

# COVID IN CHILDREN

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# BACKGROUND

- In early December 2019, number of pneumonia cases of unknown origin emerged in Wuhan, Hubei province in China
- Most patients reported exposure to the Huanan Seafood Wholesale Market which sells many species of live animals
- 3<sup>rd</sup> January 2020, a novel member of enveloped RNA coronavirus was identified in samples of bronchoalveolar lavage from a patient in Wuhan, confirmed as a cause of disease by Chinese CDC
- 7<sup>th</sup> January 2020, WHO named the virus 2019 novel coronavirus i.e. 2019-nCoV
- 11<sup>th</sup> February 2020, Who named the illness associated with 2019-nCoV as 2019 coronavirus disease (**COVID-19**)
- 11<sup>th</sup> March 2020, WHO declares COVID-19 a pandemic

# CORONAVIRUSES

- Are large enveloped positive strand RNA viruses
- Divided into 4 genera- alpha, beta, delta and gamma
- Alpha and beta infect humans, are called human coronaviruses (HCoVs)
- There are 4 HCoVs- 229E, NL63, OC43 and HKU1, they are endemic globally, account for 10-30% of upper respiratory tract infection in adults
- Have been considered inconsequential until 21<sup>st</sup> century when there has two large scale-epidemics
  - Severe acute respiratory syndrome coronavirus (SARS) - SARS-CoV – 2003
  - Middle East respiratory syndrome coronavirus (MERS) – MERS-Cov- 2012
  - 2019 novel coronavirus disease (COVID-19)- SARS-Cov2- 2019

# ORIGINS OF 2019-NCOV

- Genomic analysis suggests that it may originally be from bats because of similarity of its genetic sequences with coronaviruses found in bats
- Probably transmitted to humans by other animals which might have served as intermediate hosts, facilitating mutations events
- Pangolin identified as one of potential source as the intermediate host as genetic sequences of viruses isolated from the scaly animals are 99% similar to that of circulating virus

# TRANSMISSION OF THE VIRUS

# PRINCIPLES OF DISEASE TRANSMISSION

# DIRECT CONTACT

- Touching an ill person or a contaminated surface
- E.g. agents of diarrhoea, skin infections, common cold, ebola virus

## Control

- Gloves, +/- gowns, masks, visors (to prevent mucous membrane splashes, contamination of clothing)



# DROPLET SPREAD

- Inhaling droplets (up to 1/4mm in diameter)
- Persons within 2m radius are at risk. On aircraft, 2 rows behind and in front
- E.g. agents of bacterial pneumonia, Neisseria meningitidis

## Control

- Gloves, surgical masks, +/- gowns, masks, visors (to prevent mucous membrane splashes, contamination of clothing)





# AIRBORNE SPREAD

- Inhaling droplets nuclei (10-20um in diameter)
- Persons breathing the same air
- E.g. influenza, measles, chickenpox,

## **Control**

- Gloves, N95 masks, +/- gowns, masks, visors (to prevent mucous membrane splashes, contamination of clothing)

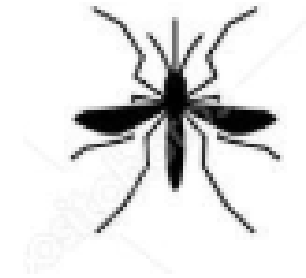


# VECTOR TRANSMISSION

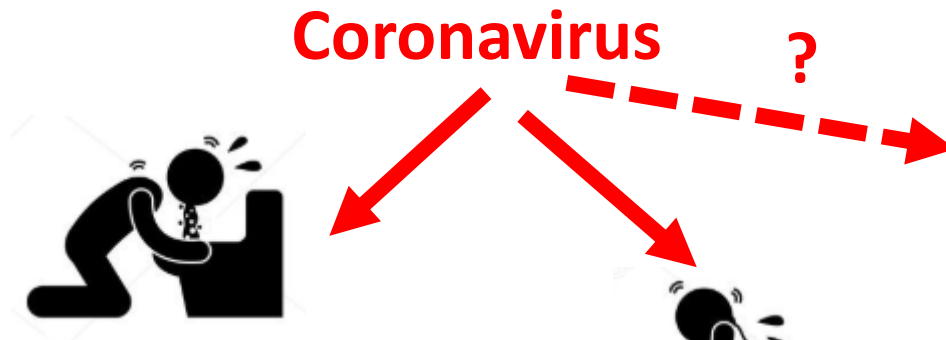
- Contact with vector
- E.g. malaria, dengue, Zika,

