirus T14|Sorex araneus
KY967715|Suncus murinus coronavirus X74|Suncus murinus
Alphacoronavirus

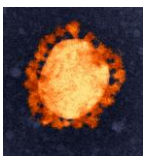

BETA
Human
Livestock
Domestic fowls
Bird
Bat
Rat
Others
AY585228|HumCoV OC43|Human
MG977444|HumCoV OC43 isolate TNP F1778_2|Pan troglodytes verus
KF906251|HKU23|Dromedary camel
NC_003045|BovCoV|Bovine
EF424621|SACoV|Sable antelope
EF424622|GiCoV|Giraffe
DQ915164|Bovine coronavirus isolate Alpaca|Alpaca
JX860640|Canine respiratory coronavirus K37|Dog
DQ011855|PHEV|Porcine
LC061272|Equine coronavirus|Equus caballus adult
JN874559|HKU14|Rabbit
KM349742|HKU24|Rattus norvegicus
KY370046|Myodes coronavirus 2JL14|Myodes rufocanus
AY597011|HKU1|Human
AF029248|MHV|Mouse
FJ938068|Rat coronavirus Parker|Rat
EF065505|HKU4|Tylonycteris bat
EF065509|HKU5|Pipistrellus bat
JX869059|MERS-CoV|Human
KT751244|MERS-CoV|Camel
KC545383|Hedgehog coronavirus 1|Erinaceus europaeus
EF065513|HKU9|Rousettus bat
NC_030886|Rousettus bat coronavirus GCCDC1|Rousettus leschenaulti
MG693168|Eidolon bat coronavirus C704|Eidolon helvum
AY274119|SARS-CoV|Human
AY686863|SARS-CoV|Palm civet
AY545919|SARS-CoV|Badger
KC881005|Bat-SL-CoV RsSHC014|Rhinolophus sinicus
KC881006|Bat-SL-CoV Rs3367|Rhinolophus sinicus
KF367457|Bat-SL-CoV WIV1|Rhinolophus sinicus
DQ022305|HKU3|Rhinolophus bat
MG772933|Bat-SL-CoV ZC45|Rhinolophus pusillus
MG772934|Bat-SL-CoV ZXC21|Rhinolophus pusillus
MN996532|Bat-CoV RaTG13|Rhinolophus affinis
EPI_ISL_412977|Bat-CoV RmYN02|Rhinolophus malayanus
NC_045512|SARS-CoV-2|Human
EPI_ISL_487275|Cat-CoV|Felis catus
EPI_ISL_420293|Tiger-CoV|Panthera tigris jacksoni
EPI_ISL_450403|Dog-CoV|Canis lupus familiaris
EPI_ISL_577800|Mink-CoV|Neovison vison
EPI_ISL_410721|GD pangolin-CoV|Manis javanica
NC_025217|Bat Hp-betacoronavirus Zhejiang2013|Hipposideros pratti
Betacoronavirus

## GAMMA, DELTA

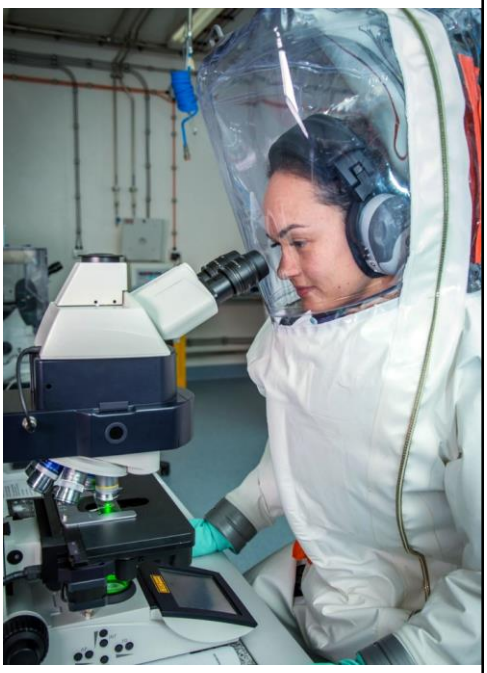



# Learning from the past

- The 20+ year outlook: CSIRO **Australian Centre for Disease Preparedness**
  - Provides Australia's highest level of biocontainment within purpose-built biosecurity infrastructure.
  - Relationship with the Coalition for Epidemic Preparedness Innovations (CEPI) pre-dated the emergence of COVID-19. In October 2019, they pre-qualified with CEPI to develop a pre-clinical vaccine trial pipeline, in anticipation of "Disease-X" emerging from a wildlife source and requiring rapid assessment of candidate vaccines.



