EPIDEMIOLOGY AND CONTROL OF CORONA

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LEARNING OBJECTIVES

By the end of this presentation, the students of 3rd year MBBS will be able to

- Describe the epidemiological determinants, frequency and distribution of corona
- Compare the prevalence/incidence of corona in different parts of the world
- Describe various preventive and control measures for covid
- Describe the role of Pakistan government in corona control program

Disease

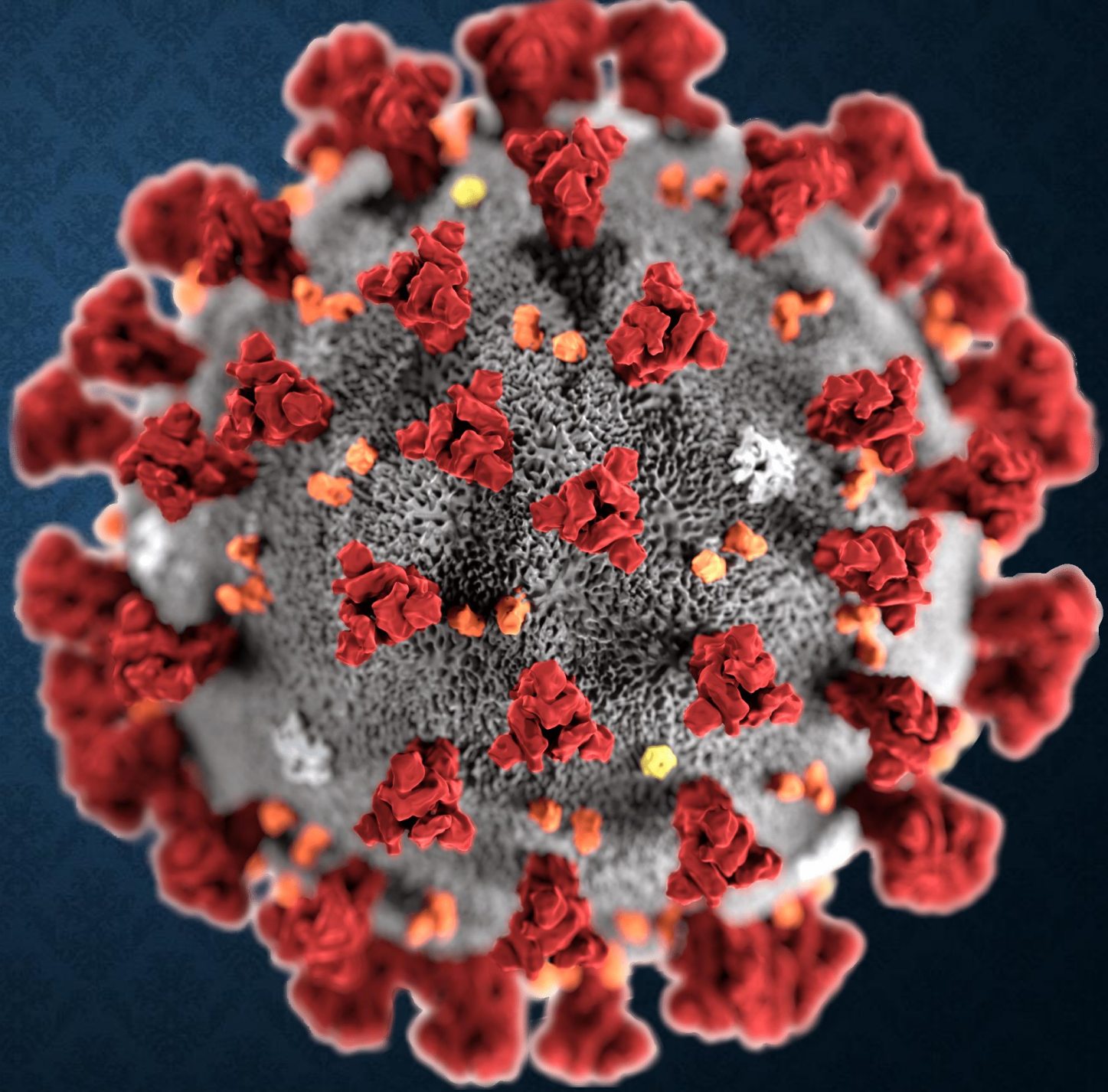
COVID-19

SARS-COV-2

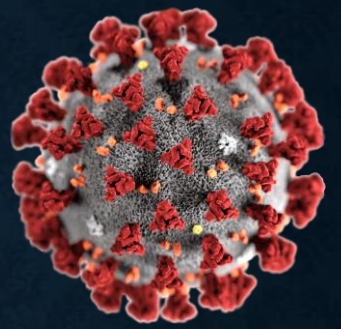
2019-NCOV

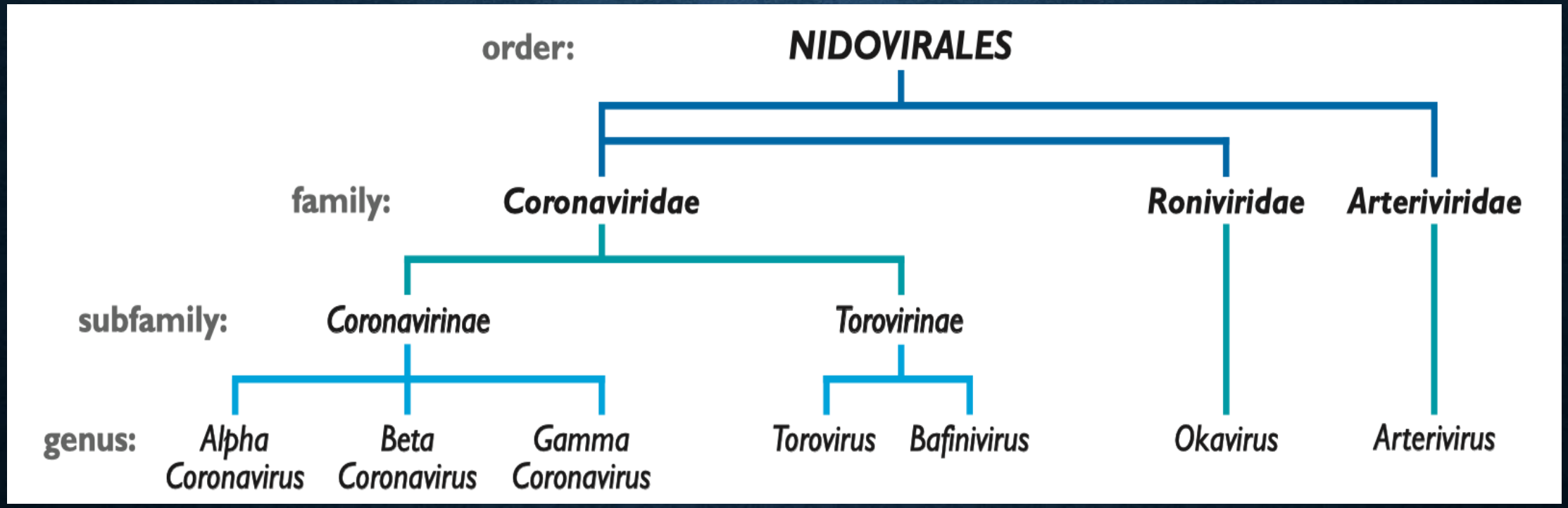
HCOV-19

Virus Name

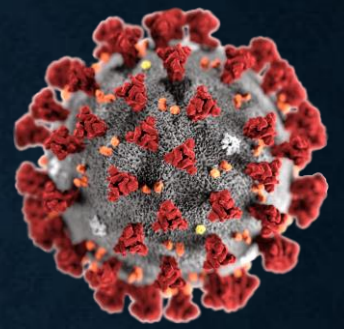


7 HUMAN CORONAVIRUSES: 4 NORMAL; 3 "NOVEL"



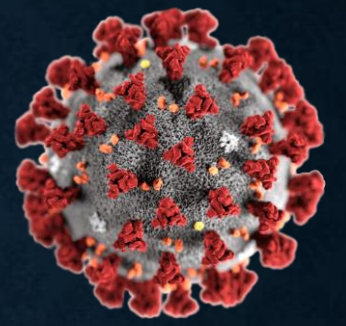


Alpha: **HCoV-229E, HCoV-NL63** Beta: **HCoV-HKU1, HCoV-OC43, MERS-CoV, SARS-CoV, SARS-CoV-2**



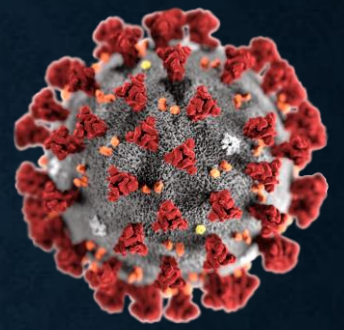
UPPER RESPIRATORY INFECTIONS

- Normal human coronaviruses cause 5-10% of common cold/URIs, with outbreaks to 30% of common cold
  - **229E** and **NL63 (alpha coronaviruses)**
  - **OC43** and **HKU1 (beta coronaviruses)**
- These four predominately attach to receptors in UPPER airway (receptors: aminopeptidase N, dipeptidyl peptidase 4)
- Seasonality unpredictable (generally winter, but persists year round), different pattern in tropics than temperate regions
- URI symptoms, croupy or dry cough, rarely pneumonia (except sometimes NL63, but usually just causes croup); Mild diarrhea in infants