## **Control**

- Prevent/eliminate exposure to vector
- Chemoprophylaxis if possible



# PRINCIPLES OF DISEASE TRANSMISSION



## Direct contact

- Touching an ill person or a contaminated surface
- E.g. agents of diarrhoea, skin infections, common cold, ebola virus

## Control

- Gloves, +/- gowns, masks, visors (to prevent mucous membrane splashes, contamination of clothing)

## Droplet transmission

- Inhaling droplets (up to 1/4mm in diameter)
- Persons within 2m radius are at risk. On aircraft, 2 rows behind and in front
- E.g. agents of bacterial pneumonia, Neisseria meningitidis

## Control

- Gloves, surgical masks, +/- gowns, masks, visors (to prevent mucous membrane splashes, contamination of clothing)

## Airborne transmission

- Inhaling droplets nuclei (10-20um in diameter)
- Persons breathing the same air
- E.g. influenza, measles, chickenpox,

## Control

- Gloves, N95 masks, +/- gowns, masks, visors (to prevent mucous membrane splashes, contamination of clothing)



## Vector transmission

- Contact with vector
- E.g. malaria, dengue, Zika,

## Control

- Prevent/eliminate exposure to vector
- Chemoprophylaxis if possible



# TRANSMISSION

- Vast majority of cases arise from close contacts with symptomatic cases
- Transmission in most settings is driven by family-clusters
- Transmission in other settings does happen
  - Work
  - Gatherings

