COVID-19  SARS-COV-2


JOSEPH ZACHARIAH D.O.
PRIVATE PRACTICE INFECTIOUS DISEASE
DESERT VALLEY INFECTIOUS DISEASE
BANNER BAYWOOD & HEART HOSPITAL

"COURAGE IS NOT THE ABSENCE OF FEAR, BUT RATHER THE UNDERSTANDING THAT SOMETHING ELSE IS MORE IMPORTANT THAN FEAR"

FDR
NOVEL CORONA VIRUS FROM PATIENTS WITH PNEUMONIA IN CHINA 2019

12/20 - 27/2019
61 MALE WITH FEVER & COUGH
49 FEMALE WITH FEVER & COUGH
32 MALE WITH FEVER & COUGH

RETAILER AND VISITORS AT WHOLE SALE SEA FOOD MARKET

NEJM 1/29/20
61 YO MALE DIED IN 7 DAYS

ALL ROUTINE BACTERIAL AND VIRAL STUDIES – NEGATIVE
VIRAL RNA FROM BAL WAS CLONED & SEQUENCED
MATCHED GENOME OF B-CORONA VIRUS FAMILY
DID NOT MATCH KNOWN CORONA VIRUSES

89% NUCLEOTIDE IDENTITY WIT BAT COV2C45 VIRUS

NEJM 1/29/2020
COVID - 19

1965
TYRELL & BOWE, HAMRE & PROCKNOW

CULTURED THROAT SAMPLES OF PEOPLE WITH URI
INFECTED VOLUNTEERS BUT FAILED TO GROW IN CULTURE
ISOLATED AN RNA VIRUS

CLUB SHAPED WITH ROUND SURFACE PROJECTIONS

BMJ 1965; 1: 1467-70
COVID-19

SARS-COV-2

1967
HAMRE & PROCKNOW

INOCULATED 50 VOLUNTEERS

INCUBATION: 2-4 DAYS
50% BECAME ILL

MYALGIA/SORE THROAT/HEADACHE/FEVER/COUGH

MILD – 77%
MOD – 15%
SEVERE – 8%

BMJ 1967: 3 767-9

CORONA VIRUSES

COMMON COMMUNITY

229 E
0C 43
NL 63
HKUI

SARS-COV 1 .... 2002
MERS .... 2012

JZACHARIAH:COVID19-4/1/2020
COVID-19

TIMELINE

CHINA
- MID NOVEMBER/MUTATION IN GLYCOPROTEIN SPIKES
- WHO NOTIFIED .... 12/31/2019

USA
- SEATTLE : 1/15/2019
- PANDEMIC DECLARED 3/11/2020
- US EMERGENCY 3/12/2020

JZACHARIAH:COVID19- 4/1/2020
COVID-19

SARS - COV -2

<table>
<thead>
<tr>
<th>Country</th>
<th>3/18/20</th>
<th>3/31/20</th>
<th>Cases/1 Million</th>
<th>Deaths/1 Million</th>
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<td>CHINA</td>
<td>80000</td>
<td>81439</td>
<td>57</td>
<td>2</td>
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<td>950</td>
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<td>13</td>
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WORLDOMETERS.INFO

JZACHARIAH COVID-19 – 4/1/2020

COVID-19

GLYCOPROTEIN SPIKES ATTACH TO ACE-2 RECEPTORS

HIGHER VIRAL LOAD IN NARES

ASYMPTOMATIC PATIENT HAD SIMILAR VL

NEJM DOI:10.1056/NEJMc2001737
COVID-19 SARS-COV-2

Index Patient
- Visit to Germany
- Flight to China
- Symptoms
- Positive PCR

Patient 1
- Attended business meetings
- Positive PCR

Patient 2
- Attended business meetings
- Symptoms
- Positive PCR

Patient 3
- Symptoms
- Positive PCR

Patient 4
- Symptoms
- Positive PCR

Date
Jan. 19 20 21 22 23 24 25 26 27 28 29

COVID-19 SARS-COV-2

HIGHER TRANSMISSION

A) HIGHER VIRAL CONCENTRATION IN NARES

B) PRESYMPTOMATIC OR ASYMPTOMATIC TRANSMISSION
- CRUISE SHIP: 692 PCR (+), 50% NO SYMPTOMS
- SNF SEATTLE: 13/24 NO SYMPTOMS..... 10 GOT ILL LATER
- TRULY ASYMPTOMATIC: 18%