  - Don’t forget other URI viruses: Rhinovirus, Influenza A/B, Adenovirus, Parainfluenza, Respiratory syncytial virus, Human metapneumovirus



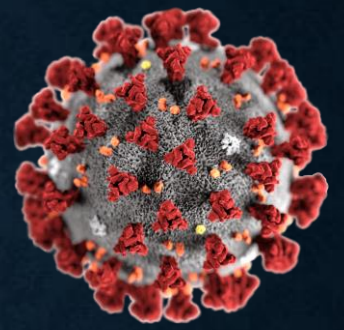
"NOVEL" CORONAVIRUSES

- Novel coronaviruses predominantly in LOWER respiratory tract
  - **SARS, MERS, SARS-CoV-2**
  - Don't forget other LRIs:
    - Viral Pneumonia: Influenza (A/B), Adenovirus, Parainfluenza (Type 1-4), Respiratory syncytial virus, Human metapneumovirus, **NL63**
    - Typical bacteria CAP: Lobar – *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Haemophilus influenzae*, *Moraxella catarrhalis; Gram neg, anaerobic if aspiration*
    - Bacterial bronchitis or atypical CAP: *Bordetella pertussis, Mycoplasma pneumoniae*, and *Chlamydia pneumoniae*
- SARS (2002-2003): Contained. CFR 10%. >50% mortality in >60 years.
- MERS: Not Contained. CFR 35%. Linked to direct camel exposure.
- High healthcare worker infection and other nosocomial spread
  - Aerosolization during procedures (intubation, nebs, BiPAP, suctioning)



SARS-COV-2 ORIGIN

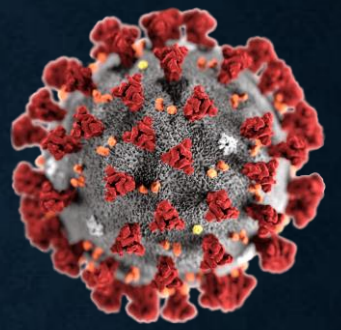
- Bat to a mammal (pangolin?) to human in Nov/Dec 2019
- Pangolins used in Chinese medicine
- Probable link to seafood/exotic animal market
- Other plausible theory:
  - Wuhan Level 4 Biohazard lab experimental animals sold for human consumption



EPIDEMIOLOGY

"the branch of medicine which deals with the **incidence**, **distribution**, and **possible control** of diseases and other factors relating to health."

