OBJECTIVES

- Describe the criteria that constitutes a pandemic
- Explore the pandemics that occurred at different periods in history
- Discuss the public health response to pandemics

PANDEMIC OR EPIDEMIC?

- **Epidemic**
  - Affects many people at once and spreads rapidly
  - Sudden, often unexpected escalation in number of cases
  - May occur in a specific community, geographical location, or across several countries

- **Pandemic**
  - A type of epidemic
  - Affects an entire nation or the entire world

WHEN DOES AN EPIDEMIC BECOME A PANDEMIC?

- When it has spread over a large geographical location
- OR
- When it affects a certain percentage of overall population

THE HISTORY OF PANDEMICS: FROM THE BLACK DEATH TO COVID-19

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Just as people have spread across the world...

...so have infectious diseases

WE SEE OUTBREAKS CONTINUALLY, THEY JUST ALL DON’T REACH PANDEMIC LEVEL
PANDEMICS

- Affect larger number of people
- Often caused by new virus or disease that has not been in circulation for centuries or decades
- Most humans have little to no immunity against the disease
- Known to cause more deaths than epidemics
- Often results in social disruption and/or economic loss

“Very few phenomena throughout human history have shaped our societies and cultures the way outbreaks of infectious diseases have...pandemic outbreaks have decimated societies, determined outcomes of wars, wiped out entire populations, but also, paradoxically, cleared the way for innovations and advances in sciences (including medicine and public health), economy, and political systems.”
- Damir Huremović

A FITTING START IN HISTORY... PLAGUE

- Stems from Greek word plaga, which means strike or blow
- The term “plague” used interchangeably:
  - Describe the contagious febrile disease caused by Yersenia pestis
  - General term to describe any epidemic disease causing a sudden outbreak
  - Some people interpret plagues as “divine punishment for sins”, others consider them the “end of days”
- Recorded pandemics have shaped our history, society, and modern medicine

ATHENIAN PLAGUE OF 430 B.C.

- 430-26 B.C. during Peloponnesian War
- Originated in Ethiopia – spread throughout Egypt and Greece
- Initial symptoms:
  - Headache
  - Conjunctivitis
  - Rash covering body
  - Fever
  - Followed by hemoptysis, extreme abdominal cramps, and vomiting
  - Death often occurred by the 7th or 8th day
  - Survivors usually suffered from partial paralysis, amnesia, or blindness
ATHENIAN PLAGUE OF 430 B.C.

- Since this was during a war, there was substantial overcrowding in Athens
- Plague spread quickly
- Killed over 25% of the population
- Cause of Athenian Plague unknown:
  - Typhoid fever?
  - Ebola virus?

ANTONINE PLAGUE

THE ANTONINE PLAGUE

- 165-180 A.D.
- Also known as the Plague of Galen
- Occurred in Roman Empire
  - Brought into empire by soldiers from Selucia
  - Affected Asia Minor, Egypt, Greece, and Italy
- Killed almost 1/3 of the population (~5 million)
- Thought to be caused by smallpox or measles

IMPACT OF THE ANTONINE PLAGUE

- Weakened the military & economic supremacy
- Affected ancient Roman traditions
- Led to the spread of new religions
- Likely started the decline of the Roman Empire

THE JUSTINIAN PLAGUE

- First documentation of a "real plague" caused by Yersinia pestis
- 541-542 AD
- Unknown origin → Either started in Ethiopia, moving through Egypt; or started in Central Asia, traveling along caravan routes
- Spread throughout the Roman world...and beyond
- Significant in coastal cities because is followed trading routes "exchange of infections as well as goods"
THE JUSTINIAN PLAGUE

- Hallucinations prior to outbreak of illness
- Symptoms:
  - Fever
  - Fatigue
  - Buboes in groin area or armpit, occasionally besides ears
  - Rapid progression after onset of early symptoms
  - Delirium, lethargy, refused to eat or drink
  - Death within days

- 40% population of Byzantine Empire died
- Over 50% of population in Constantinople died
- Gravesites beyond capacity in short time
- Dug vast pits and placed bodies there
- Religion came into the picture, as Christians during this time explained the plague as "punishment for sin" or retribution for the induction of "God's wrath"