Working in our highly secure laboratory, droplets of SARS-CoV-2 in artificial mucous were applied to test surfaces.



# Gains from the pandemic: Onshore capability

- Vaccine clinical trials capability
- Vaccine design approaches
- Vaccine production
- Mask and respirator production

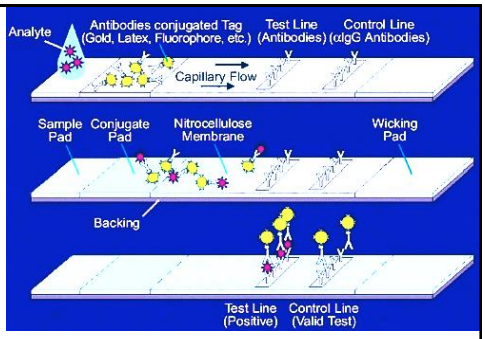
- PoC Diagnostic device production
- Mask testing and certification

| Identification[22] | | | Emergence | | | Changes relative to previously circulating variants at the time and place of emergence | | | | Neutralising antibody activity (or efficacy when available) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WHO label | PANGO lineage | Nextstrain clade | First outbreak | Earliest sample[25] | Designated VOC | Notable mutations | Transmissibility | Hospitalisation | Mortality | From natural infection[A] | From vaccination |
| Delta | B.1.617.2 | 21A | India | Oct 2020 | 6 May 2021[26] | L452R, T478K, P681R[27] | +97% (76–117%)[28] | +85% (39–147%) relative to Alpha[D] | +137% (50–230%)[B] | Reinfections happened, with smaller occurrence rate than vaccinated infections[E][31] | Efficacy reduction for non-severe disease[22][31][F] |
| Alpha | B.1.1.7 | 20I (V1) | UK | 20 Sep 2020[33] | 18 Dec 2020[34] | 69–70del, N501Y, P681H[35][36] | +29% (24–33%)[28][G] | +52% (47–57%)[H][G] | +59% (44–74%)[H][G] | Minimal reduction[15] | Minimal reduction[15] |
| Gamma | P.1 (B.1.1.28.1) | 20J (V3) | Brazil | Nov 2020 | 15 Jan 2021[38][39] | K417T, E484K, N501Y[35] | +38% (29–48%)[28] | Possibly increased[22] | +50% (50% CrI, 20–90%)[I][J] | Reduced[15] | Retained by many[K] |
| Beta | B.1.351 | 20H (V2) | ZA | May 2020 | 14 Jan 2021[40] | K417N, E484K, N501Y[35] | +25% (20–30%)[28] | *Under investigation* | Possibly increased[17][22] | Reduced, T cell response elicited by D614G virus remains effective[15][22] | Efficacy reduction against symptomatic disease,[L] retained against severe disease[22] |
| Omicron | B.1.1.529 | 21K | ZA | 9 Nov 2021[41] | 26 Nov 2021[24] | P681H, N440K, N501Y, S477N, many others[42] | Possibly increased[43] | −41% (37–45%) relative to Delta[43][44] | *Under investigation* | Increased reinfection rate[43] | Efficacy reduction against symptomatic disease, unknown for severe disease[43] |