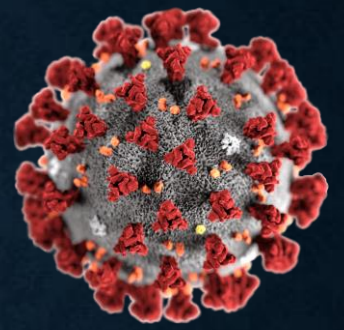
- Incidence
- Prevalence
- R0 and R
- Case Fatality Rate
- Mortality Rate
- Prevention
- Containment
- Mitigation
- Infection, Prevention and Control (IPC)



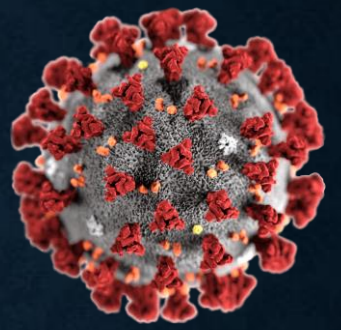
EPIDEMIOLOGY

- Outbreak: “more disease than would be expected”
  - e.g. measles outbreaks
- Endemic: “diseases that remain in an area naturally”
  - Outbreaks can also occur in endemic areas
  - Endemic diseases can be exported to other places, causing outbreaks
- Public Health Emergency of International Concern (PHEIC):
  - WHO declares if it 1. constitutes a public health risk to other States 2. potentially requires a coordinated international response
  - Emergency Committee established, unlocks funding, supplies and international response
  - Can also increase stigma, xenophobia, economic harm (tourism) to affected country
- Epidemic: “regional outbreak of a disease that spreads suddenly and unexpectedly”
- Pandemic: “worldwide, often rapid, spread of a disease”
  - WHO declares and has implications for activation of worldwide response, national

BASIC REPRODUCTION NUMBER (R_0)



- "Number of cases directly generated by one case in completely susceptible population without interventions"
- Effective Reproduction Number (R): "number of cases generated by one case with interventions/immunity"
  - Some individuals immunized or already infected/recovered
  - Nonpharmaceutical Interventions (NPI) implemented (social distancing, quarantines, isolation, treatment)

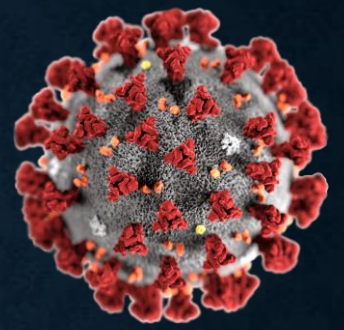


CASE FATALITY RATE

- **Case fatality rate/risk/ratio (CFR)** is the ratio of deaths from a certain disease to the total number of people diagnosed with this disease for a certain period of time

Deaths/Total Cases = CFR

- During epidemics, CFR often initially over-estimated as predominantly testing cases that are sicker in hospital (numerator); then CFR is under-estimated as increase testing of mild cases (denominator) that have not yet resolved (recovered or died)
  - Longer time to resolution or death can make CFR look better than it really is until final outcome



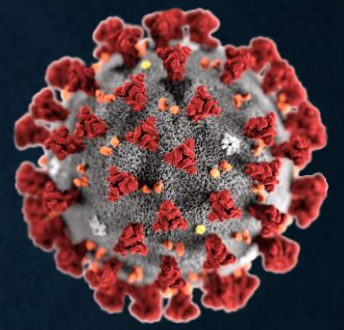
MORTALITY RATE

- Mortality rate (death rate): Number of deaths in general or due to specific cause in particular population per unit of time.

  e.g. mortality rate of influenza per week is total deaths related to influenza

- Epidemic threshold: level of incidence (of disease or of death) above which an urgent response is needed; varies by disease.

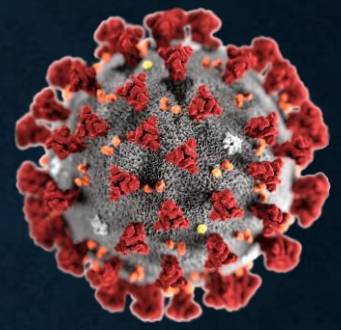
  e.g. For influenza, if the mortality rate >7.3% that is, by definition, an epidemic. Once it drops below that, it is no longer epidemic. CFR is 0.1% but the mortality rate per week in the hospital will rise and fall.