C) SUPER SPREADING EVENTS: LARGE & SMALL

JIACHARIAH: COVID19-4/1/2020
Infectious Droplets & Droplet Nuclei travel lengths

TRANSMISSION – GENERAL ACTIVITIES

DROPLET 1 - 6 FEET
- Coughing
- Sneezing
- Laughing
- Singing
- Talking

CHURCHES, SPORTING EVENTS, MARD GRAS, FUNERALS
COVID-19
SARS-COV-2

RISK OF AEROSOL

SVN THERAPY
BIPAP & CPAP, OPEN SUCTIONING
HIGH FLOW OXYGEN > 16L/MINUTE
TRACHEOSTOMY
BRONCHOSCOPY
INTUBATION & EXTUBATION
CPR & MANUAL VENTILATION
EGD & COLONOSCOPY
LARYNGOSCOPY / DENTAL PROCEDURES

IIACHARIAN: COVID 19- 2/1/2020

COVlD -19
SARS - COV -2

A. Time of Positive Viral RNA
B. Radiology of Chest X-Ray
C. Length of Stay in Hospital
THERE IS A DIFFERENCE BETWEEN WHAT IS POSSIBLE AND WHAT HAPPENS IN REAL LIFE

TRANSMISSION - SECONDARY ATTACK RATE

- CRUISE SHIP: 2% CREW DEVELOPED INFECTION
- US RETURNEES: 10% HOUSEHOLD CONTACTS
- CHINA: 0.45% OTHER CLOSE CONTACTS
- CHINA: 1-5% OF CLOSE CONTACTS

MMWR 2020;69;3;312
WHO: RTS 16:24 Joint Mission

COVID-19 SARS-COV-2
How Contagious Is That Disease?
Approximate reproduction number (R0)

- COVID: 3.3
- SARS: 3.0
- Measles: 12
- Influenza: 1.8
- Ebola: 1.9
- SARS-CoV-2: 3.0

Sources: World Health Organization, Centers for Disease Control, King Saud University, Nature.

**ISOLATION**

**ENHANCED PRECAUTIONS**: DROPLET/CONTACT/EYE SHIELD/GLOVES

**SURGICAL MASKS**: Protects from splashes/sprays

**N-95**: Filters inspired air

Reserve when likely to generate aerosols

**BIPAP/BRONCHOSCOPY/SVN**

**INTUBATION/EXTUBATION**

Use when patient in negative pressure room

Wash hands with soap & H2O for 20 sec.

Hand sanitizers
COVID-19  SARS-COV-2

CO COVID-19  SARS-COV-2
KEEPS YOUR DROPLETS TO YOURSELF
PREVENTS YOU TOUCHING FACE
FASHION STATEMENT
PEACE OF MIND
COVID-19          SARS-COV-2

AGE DISTRIBUTION

CHINA
< 39  10%
40-49 23%
50-59 30%
60-69 22%
>70  15%

USA (N=2449)
0-19  5%
20-44 29%
45-54 18%
55-64 18%
65-84 25%
>85  6%

Lancet 1/29/20
MMWR 3/18/20

COVID-19          SARS-COV-2

The symptoms of coronavirus disease (COVID-19) are:

- Fever
- Cough
- Exhaustion
- Shortness of breath
- Muscle pain
- Headache
- Diarrhea