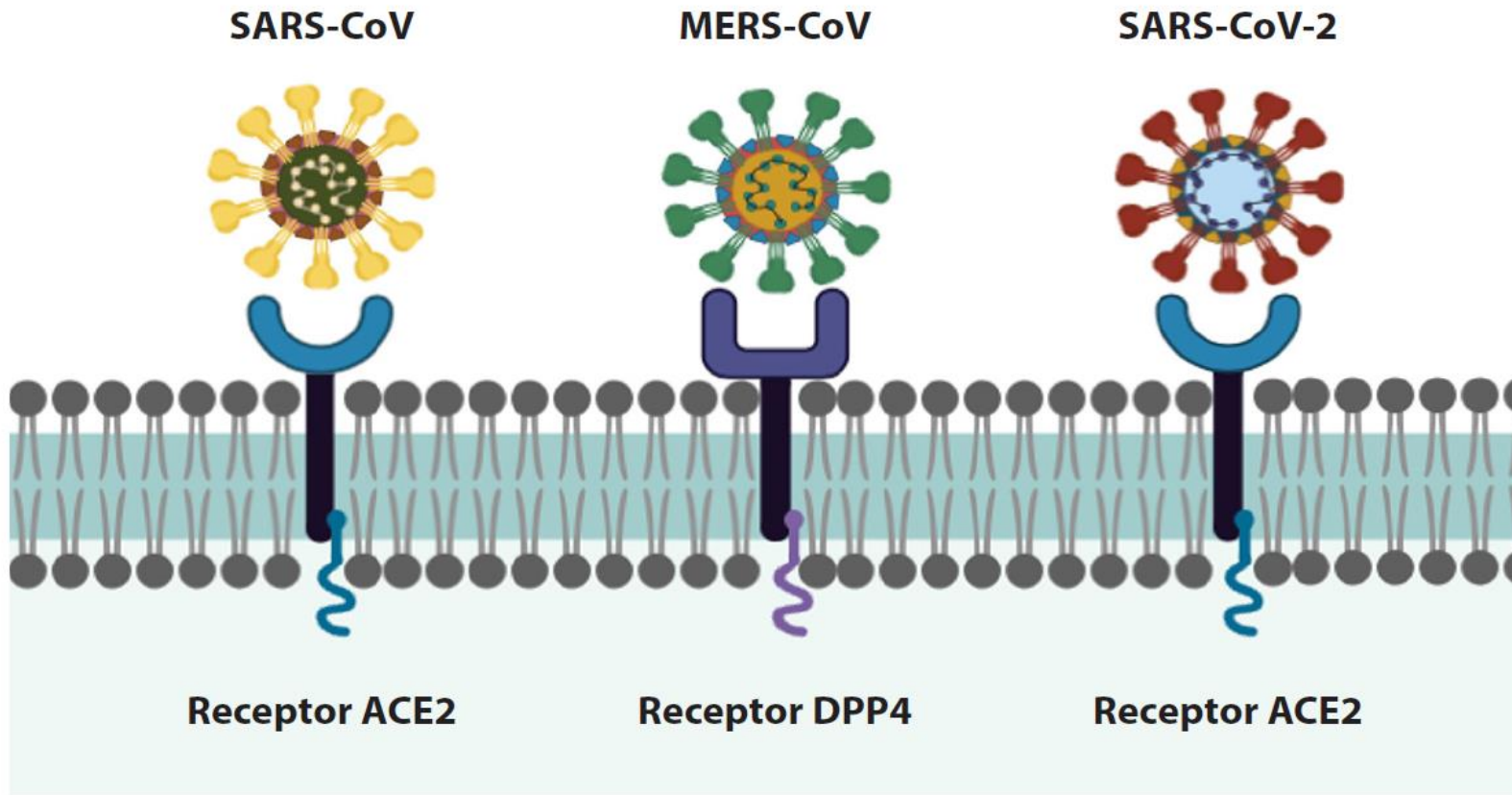
# TRANSMISSION POTENTIAL

- Very contagious
  - Reproduction number  $R_0$ - close to 3
    - 1 person infects 2-3 people
- Stable:
  - In aerosol form- for hours
  - On solid surfaces- for days