Very high risk | High risk | Medium risk | Low risk | Unknown risk

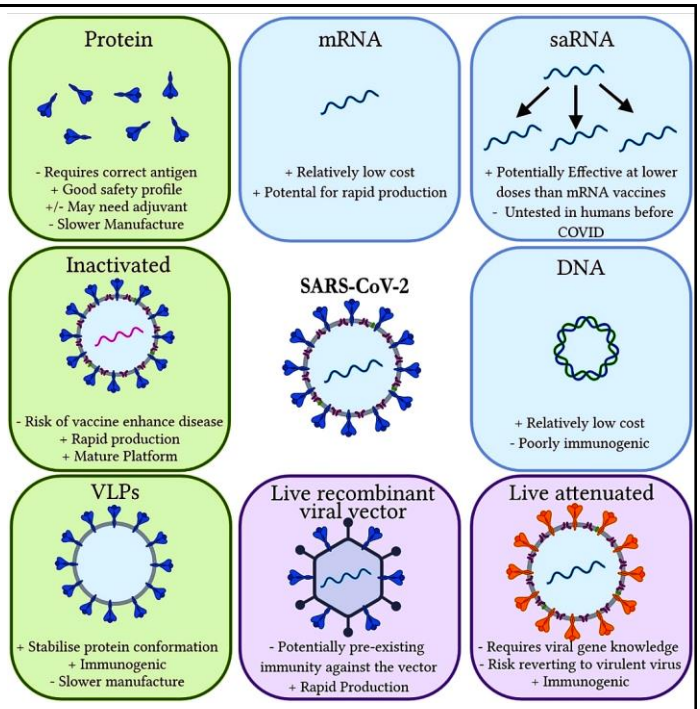
# The changing enemy

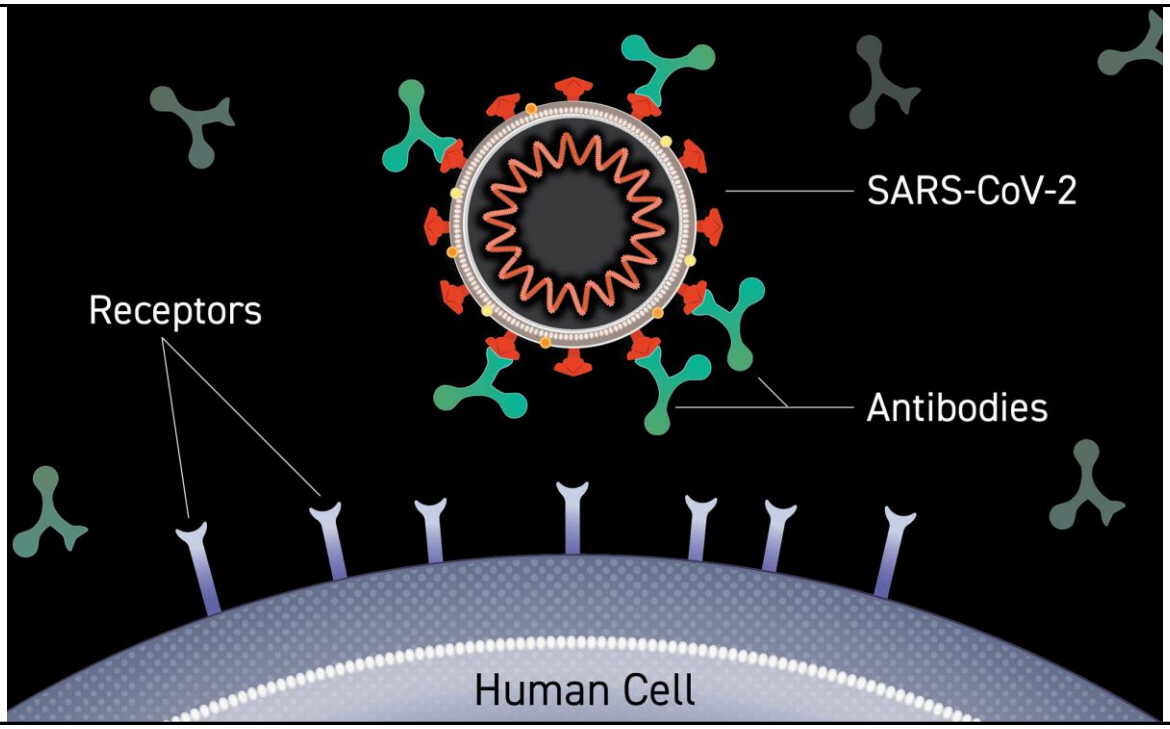

- More VoC emerge in non-immunized popn
- Viral mutation impacts on:
  - Transmission ($R_0$ value)
  - Virulence (Hosp/ICU, excess deaths)
  - PCR testing
  - RAT (lateral flow) testing
  - Vaccine design
- Attenuation with time
- Disease sequestering into unvax popn