Our World in Data
COVID-19 SARS - COV -2

Coronaviruses (COVID-19): the severity of diagnosed cases in China

AIDS patients with moderate, severe, and critical cases

AIDS patients with mild and critical cases

AIDS patients with moderate and critical cases

AIDS patients with moderate and critical cases

2.3% of all cases died

COVID-19 SARS - COV -2

WHICH PATIENTS TO TEST

NEW ONSET OF FEVER / COUGH / DYSPIA WITHIN 7 DAYS

a) HOSPITALIZED PATIENTS WITH SYMPTOMS COMPATIBLE WITH COVID-19 IN ORDER TO INFORM DECISIONS RELATED TO INFECTION PREVENTION

b) SYMPTOMATIC PATIENTS WITH HIGHER RISK IN THE OUTPATIENT SETTING

c) ANYONE WITH SYMPTOMS AND EXPOSURE WITHIN 14 DAYS OF TRAVEL TO RISK AREAS OR EXPOSURE TO ONE WITH COVID-19 CONFIRMED OR SUSPECTED CASE

d) ANYONE WHO ASKS FOR IT — COVID TESTS AVAILABLE.
COVID-19

TESTS
RT PCR
**Sensitivity - 80%**
**Specificity - 95%**

Turnaround Time
24 to 36 hours

Point of Care Testing
Weeks away

SEROLOGY
Weeks - Months away

COVID-19

LABORATORY PARAMETERS
WBC
4700 (3500–6000) 34% < 4000, 4% > 10000

LYMPH
1000 (83% < 1500)

PLATELETS
168,000 (36% < 150)

LDH
> 250 (40%)

AST/ALT
> 40 (20%)

CREAT
> 1.33 mmol/L 1.8%

D-DIMER
> 0.5 - 46%, CPK > 200 - 14%, PROCALCITONIN > 0.3 - 5%

NEJM 3/3/2020
COVID-19 SARS-COV-2

LOCAL EXPERIENCE AT MY HOSPITAL

FIRST CASE MAY 14
TOTAL CASES 19 INPATIENT, ED & HOME - 6
AGE 27-94
SEX M - 10, F - 9
DEATHS 5

COVID-19 SARS-COV-2

LOCAL EXPERIENCE

CASE 1

67 YC MALE WITH 7 DAY ONSET OF SORE THROAT, BODY ACHES, FEVER AND COUGH, DYSPIA BROUGH HIM TO HOSPITAL

FEVER 102
FINE CRACKLES
WBC 6.5, LYMFI 2%
PAO2 - 90%
CASE 2: 80 YO MALE WITH ESRD, LETHARIOUS, 1 WEEK OF DRY COUGH
APRILE
HYPOXIC ON BIPAP

CASE 3: 55 YO WORKER AT SHF, 2 WEEKS OF COUGH, FEVER AND NOW DYSPNEA PROMPTED ED VISIT
TEMP = 102
PULSE = 90/
RALES = 1/4
COVID-19

**CLINICAL SYNDROMES**

**UNCOMPROMICATED ILLNESS**
- FEVER - COUGH - SORE THROAT - NAUSEA - CONGESTION - BODY ACHES

**MILD PNEUMONIA**
- **RR < 30** - **PAO2 >92% ON RA** - **CXR <50% INFL\TRATE**

**MODERATE PNEUMONIA**
- **RR > 30** - **PAO2 < 92% ON RA** - **CXR >50% INFL\TRATE**

**SEVERE DISEASE**
- **VOLUME - ARDS - SHOCK - RACK**

**ADAPTED - WHO**

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COVID-19

**CHARACTERISTICS OF HOSPITALIZED PATIENTS IN CHINA**

N = 1099

- SEPTIC SHOCK 11%
- ARDS 3.4%
- ARF 0.5%
- DIC 0.1%
- Rhabdomyolysis 0.2%

**NEJM 3/3/2020**

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COVID-19  SARS-COV-2

**Complications**

- ARDS: 20.4% of hospitalized patients
- Age > 65, DiM, HTN, COPD

**Cardiac**

- N=130: Arrhythmia 17%, Cardiac Injury 7%, Shock 5%
- N=17: Severe ILI, 33% Cardiomyopathy