# SHEDDING OF VIRUS

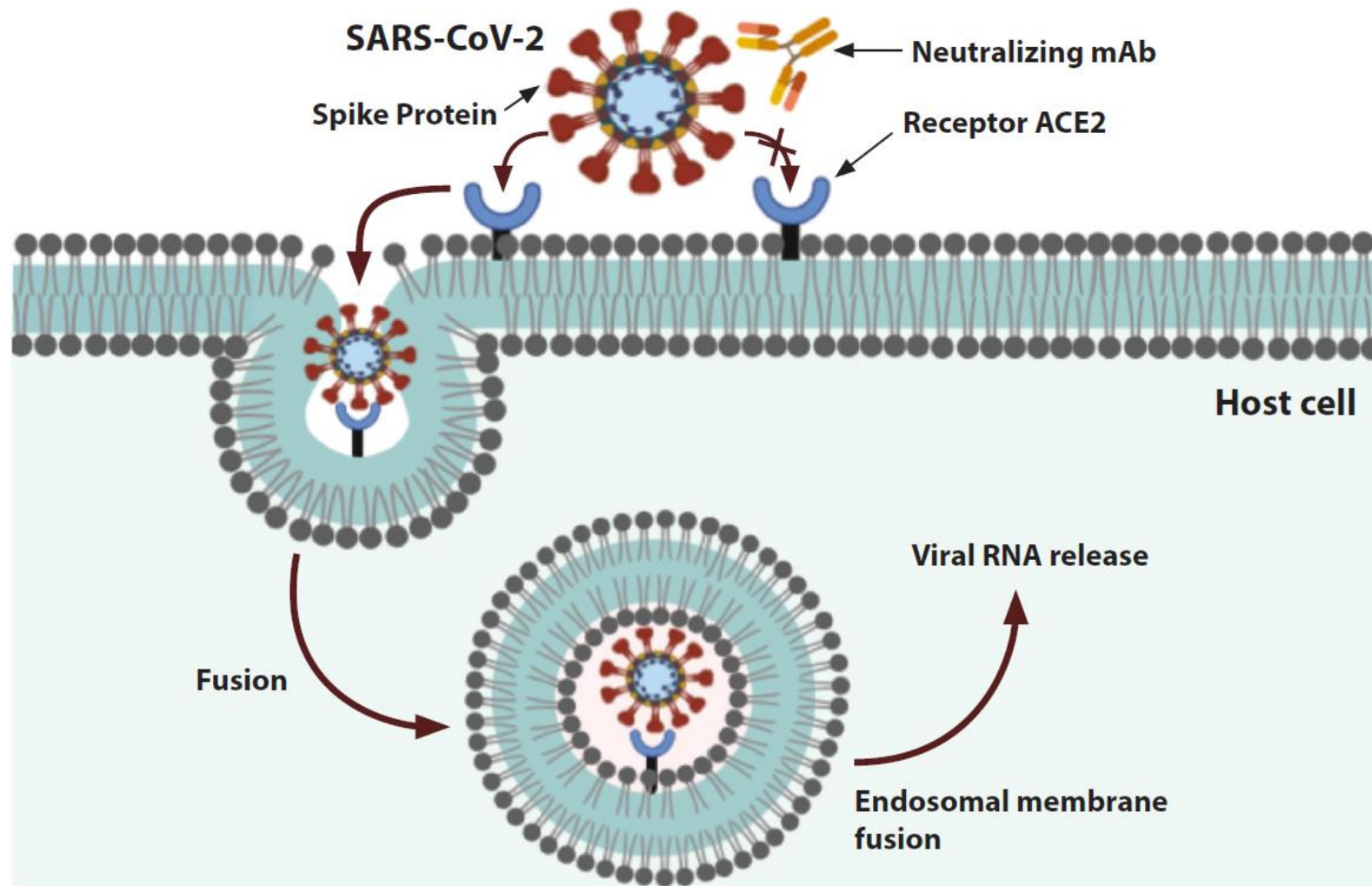
- Highest early in the course of disease
- Usually continues for 7-14 days in mild to moderate cases
- Can be for more than 2 weeks in severe cases

# Pathophysiology



- Infect cells via the Angiotensin Converting Enzyme II Receptor (ACEII Receptors)
- ACE II receptors are expressed in various organs including lungs  
Children express the receptor less than adults

# Pathophysiology (Cont'd)



Increases levels of cytokines (cytokine storm)  
- Leads to tissue damage



# CLINICAL PRESENTATION

Symptom	Percent
Fever	90%
Cough	68%
Fatigue	38%
Sputum production	34%
Shortness of breath	19%
Headache	14%
Chills	12%
Nausea and vomiting	5%
Diarrhoea	4%

# NATURAL HISTORY

- At diagnosis: approx. 80% are mild/moderate; 15% severe; 5% critical
- Progression: approx. 10-15% of mild/moderate cases become severe, and approximately 15-20% of severe become critical
- Average times:
  - from exposure to symptom onset is 5-7 days after infection;
  - from symptoms to recovery for mild cases is 2 weeks;
  - from symptoms to recovery for severe cases is 3-6 weeks;
  - from symptoms onset to death is from 1 week (critical) to 2-8 weeks.
  - truly asymptomatic infection appears to be rare (e.g. 1-3%)
- an estimated 75% of 'asymptomatic' cases soon progress to disease
- children tend to have milder disease than adults;
- COVID- less frequent in children with infrequent onward transmission from children, (?due to school closure)

# TESTING

- How is COVID-19 diagnosed?
  - The lab detects genetic material (RNA) in samples from the respiratory tract (sputum, throat swab)
    - RT-PCR
    - Gene-X-pert (In development)
  - Other tests- serology based- might be negative at early stages of the disease
  - The test more likely to be positive if a person has active disease (which may vary from very mild to severe)
  - The test might not identify persons who are incubating the infection
- Who should be tested?
  - Asymptomatic?
    - For surveillance purposes
  - Symptomatic
    - To detect those with the disease