CASE FATALITY RATE

- COVID-19: **0.7 to 3.4%** (>5% in Wuhan itself during peak)
  - Will be higher without access to healthcare, oxygen and ventilators

- Spanish Influenza 1918: **>2.5%** Mostly younger people
- Seasonal Influenza: **0.1-0.2%**

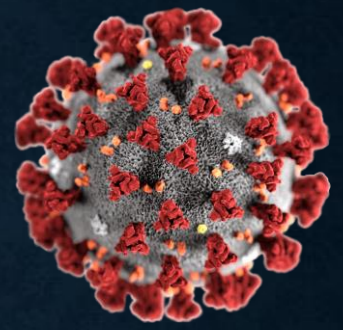


SARS-COV-2 TRANSMISSION

- Novel: No herd immunity, No antibodies cross-reacting
- Incubation 2-14 days (outlier 27 days)
  - Symptom onset median: Day 5-6 from exposure
- Doubling time: 6-7 days
- High viral shedding occurs early in disease course, even those with mild symptoms
- Prolonged shedding noted (unlikely reinfection)
- ? Up to 23% of transmissions due to pre-symptomatic cases in Shenzen
- True asymptotic cases apparently only 1% per WHO?
  - Viral load apparently still high
  - Apparently infectious?

https://cmmid.github.io/topics/covid19/control-measures/pre-symptomatic-transmission.html

https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf



SARS-COV-2 TRANSMISSION

- Respiratory droplets (large - 3 ft, medium - 6 ft)
- Hand-to-mucus-membrane contact – sticks to skin easily!
  - T-zone: eyes, nose, mouth vulnerable
- Viable for 3 days on solids (plastics, porcelain, steel); ~24 hours cardboard, dependent also on temperature/humidity; 3 hours if aerosolized
- Airborne – likely not airborne with cough? But certainly possible with intubation, non-invasive positive pressure ventilation, high flow O2, nebulizer, suctioning
- ?Fecal/oral? – viral shedding present in stool and diarrhea is common

https://www.medrxiv.org/content/10.1101/2020.03.09.20033217v1.full.pdf

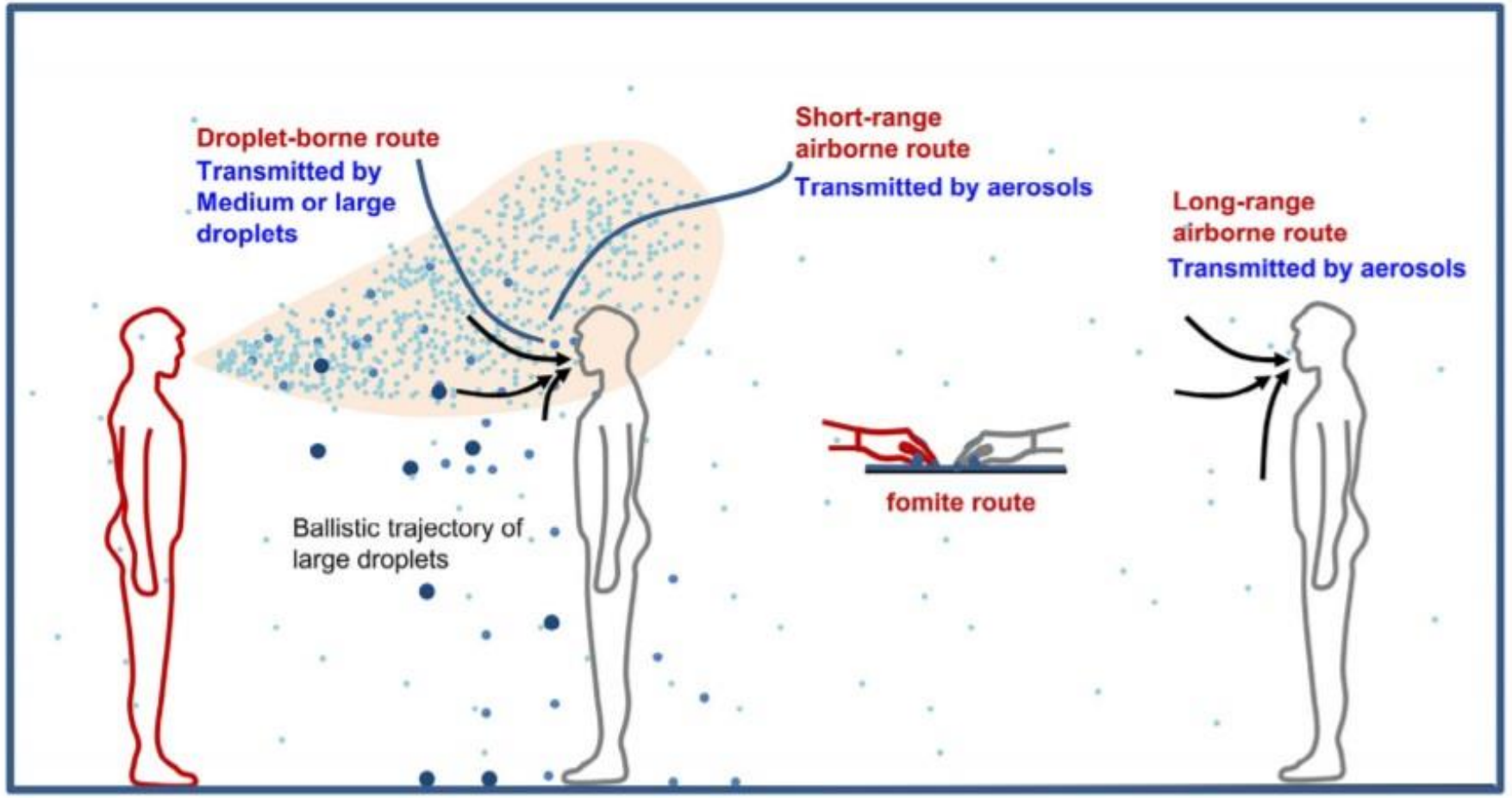
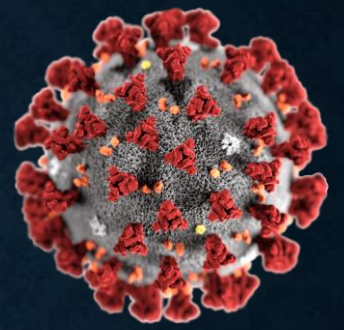


Fig 4. Illustration of different transmission routes. Small droplets (<5 μm), sometimes called aerosols, are responsible for the short-range airborne route, long-range airborne route, and indirect contact route; large droplets are responsible for the direct spray route and indirect contact route.