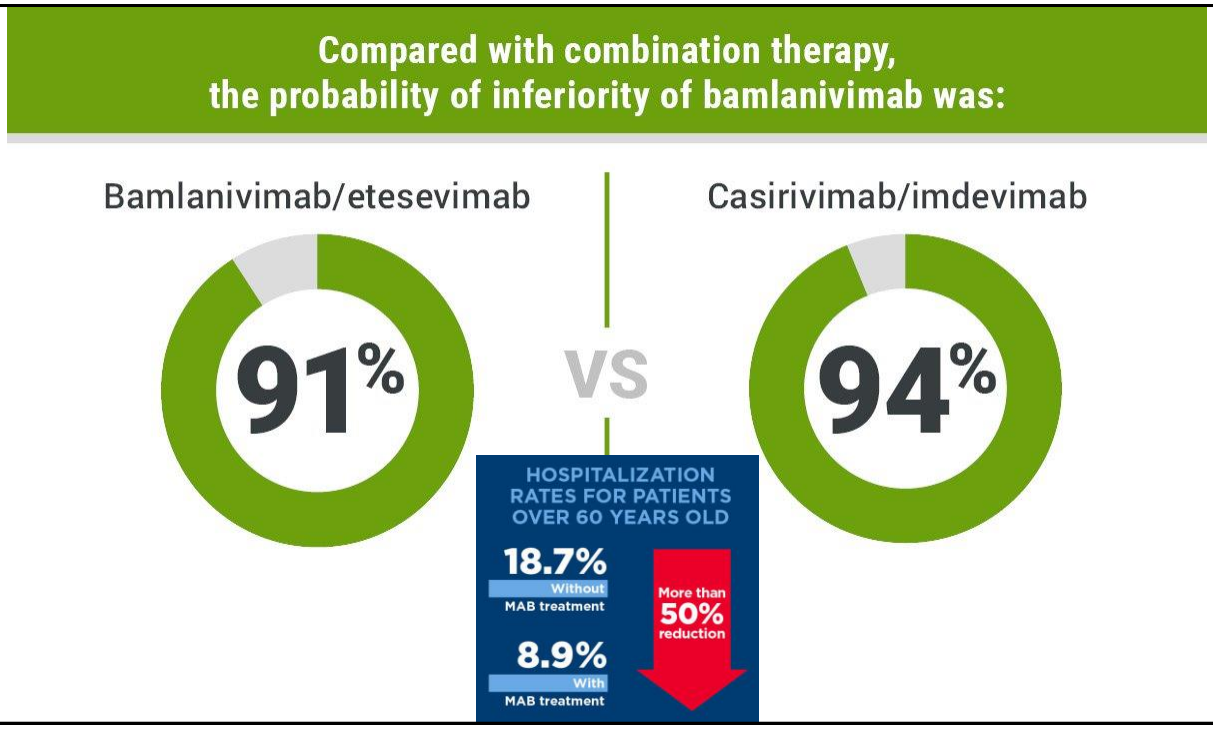



# Defences

- Antibody vs. T cell immunity
- Profiling booster periods
- Vaccines
  - Updated mRNA vaccines
  - Wider epitope coverage
  - Link to influenza vaccination
  - Needle-free tech (patch)
- New biologics to treat severe infections
- Neutralizing monoclonal Abs
- New antiviral agents
- Mx of LONG COVID