# WHO SHOULD BE TESTED for COVID-19?: NICD

- Person with acute respiratory illness with sudden onset of at least one of the following, irrespective of admission status
  - Cough
  - Sore throat
  - Shortness of breath
  - Fever (history or measured) if measured  $\geq 38^{\circ}\text{C}$

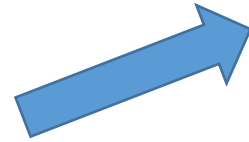
# PERSONS AT HIGHEST RISK OF COVID-19

- Has acute respiratory illness and in the 14 days prior to onset of symptoms met at least one of the following epidemiological criteria
  - Close contact with confirmed or probable cases of SARS-CoV2 infection **OR**
  - History of travel to areas with local transmission of SARS-CoV2 **OR**
  - Worked in or attended a healthcare facility where patients with SARS-Cov2 infection are being treated **OR**
  - Admitted with severe pneumonia of unknown origin

**PREVENTION**

# COVID 2019: How is it Spread? (Reminder)

**By breathing in droplets  
– when standing within  
1m of a person who is  
infected**



**By direct contact  
followed by touching  
of mouth, nose and  
eyes (auto-  
inoculation)**



# COVID-2019: How do we stop it from spreading?

By breathing in droplets  
– when standing within  
1m of a person who is  
infected



By direct contact  
followed by touching of  
mouth, nose and eyes  
(auto-inoculation)



Stop ill persons from making  
droplets

- Encourage sick people to stay at home
- In hospital cover persons with a mask
- Keep a distance from people
- Avoid touching mouth or nose
- Wash hands frequently and/or use alcohol-based hand sanitizer
- Clean surfaces which people touch
- Find other ways of greeting people



# COVID-2019: how do we stop it from spreading?

- Do masks help?
  - Surgical masks are useful to trap larger invisible droplets which may contain infectious particles
  - N95 masks are 'filters' and remove 95% of the smallest infectious particles which are found in the air.
- When should we wear masks?
  - The WHO says that members of the public who are well don't benefit from wearing masks
    - **Others say everyone should wear mask**
  - Sick/coughing persons protect other people by wearing surgical masks
  - N95 masks are used by health workers in special circumstances



Surgical  
(medical)  
mask



N95  
respirator



# A case of coronavirus has been identified in my community.....

- What should we do as a community?
  - Don't panic and act from fear
  - Don't spread fake news or confidential information!!
  - Support the patient and persons who are in quarantine by
    - Respecting their privacy
    - Offering help – food, communication and kindness
    - BUT keep your distance - >1m, in outside air, no touching
  - Change the way we greet people
    - Don't shake hands – touch elbows like West Africans did during Ebola
  - Educate but don't stigmatise
    - Encourage handwashing and make it easy
  - Be vigilant regarding symptoms and self-isolate if ill

# A case of coronavirus has been identified in my community.....

- What does 'quarantine' mean?
  - Separating a WELL person who is a contact (i.e. is at risk of infection) from others, so that if that person develops illness, s/he will not pass the infection on.
- What does 'isolation' mean?
  - Separating an ILL person who has the disease (or may have the disease) from others, so that if that person develops illness, s/he will not pass the infection on.