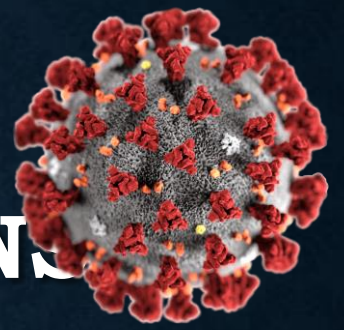
https://www.ajicjournal.org/article/S0196-6553(16)30531-4/pdf

SYMPTOMS AND DISEASE COURSE



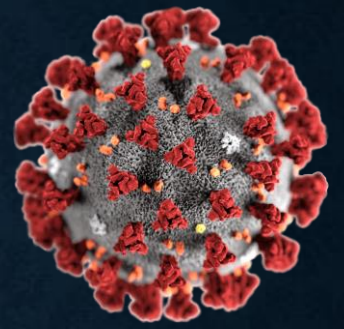
- Week 1: Fever (77-98%) (intermittent or persistent), Fatigue/Malaise (11-52%), Dry cough (46-82%), dyspnea (3-31%);
  - Less common: Sputum (33%), Myalgia (15%), Headache (13%), Sore throat (14%), Diarrhea (4%), Nausea/Vomiting (5%), Nasal congestion (4%), Hemoptysis (1%)
- Week 2 (~ day 6-9 of symptoms): ~ 15-20% develop severe dyspnea due to viral pneumonia
  - Hospitalization, supportive care, oxygen
- Week 2-3: Of hospitalized patients, 1/3 ultimately need ICU care, with up to half needing intubation (i.e. ~5% of total diagnosed cases need ICU)
  - Can rapidly decline (over 12-24 hrs) from mild hypoxia to frank ARDS
  - Cytokine Storm, Multi-organ failure
  - Late stage sudden cardiomyopathy/viral myocarditis, cardiac shock

CORMORBIDITIES AND RISK CONDITIONS



- Age
- HTN
- Diabetes
- Coronary Heart Disease
- Hep B
- Cerebrovascular Disease
- COPD
- Cancer

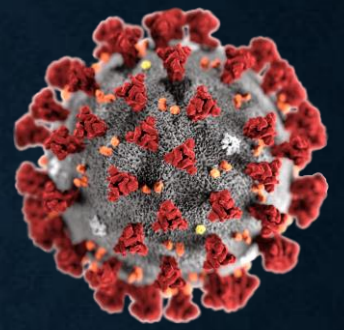
- Children and pregnant women seem to do okay



DIAGNOSIS

- Travel History, Exposure and Symptoms most important
- Person Under Investigation Criteria
- No specific physical exam findings. Lungs may have rales or rhonchi.
- Hypoxia, even silent hypoxia, may be present, esp elders.
- Tachycardia and tachypnea.
- May present as severe asthma or COPD exacerbation.

PERSON UNDER INVESTIGATION (PUI)

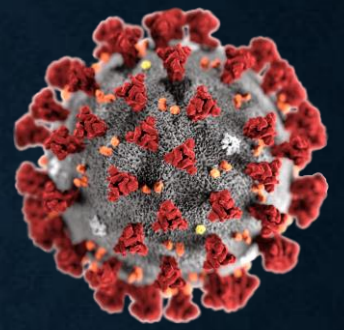


Clinicians should use their judgment. Most patients with COVID-19 have fever and/or cough or difficulty breathing.

Priority may be given to:

- **Hospitalized patients who have signs and symptoms** compatible with COVID-19 in order to inform decisions related to infection control precautions.
- **Symptomatic patients** such as, **older adults and individuals with chronic medical conditions** and/or an **immunocompromised state** (e.g., diabetes, heart disease, receiving immunosuppressive medications, chronic lung disease, chronic kidney disease).
- Any persons including **healthcare personnel**, who within 14 days of **symptom onset** had **close contact** with a suspect or laboratory-confirmed COVID-19 patient, or who have a history of travel from affected geographic areas within 14 days of their symptom onset.

PERSON UNDER INVESTIGATION (PUI)



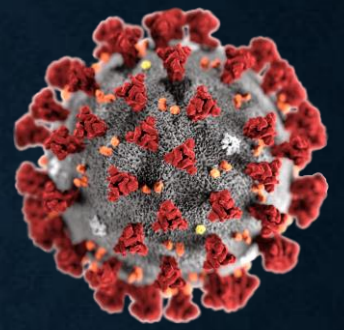
Close contact is defined as—

a) being within approximately 6 feet (2 meters) of a COVID-19 case for a prolonged period of time; close contact can occur while caring for, living with, visiting, or sharing a healthcare waiting area or room with a COVID-19 case

– or –

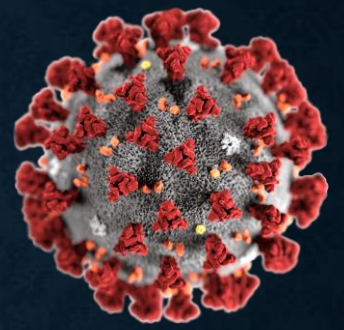
b) having direct contact with infectious secretions of a COVID-19 case (e.g., being coughed on)

If such contact occurs while not wearing recommended personal protective equipment or PPE (e.g., gowns, gloves, NIOSH-certified disposable N95 respirator, eye protection), **criteria for PUI consideration are met.**