THE JUSTINIAN PLAGUE

- Prior to the pandemic, the Byzantine Empire was an advanced society
- Weakened it physical, economic, and cultural infrastructure
- All trade stopped
- People either died of starvation or the disease
- Tax base gone
- No economic output
- Army suffered

THE BLACK DEATH

- "The Plague"
- Global outbreak of bubonic plague
- Originated in China in 1334
  - Spread through central Asia and northern India – trading route called Silk Road
  - Arrived in Europe in 1347
  - Spread through entire continent of Europe within 5 years
  - Moved into Russia and Middle East
  - Within 50 years, Black Death killed ~200 million
    - 60% of European population
- Mortality (if untreated) was close to 70%
  - Most died within 8 days
- Initially Black Death was blamed on the alignment of three planets
  - Caused "great pestilence in the air"
- Later blamed on bad air
- Late 19th century – discovered that the Black Plague was due to a massive Yersinia pestis pandemic (rat fleas)
THE BLACK DEATH

- At the time, with no reasonable explanation, people turned to religion
- General population centered on the plague as "punishment for sins"
- Identified groups that were hit the hardest as the "gravest sinners against God"
- Frequently singled out minorities or women
- Jews in Europe accused of poisoning the wells
- Sultan in Cairo placed a law prohibiting women from making public appearances as they may tempt men into sin
- Societies were terrified

THE BLACK DEATH

- Led to breakdown of societal structure
- Shortage of doctors → led to people selling useless cures
- Shortage of labor
  - Crops not harvested
  - Settlements abandoned
  - Trade stopped

QUARANTINE

- Medieval societies recognized connection between passage of time and onset of symptoms
- Noted that after a period of observation, those who had not developed symptoms of illness would likely not be affected...therefore, would not spread disease
- Started instituting mandatory isolation

QUARANTINE

- First known quarantine in Ragusa in 1377
  - Arrivals spent 30 days (later changed to 40) isolated on nearby island before entering city
- Effective during the Black Death
- We still use quarantining as an effective public health measure to combat outbreaks

THE SPANISH FLU PANDEMIC

- 1918-1920
- First true global pandemic
- First pandemic to occur in setting of modern medicine
- Last true global pandemic with devastating consequences for societies around the world
THE SPANISH FLU

- Caused by H1N1 strain of influenza virus
- Outbreak of same strain again, in 2009-2010 (Swine Flu)
- True origin of pandemic is unknown
  - Possibly Spain, U.S., China, France, or Austria
- Spread all over the world
- Mortality rate of 10-20%
  - Affected over ¼ global population
  - Death toll at 40-50 million

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THE SPANISH FLU

- Higher mortality among young, previously healthy individuals
- Likely due to cytokine storm
- Mutated & returned to kill those who avoided infection the first time

THE SPANISH FLU

- Enormous impact on society, world-wide
- First pandemic where long-lingering effects could be observed and quantified
  - Census data for 1960-1980: “children born to women exposed to Spanish flu had more physical ailments and lower lifetime income”
  - 2006 study found that “cohorts in utero during the pandemic displayed reduced educational attainment, increased rates of physical disability, lower income, and lower socioeconomic status”

THE SPANISH FLU

- Has been referred to as the “forgotten pandemic”
- Only lasted about 9 months
- Overshadowed by the ending of WWI
- This is just how society deals with such rapidly spreading pandemics: first with great interest → horror and panic → dispassionate interest

SMALLPOX

- 1520-onward
- Highly contagious virus
- Fever & pustules on skin
- 30% mortality rate
  - 56 million deaths
SMALLPOX

• Led to the world’s first vaccine in 1798
• Well-coordinated effort in 1967 led to global eradication
• WHO announced complete eradication in 1980

SMALLPOX – YUGOSLAVIA 1972

• Started with pilgrim returning from Middle East with fever and skin eruptions
• Physicians had not seen this in over 30 years → Incorrectly diagnosed
• This patient infected 38 others (including healthcare workers)
• Mandatory revaccination & quarantined villages/neighborhoods
• Closed borders
• Suspended non-essential travel