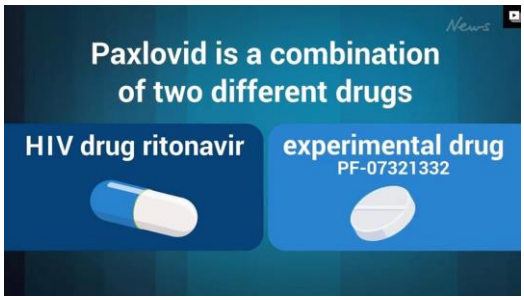




SARS-CoV-2
Receptors
Antibodies
Human Cell


Compared with combination therapy,
the probability of inferiority of bamlanivimab was:
Bamlanivimab/etesevimab
91%
VS
Casirivimab/imdevimab
94%
HOSPITALIZATION RATES FOR PATIENTS OVER 60 YEARS OLD
18.7%
Without MAB treatment
8.9%
With MAB treatment
More than 50% reduction

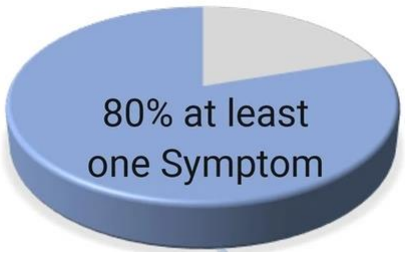
# New antivirals

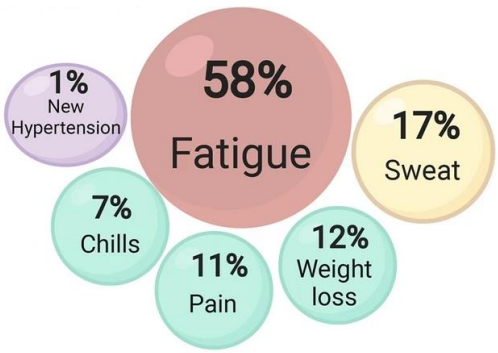
- Paxlovid
  - Nirmatralvir
  - Protease inhibitor
  - Blocks replication
  - High effect on Omicron
- Molnupravir
  - Nucleoside analogue