## How do I quarantine myself?

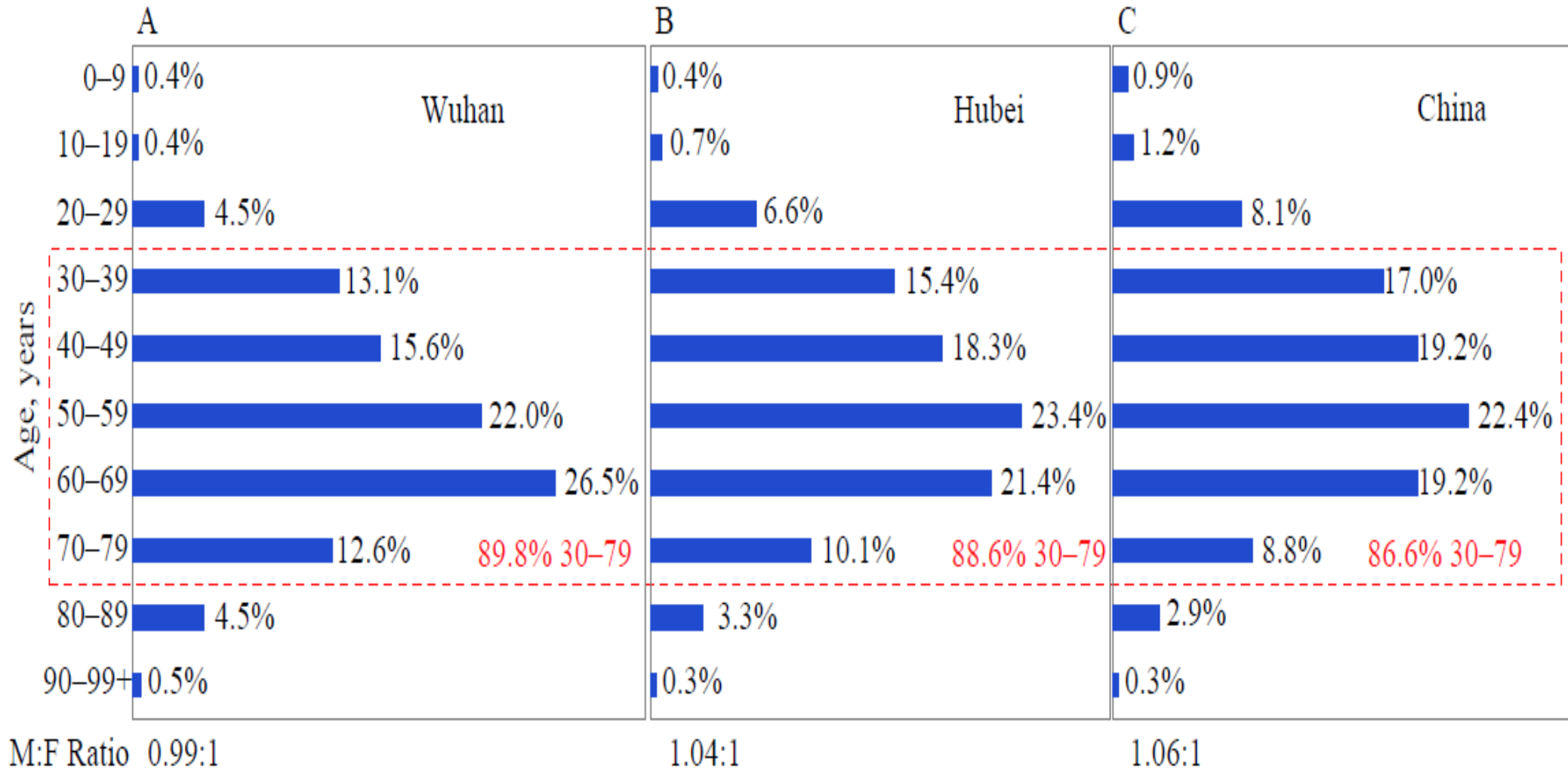
- Do not go to work/school
- Stay at home
- Keep separate from other household members
- Don't go out
- Don't use public transport
- Check temperatures and symptoms daily using a form on the NICD website (contact monitoring form)
- If illness develops, use a mask and get tested

# OUTCOME – MORTALITY: AS OF 6<sup>th</sup> APRIL 2020

	COVID-19 Cases	Deaths	Percent
<b>Globally</b>	1 349 889	74 820	5.5%
<b>USA</b>	367 650	10 943	3.0%
<b>Spain</b>	136 675	13 341	9.8%
<b>Italy</b>	132 547	16 523	12.5%
<b>Germany</b>	103 675	1 810	1.7%
<b>China</b>	81 740	3 331	4.1%
<b>S. Korea</b>	10 331	192	1.9%
<b>Russia</b>	7 497	58	0.8%
<b>India</b>	4 858	136	2.8%
<b>Brazil</b>	12 232	566	4.6%
<b>South Africa</b>	1 686	12	0.7%
<b>Algeria</b>	1 423	173	12.2%
<b>Egypt</b>	1 322	85	6.4%
<b>Cuba</b>	363	9	2.5%