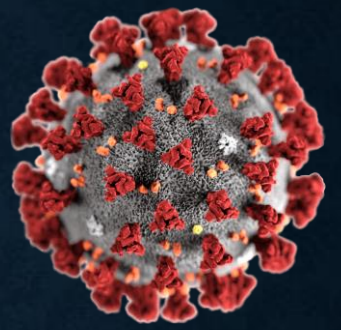
TESTING

- RT-PCR:
  - Real-time Polymerase Chain Reaction of RNA
    - Nasal AND Orophangeal Swabs (Collect 2 swabs)
    - Sputum better (but more dangerous to collect?)
    - Stool – not generally used for testing
    - Blood or urine – virus not detected; blood could be tested for IgM, IgG later. DO get (bacterial) blood cultures for any sick patient.
- PCR ~ **60-80% sensitive**
  - A single negative RT-PCR *doesn't* exclude COVID-19 (*especially* if obtained from a nasopharyngeal source or relatively early in the disease course).
  - If RT-PCR is negative but suspicion remains, consider ongoing isolation and re-sampling several days later.
  - Sensitivity from private labs may vary; no data yet. Also dependent on collection technique and timing – early test on asymptomatic may not be accurate



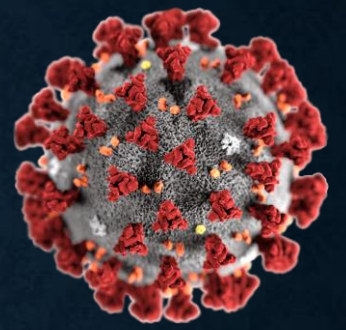
TREATMENT

- Mild/moderate symptoms (80%)
  - Outpatient management of symptoms and **isolation**
  - OTC Tylenol, cough and cold medications
  - Avoid steroids (ICS or oral/IM) unless compelling need (COPD or Asthma Exac)
  - Possibly avoid ACEI or Ibuprofen – data unclear!
  - Need to protect family members! (Check CDC guidelines)
  - At least 2 weeks isolation?
    - Unclear when viral shedding no longer present.
    - Unclear if we will require two negative tests and/or begin testing IgM IgG



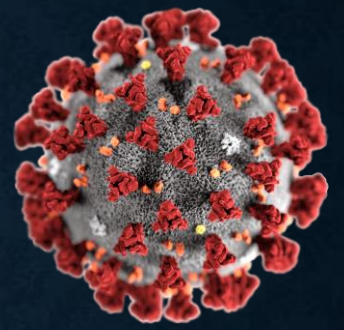
TREATMENT

- Moderate with risks/severe/critical symptoms (15-20%)
  - Inpatient management and supportive care
  - Obtain Advanced Directives! Offer Chaplain Support for high risk patients.
  - Oxygen by NC (place surgical face mask over NC to reduce aerosolization?)
  - Anticipate rapid progression to High Flow/NRB
  - Avoid NIV/BiPAP/Bronchoscopy if possible (increased aerosolization -> risk to others!)
  - ARDS: **Controlled early intubation** with airway pressure release ventilation (APRV), Paralysis, Prone positioning, Flolan. Tight connections of ETT and tubing.
  - Avoid fluid blousing, sepsis protocol bolusing. NG tube for feeds (ARDS takes time to resolve)
  - Daily labs: Renal, Mag, CBC with diff, DIC labs, ?LFTs, ?ABG (permissive hypercapnia if needed)



TREATMENT

- Moderate with risks/severe/critical symptoms (15-20%)
  - BiPAP increases risk of areolation due to positive pressure (as would CPAP), AND generally patients needing BiPAP end up needing intubation.
  - Patients do worse on BiPAP compared to HFNC/NRB.
  - If BiPAP is the ONLY option (no vents) or is needed due to COPD, negative pressure room, air filtration, helmet interface.

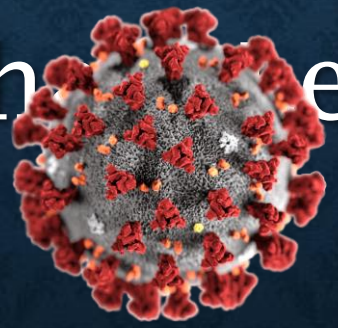


TREATMENT

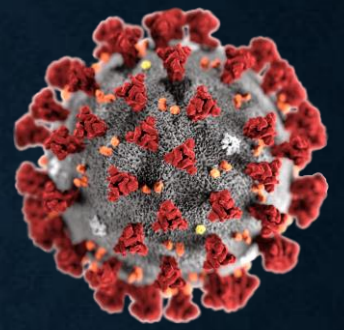
- Moderate with risks/severe/critical symptoms (15-20%)
  - Antibiotics, Antifungal probably not helpful (RARE secondary infections)
    - Procal and cultures can guide – discontinue at 48 hours
    - Watch for HAP/VAP
  - Steroid could:
    1. increase viral levels, shedding time, lung damage -> ? increase mortality
    2. reduce pathological hyper-immune response (beneficial for ARDS)
    - At least NOT high dose pulsed steroids (not Solumedrol or Hydrocortisone)
  - Cardiac: Watch for late onset cardiomyopathy (? Viral myocarditis) with sudden EF <10% leading to cardiogenic shock
  - Be careful if coding patients – high risk to you, low chance of survival
  - See https://emcrit.org/ibcc/COVID19/ for more critical care management!