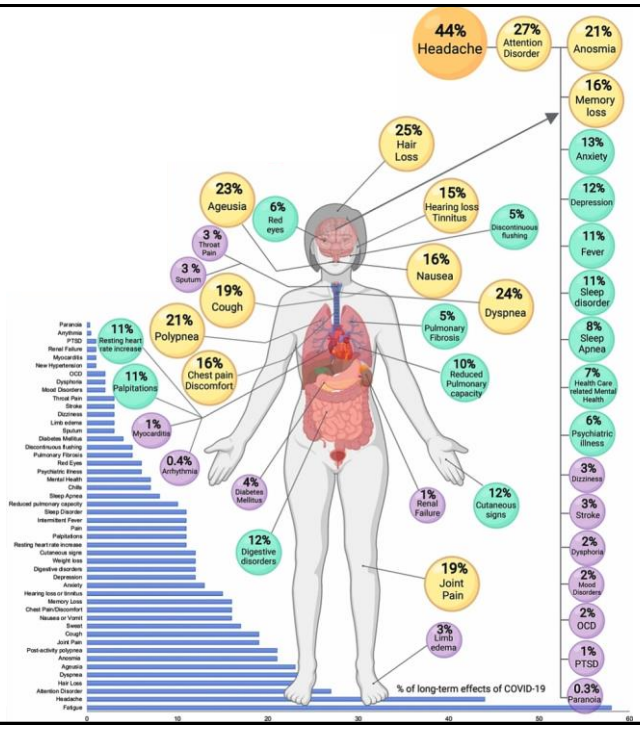






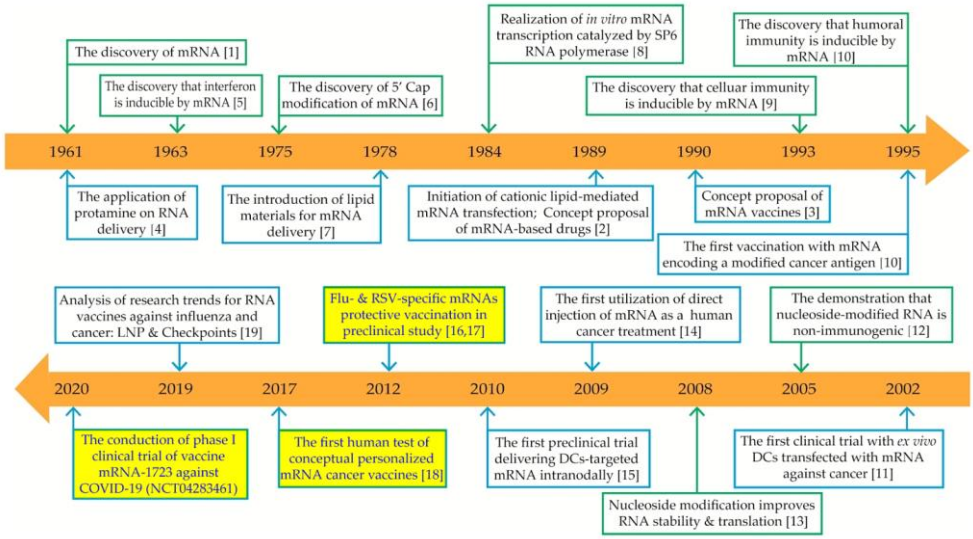


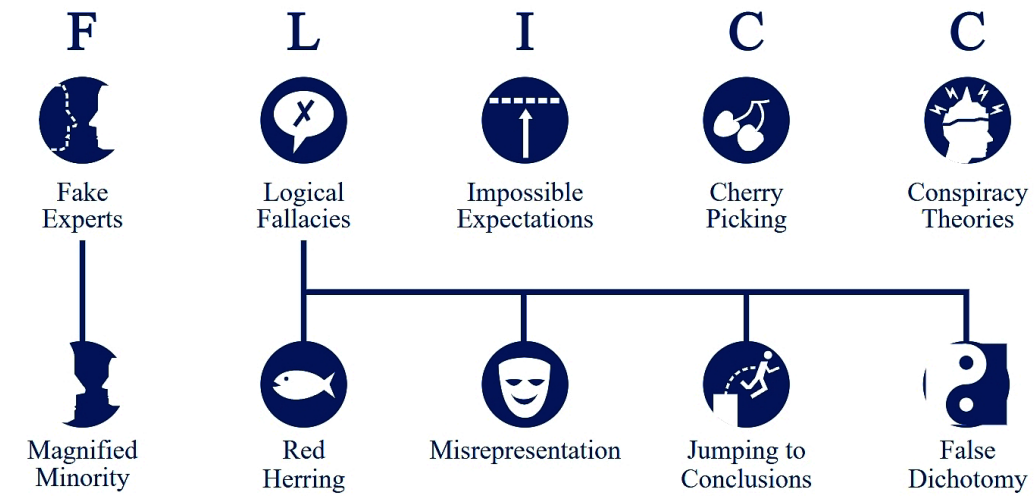



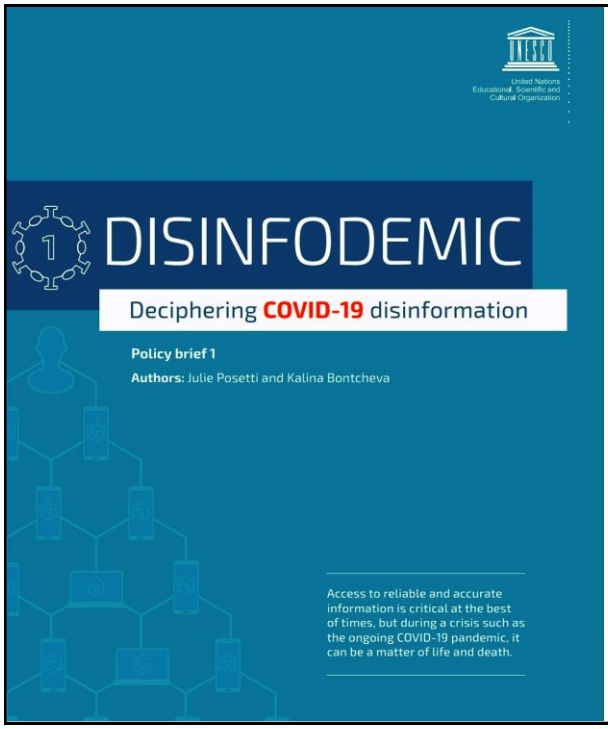
# Dealing with vaccine misinformation

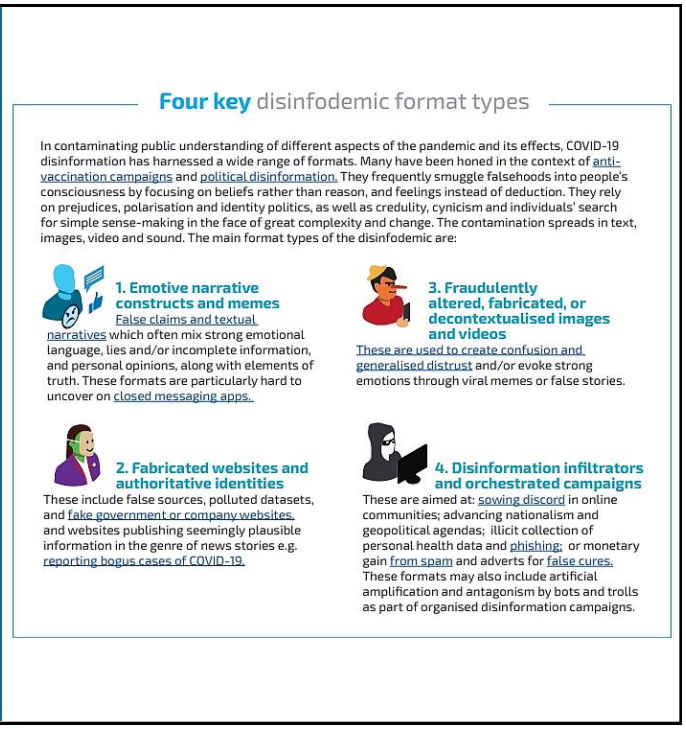
- mRNA vaccines for RNA viruses are <u>not</u> new




# Anti-science and COVID-19: Science denial common traits

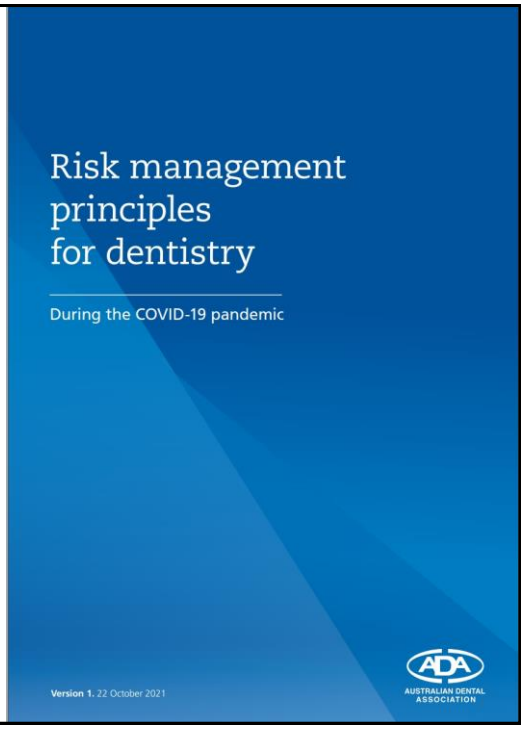





# Controls

- Hierarchy of risk controls:
  - **ADA Risk Mx Principles, Oct 2021**
- Respiratory protection:
  - BFE vs. PFE
- Face and eye protection
- Aerosol and droplet spread patterns
- Impact of HVE
- Air quality issues



# What might stay

- Pre-appt screening
- Pre-procedural rinsing
- Lower water spray
- Face shields
- HVE – testing to 250 L/min
- More attention to air handling in operatory design


UQ Oral Health Centre