# COVID-19 IN CHILDREN

# What Ages get Affected?



# Children with COVID-19 in USA- MMWR

- 149 082 cases with confirmed COVID-19 with known age
  - 2 572 (1.7%) – Children <18 years
  - 146 510 (98.3%) – Adults ≥18 years

# Characteristics of Children with COVID-19: USA

- N = 2572 confirmed cases
  - Median age- 11 years (0-17years)
    - <1 year – 15%
    - 1-4 years – 11%
    - 5-9 years – 15%
    - 10-14 years – 27%
    - 15-17 years – 32%
  - Sex- Male: 57%
  - 184 (7.2%) with known exposure: 9% travel history; 91% household/community
  - 745 information on hospitalization
    - 5.7-20% - Hospitalized
    - 0.6-2% - Admitted to ICU
    - 15-62% of admitted children were <1year



# Symptoms in Children with COVID-19: USA

	<b>Pediatric (&lt;18 years)</b> <b>N = 291</b> <b>n (%)</b>	<b>Adults</b> <b>N = 10944</b> <b>n (%)</b>
Fever, Cough and Shortness of breath	213 (73%)	10 167 (93%)
Fever	163 (56)	7 794 (71)
Cough	158 (54)	8 775 (80)
Shortness of breath	39 (13)	4 674 (43)
Myalgia	66 (23)	6 713 (61)
Runny nose	21 (7.2)	757 (6.9)
Sore throat	71 (24)	3 795 (35)
Headache	81 (28)	6 335 (58)
Nausea and vomiting	31 (11)	1 746 (16)
Abdominal pain	17 (5.8)	1 329 (12)
Diarrhoea	37 (13)	3 353 (31)

# Characteristics of Children with Suspected or Confirmed COVID: China

Characteristic	All cases N = 2143 N (%)	Confirmed N = 731 (34.1%) N (%)	Suspected N = 1412 (65.9%) N (%)
Age group (in years)			
< 1	379 (17.7)	86 (11.8)	293 (20.8)
1-5	493 (23.0)	137 (18.7)	356 (25.2)
6-10	523 (24.4)	171 (23.4)	352 (24.9)
11-15	413 (19.3)	180 (24.6)	233 (16.5)
>15	335 (15.6)	157 (21.5)	178 (12.6)
Sex			
Male	1213 (56.6)	420 (57.5)	793 (56.2)
Female	930 (43.4)	311 (42.5)	619 (43.8)

# Characteristics of Children with Suspected or Confirmed COVID: China

Characteristic	All cases N = 2143 N (%)	Confirmed N = 731 (34.1%) N (%)	Suspected N = 1412 (65.9%) N (%)
Age group (in years)			
Asymptomatic	94 (4.4)	94 (12.9)	0 (0)
Mild	1091 (50.9)	315 (43.1)	776 (54.9)
Moderate	831 (38.8)	300 (41.0)	531 (37.6)
Severe	112 (5.2)	18 (2.5)	94 (6.7)
Critical	13 (0.6)	3 (0.4)	10 (0.7)
Days from symptom onset to diagnosis			
Median (Interquartile range)	2 (4.0)	3 (4.0)	2 (4.0)
Range	0-42	0-42	0-36

Mild: symptoms only- fever, cough, sore throat, runny nose, examination normal

Moderate: pneumonia, but no shortness of breath

Severe: Dyspnoea with central cyanosis, saturation <92% in room air

Critical: ARDS, respiratory failure, shock, encephalopathy, myocardial injury, acute kidney injury