“EVERYTHING WE DO BEFORE A PANDEMIC WILL SEEM ALARMIST. EVERYTHING WE DO AFTER WILL SEEM INADEQUATE”

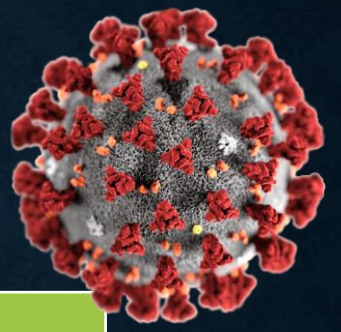
~ Mich eavitt



MANAGEMENT OF EPIDEMIC



- Prevention!
  - Safe public health practices – vaccines, WASH (water, sanitation and hygiene) and IPC (Infection Prevention and Control) measures, Universal Precautions
  - Surveillance systems of WHO, CDC/Ministry of Health, Public/Community Health
- Containment:
  - Isolation of sick persons, Contact Tracing, Quarantine of exposed persons
- Mitigation: Nonpharmaceutical interventions
  - Personal – Hand hygiene, Cover cough, Stayi away from sick persons, Avoid Face
  - Social – Social distancing, Canceling mass gatherings/non-essential activities
  - Environmental – Cleaning measures



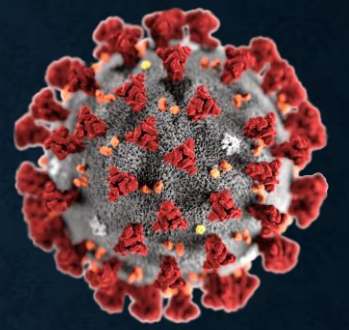
QUARANTINE VS ISOLATION

Quarantine:

- To separate and restrict movement of well persons who may have been exposed
- Monitor to see if they become ill

Isolation:

- To separate ill persons who have a communicable disease
- Restrict movement



HOME ISOLATION

- The patient is stable enough to receive care at home.
- Separate bedroom (bathroom recommended), access to food and other necessities. Appropriate caregivers.
- The patient and other household members must have access to PPE (minimum gloves and facemask) and are capable of adhering to precautions (e.g., respiratory hygiene, cough etiquette, hand hygiene);
- Consider at-risk populations in home (people >65 years old, young children, pregnant women, immunocompromised, chronic heart, lung, or kidney Dx).
- Provide Guidance for Precautions to Implement during Home Care
  - A healthcare professional should
  - Provide CDC's Interim Guidance for Preventing Coronavirus Disease 2019 (COVID-19) from Spreading to Others in Homes and Communities to the patient, caregiver, and household members; and
  - Contact their state or local health department to discuss criteria for discontinuing any such measures. Check available hours when contacting local health departments.

Hand washing technique with soap and water

Wet hands with water

Apply enough soap to cover all hand surfaces

Rub hands palm to palm

Rub back of each hand with palm of other hand with fingers interlaced

Rub palm to palm with fingers interlaced

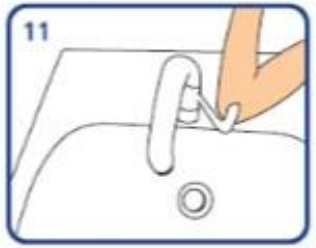
Rub with back of fingers to opposing palms with fingers interlocked

Rub each thumb clasped in opposite hand using a rotational movement

Rub tips of fingers in opposite palm in a circular motion

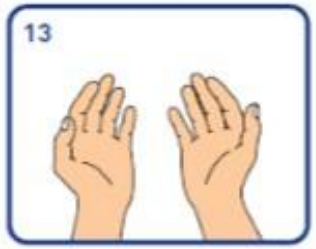
Rub each wrist with opposite hand

Rinse hands with water



Use elbow to turn off tap
(if no elbow tap available use paper towel to turn off tap)

Dry thoroughly with a single-use towel



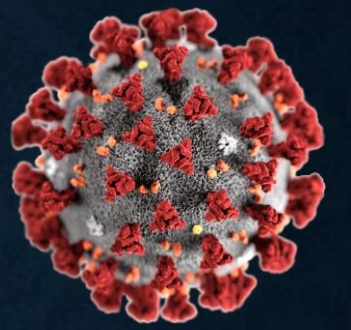
Hand washing should take 40-60 seconds

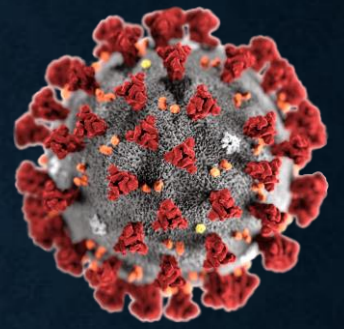
Issued by deb www.debgroup.com

World Health Organization

Adapted from World Health Organization Guidelines on Hand Hygiene in Health Care 2009