*JAMA 3/4/2020*

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**COVID-19  SARS-COV-2**

**Work Up**

- Isolate, have patient wear mask
- CXR, if CXR is normal & Resp symptoms with hypoxia get CT chest
- WWF test for Seasonal viral pathogens
- Blood & sputum cultures
- Fluid sparing resuscitation - per judgement
- Empiric antibiotics for CAP or HCAP
- Early intubation if needed, .... elderly
- Judicious use of BiPAP - avoid if possible
- Lung protective ventilation
' THERE IS NO SINGLE, EFFECTIVE AND PROVEN TREATMENT SO FAR'

DR ANTHONY FAUCI

MEDICATIONS: MECHANISMS DO NOT EQUATE TO EFFICACY

>90% PATIENTS RECOVER ON THEIR OWN

- REMDESIVIR - INHIBITS RNA POLYMERASE
- CHLOROQUINE - BLOCKS VIRAL ENTRY INTO ENDOSONE
- OSeltamivir - BLOCKS NEURAMINIDASE
- Lopinavir/Ritonavir - PROTEASE INHIBITOR
- TOCILIZUMAB - BLOCKS IL-6
- CORTICOSTEROIDS - BLOCKS T CELLS
- VACCINE TRIALS - STARTED 3/16
COVID-19  SARS-COV-2

<table>
<thead>
<tr>
<th>Drug</th>
<th>Lopinavir-ritonavir</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. at Risk</td>
<td>99</td>
<td>100</td>
</tr>
</tbody>
</table>

COVID-19  SARS-COV-2

ISSUES WITH STEROID USE IN VIRAL INFECTIONS

- MERS-CoV: < CLEARANCE OF VIRUS FROM RESPIRATORY TRACT
- SARS-CoV-1: < CLEARANCE OF VIRUS FROM BLOOD
- PSYCHOSIS, DIABETES: 33%, AVASCULAR NECROSIS: 10%
- INFLUENZA: >MORTALITY, RR: 1.75
- JEV: NO BENEFIT

LANCET: 2/7/2020 KUZEL M
COVID-19  SARS - COV -2

HYDROXYCHLOROQUINE & ZITHROMAX

N=42 (48)

CONTROLS - ANOTHER HOSPITAL
TREATMENT ARM 26, CONTROLS 16

ANALYSIS
DROPPED 6 PEOPLE OUT OF TREATMENT ARM, ADDED 21 HCU ON /
DATA ONLY FOR NP SWAB PCR'S
NO CLINICAL DATA ON OUTCOMES

COVID-19  SARS - COV -2

PROGNOSIS

AGE : > 65
IPU - 45%
ICU - 53%
DEATH - 80%

COMORBITIES
ESRD/CKD - ITALIAN EXPERIENCE
COPO
CAD/CHF
DIABETES
INMUN/INMUNO

(Handwritten notes on slide)
## COVID-19 SARS-COV-2

### Coronavirus: early-stage case fatality rates by age-group in China

<table>
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<tr>
<th>Age Group</th>
<th>Fatality Rate</th>
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</thead>
<tbody>
<tr>
<td>0-9 years</td>
<td>0%</td>
</tr>
<tr>
<td>10-19 years</td>
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<tr>
<td>20-29 years</td>
<td>0%</td>
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<tr>
<td>30-39 years</td>
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<tr>
<td>40-49 years</td>
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<tr>
<td>50-59 years</td>
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<tr>
<td>60-69 years</td>
<td>0%</td>
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<tr>
<td>70-79 years</td>
<td>0%</td>
</tr>
<tr>
<td>80+ years</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Note: Fatality rates are based on early-stage analysis of the COVID-19 outbreak in China as of February 21, 2020.*