# Severity of illness by Age Group (Suspected and Confirmed Combined): China

Age group (yrs)	Asymptomatic n (%)	Mild n (%)	Moderate n (%)	Severe n (%)	Critical n (%)	Total
<1	7 (7.4)	205 (18.8)	127 (15.3)	33 (29.5)	7 (53.8)	379 (17.7)
1-5	15 (16.0)	245 (22.5)	197 (23.7)	34 (30.4)	2 (15.4)	493 (23.0)
6-10	30 (31.9)	278 (25.5)	191 (23.0)	22 (19.6)	0 (0)	521 (24.3)
11-15	27 (28.7)	199 (18.2)	170 (20.5)	14 (12.5)	3 (23.1)	413 (19.3)
>15	15 (16.0)	164 (15.0)	146 (17.5)	9 (8.0)	1 (7.7)	335 (15.7)
<b>Total</b>	<b>94 (4.4)</b>	<b>1091 (51.0)</b>	<b>831 (38.8)</b>	<b>112 (5.2)</b>	<b>13 (0.6)</b>	<b>2141</b>

# Management in Children: Prevention and Preparation

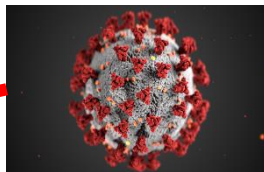
- Keep children out of healthcare system unless essential
- Use telemedicine when appropriate
- Might consider stopping elective procedures
- Increase capacity for provision of oxygen points, ventilators, bed space
- Comply with Infection and Prevention control Measures
- Ensure that all staff has access and are trained in use of PPE
- Prepare ward isolation cubicles
- Have areas for donning and doffing PPE
- Disposal of PPE

# Management of Children: General

- Reassure parents in those with mild symptoms
  - Follow up
- Involve parents
- Be vigilant, can deteriorate
- Team work

# Management of Children: Specific

- Admissions
  - FBC, CRP, and others as necessary
  - Fluids
    - Not too much, but remember insensible water losses
    - Monitor fluid balance
  - Antipyretics
    - Avoid ibuprofen
  - Antibiotics
    - Not for COVID but other possible bacterial infections
    - For very ill children on day 1
    - Not improving by day 3
    - Obvious X-ray changes
  - Respiratory support
    - High flow and nCPAP- careful as they are Aerolising Generating Procedures
    - Nebulization (AGP)- use MDI
    - Use closed in-line suctioning



**+**

**OR**

**High Clinical Suspicion (PUI)**

- Fever
- Cough
- Shortness of Breath
- Sore Throat
- Fatigue
- Myalgia
- Congestion/Runny Nose
- Diarrhea

**-**

**OR**

**Low Risk**

**Mode of Delivery**

**C-Section: Follow PPE Protocol (Updated 4/2/20)**

- Vaginal Delivery:
- Gown
  - Gloves
  - Surgical Face Mask
  - Eye Protection (e.g.: Face Shield, Goggles)

**C-Section: Gown, Surgical Face Mask with Shield**

- Vaginal Delivery:
- Gown
  - Gloves
  - Surgical Face Mask

**COVID + or PUI**

**Low Risk PUI (No Test Result)**

**COVID - Mother**

**Intubated**

**Admit to Isolation Room  
Place in Isolette**

**Surgical Face Shield  
Gloves, Gown**

**Management as  
per NICU Routine**

**NP Swab at 6 and 24 hours**

**Admit to Designated Rooms  
Pending Culture Results**

**If Negative,  
Manage as per NICU Routine**

**Manage as per  
NICU Routine**



# Management of Neonates

- Well Neonate and Mother COVID-19 positive
  - Different approaches
    - Isolate baby from other neonates and mother(minimize risk of infection from the mother)
    - If cannot separate from mother, use incubator, keep 1m distance, mask and gloves/ hand hygiene
    - Breast feeding- express breast milk, hand hygiene,
    - Testing/ Not testing
- Sick neonate and Mother COVID-19 positive
  - Different approaches
    - Isolate
    - Test
    - Mother not to visit
    - Give express breast milk

# Perinatal and Neonatal Management: Chinese Experts