UKLIT0473/0216



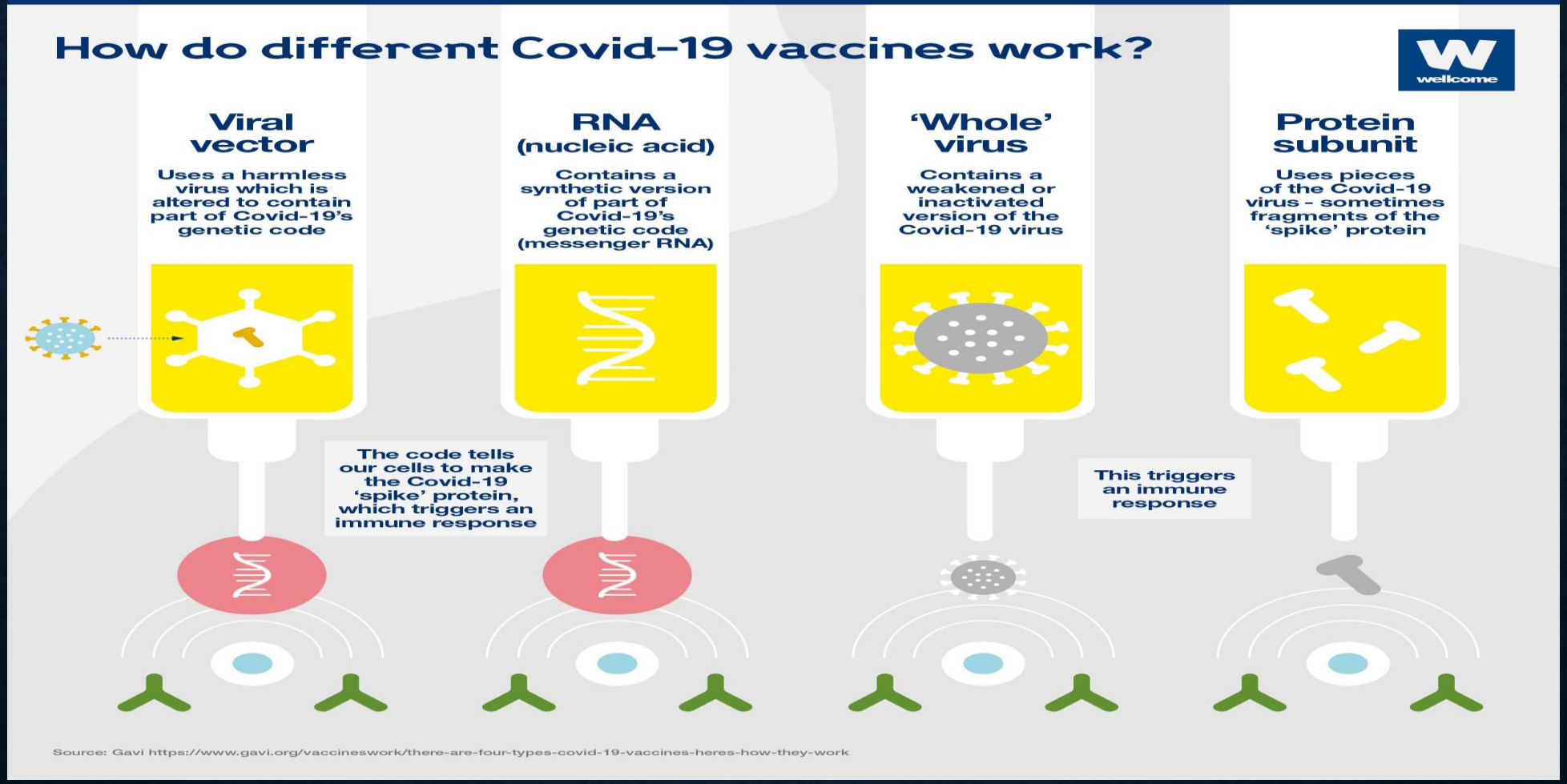


MASKS AND NIOSH STANDARD RESPIRATORS

- Simple and Surgical masks:
  - NOT a Filter, but stops DROPLETS
  - Recommended for PATIENTS who are coughing and/or if YOU are in close proximity to fluids
  - DON'T touch/adjust it! Stop pulling it down to your neck between patients! Stop putting on countertops! DON'T stick it in your white coat! (STOP WEARING WHITE COATS!)
- Respirators: N95 means >95% of particles/pathogens down to 0.3 microns are filters
  - N = not oil resistant
  - R = mildly oil resistant
  - P = oil resistant (for organic chemical poisoning protection)
  - There are also N99 and N100 and P99 and P100 masks
  - Fit is important!
  - Air valve can help with heat/moisture

https://jamanetwork.com/journals/jama/fullarticle/2762694
https://candid.technology/n95-vs-n99-vs-p95-comparison/

VACCINES


How do different Covid-19 vaccines work?
wellcome
Viral vector
Uses a harmless virus which is altered to contain part of Covid-19's genetic code
RNA (nucleic acid)
Contains a synthetic version of part of Covid-19's genetic code (messenger RNA)
'Whole' virus
Contains a weakened or inactivated version of the Covid-19 virus
Protein subunit
Uses pieces of the Covid-19 virus - sometimes fragments of the 'spike' protein
The code tells our cells to make the Covid-19 'spike' protein, which triggers an immune response
This triggers an immune response
Source: Gavi https://www.gavi.org/vaccineswork/there-are-four-types-covid-19-vaccines-heres-how-they-work


MAXAIR

PAKISTAN RESPONSE TO COVID

- Border closures with Afghanistan and Iran for two weeks and closures of all educational institutions
- Complete ban on weddings and other mass gatherings, including Pakistan Super League cricket matches, which were now to take place in empty stadiums
- Restrictions on international flights to operate only from Lahore, Karachi, and Islamabad
- Pakistan Day parade commemorating the establishment of the world’s first Islamic republic was canceled

- The Government of Pakistan with support from partners have responded to the pandemic by strengthening coordination, case management, disease surveillance, laboratory, community mobilization and sensitization

REFERENCES (IF NOT OTHERWISE INDICATED)

- https://emcrit.org/ibcc/COVID19/
- UpToDate on Coronaviruses, SARS, MERS, COVID-19
- CDC: https://www.cdc.gov/coronavirus/2019-ncov/index.html
- WHO: https://www.who.int/health-topics/coronavirus
  - Online courses at: https://openwho.org/
- https://www.worldometers.info/coronavirus/
- https://coronavirus.1point3acres.com/en?fbclid=IwAR3A3clE1Ztxi-fNBgTWtVOobWuUBGFJ1S3NBPFlAaYVruBcAtzeOcqpIjQ
- Dr James Lawler Presentation at American Hospital Association/ National Ebola Training and Education Center