### Coronavirus: early-stage case fatality rates by underlying health condition in China

<table>
<thead>
<tr>
<th>Health Condition</th>
<th>Fatality Rate</th>
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<tbody>
<tr>
<td>Cardiovascular disease</td>
<td>10.5%</td>
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<tr>
<td>Diabetes</td>
<td>7.8%</td>
</tr>
<tr>
<td>Chronic respiratory disease</td>
<td>6.0%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>4.0%</td>
</tr>
<tr>
<td>Cancer</td>
<td>5.5%</td>
</tr>
<tr>
<td>No health condition</td>
<td>0%</td>
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</tbody>
</table>

*Note: Fatality rates are based on early-stage analysis of the COVID-19 outbreak in China as of February 21, 2020.*
COVID-19

ILLNESS AND VIRAL DYNAMIC

VIRAL SHEDDING: NARES, THROAT, SPITUM, BLOOD, STOOL

HIGHEST VIRAL LOAD: EARLY STAGE OF SYMPTOMS 3-5 DAYS

DURATION OF SHEDDING AFTER ONSET OF ILLNESS
MILD DISEASE: 90% NEGATIVE NP SWAB AT 10 DAYS
SEVERE DISEASE: MEDIAN VIRAL SHEDDING 20 DAYS

JZACHARIAS:COVID19-4/1/2020

COVID-19

RETURN TO WORK

TESTING REGIMEN
1. RESOLUTION OF FEVER & RESPIRATORY SYMPTOMS
2. NEGATIVE NP SWABS 24 HOURS APART

NON-TESTING REGIMEN
1. 7 DAYS POST FIRST SYMPTOMS APPEARED
2. 3 DAYS POST RESOLUTION OF FEVER & RESPIRATORY SYMPTOMS
COVID-19  PEDIATRIC CASES

N = 2143, 731 LAB (+) AND 1412 CLINICAL (+)

MEDIAN AGE 7

M/F 56-44

90% ASYMPTOMATIC, MILD OR MODERATE

ONLY 1 DEATH: 1-4 YR OLD

10% SEVERE...<1 YEAR OLD: 10% OF CASES

COVID-19  PREGNANCY

N=28

NO VISIBLE STAINING

NO VIRUS IN AMNIOTIC FLUID/PLACENTA/CORD BLOOD/BREAST MILK

NEONATAL THROAT SWABS NEGATIVE

4 NEONATES WITH IGM AB

6 CASES OF PRETERM LABOR

ARCH OF PATHOLAB, 3/2020
In the outbreak of an epidemic early counter measures are important. During an outbreak of the virus, the number of cases grows exponentially. Without counter measures that slow the rate of infection, the healthcare system is overwhelmed. With counter measures, the peak of cases can be reduced and the healthcare system is not overwhelmed.

Figure 6: Case fatality ratio (reported deaths among total cases) for COVID-19 in China over time and by location, as of 20 February 2020.
COVID -19  SARS – COV -2

BENDING THE CURVE

Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread.

Cumulative number of cases, by number of days since 100th case

Source: FT, photos by Alex Horgan, infographic by GSE

WHAT ARE WE DOING

TRIAGE IN ED TO RESPIRATORY ILLNESS SECTION
INPATIENT RESPIRATORY TREATMENT UNIT WITH COVID TEST
DEDICATED DOCTORS/RN’S/CAN’S/RT’S
LIMIT NUMBER OF MEDICAL PARTICIPANTS
NO VISITORS IN HOSPITAL
MASK PATIENT FROM ED ONWARD
MINIMIZE BIPAP, CPAP, SVN & OTHER AEROSOLIZATION
ADDRESS OVERALL GOALS WITH PATIENT & FAMILY
COVID-19  SARS-CoV-2
ILLNESSES WE HAVE SEEN

HIV
WEST NILE VIRUS
H1NI - 250K TO 450K DEATHS .... 2009
COVID 19

F.E.A.R.
FORGET EVERYTHING AND RUN
OR
FACE EVERYTHING AND RISE

THIS IS OUR TIME, LET US RISE