SMALLPOX – YUGOSLAVIA 1972

• Revaccinated entire population in 2 weeks
• During this outbreak:
  - 175 cases identified
  - 35 fatalities
• Due to prompt response, society returned to normal in 2 months

“...has proven to be a useful model for working out scenarios for responses to an outbreak of a highly contagious disease, both as a natural occurrence and as an act of bioterrorism”

HIV/AIDS PANDEMIC

• Slowly progressing global pandemic
• Continually brings new challenges
• Started in early 1980s in U.S.
• Initially observed predominantly in gay population with high mortality
• Led to social isolation and stigma

HIV/AIDS PANDEMIC

• Global public health phenomena
• Affects ~40 million people globally
• Death toll at ~35 million people world-wide
• ~1 million deaths/year (down from nearly 2 million in 2005)
• Alarming 25% prevalence in Sub-Saharan African countries
• In U.S.:
  - ~1.2 million people live with HIV
  - 12,000 deaths/year
HIV/AIDS PANDEMIC

- Receives great amount of public health attention – national & international administrations, plus pharmaceutical companies
- Advances in treatment have turned HIV into a chronic condition
- Attention on mental health
  - Helps us understand challenges associated with infectious disease

SARS (SEVERE ACUTE RESPIRATORY SYNDROME)

- First outbreak in 21st century to get public attention
- Caused by SARS Corona virus (SARS-CoV)
  - Started in China
  - Affected < 10,000 people
- Global health concern
  - Severe respiratory symptoms
  - 10% mortality rate

SARS

- Intense public health response
- Quarantining in affected areas
- Isolating infected individuals
- Regular sanitation of surfaces
- Facemasks a common sight
- Studied mental health effects

SWINE FLU (H1N1)

- Reprise of the 1918 Spanish flu
- Far less devastating consequences
- Started in Mexico → infected over 10% of global population quickly
  - Affected ~ 60 million in U.S.
  - Death toll estimated to be up to 500,000 world-wide
**SWINE FLU (H1N1)**

- Death rate lower than typical influenza death rates
- Disproportionately affected previously healthy, young adults
- Older adults had immunity due to similar H1N1 outbreak in 1970's
- Quickly led to severe respiratory compromise
- Demonstrated how quickly a viral pandemic can spread in 21st century

> "A major legacy of the swine flu may have been how it exposed the persistent vulnerability of many countries with advanced healthcare systems to a fast-moving, flu-like illness"

**EBOLA**

- Endemic to Central and West Africa
- Began in small village in Guinea in 2014
- Quickly spread to Sierra Leone and Liberia
- Largest infection to date
- 28,000 cases
- 11,000 deaths

**EBOLA**

- Ravages countries least equipped to defend against it
- Person from Liberia, fell ill and died in Texas in 2014
- Infected two nurses
- Significant public concern of possible outbreak in U.S.
- Significant public health and military effort to address the outbreak

**ZIKA**
ZIKA

- Little known virus found in rhesus monkeys in Uganda
- Prior to 2015, only known outbreak in Micronesia (2007)
- 2015 - outbreak identified in Brazil
- Mild illness:
  - Flat, pinkish rash
  - Bloodshot eyes
  - Fever
  - Joint pain
  - Headaches
- Mosquito-borne & sexually transmitted

- May cause Guillain-Barre syndrome
- May cause severe microcephalia in unborn children of infected mothers
- In Brazil (2015), Zika linked to:
  - 2400 birth defects
  - 29 infant deaths
- Continued to spread
- Remains a significant public health concern

Modern media pandemic

- In early 2016, Zika mentioned 50 times/minute on Twitter
- Social media used to disseminate information, educate, and communicate concerns
- Public health institutions tried to promote educational aspect
- General public voiced their concerns

4 out of 5 Zika posts were accurate
- "Trending" posts were inaccurate

"requires significant attention in preparing for future outbreaks because it may hold a key not only to preparedness, but also to execution of public health plans that may involve quarantine and immunization"

COVID-19

- Outbreak of novel coronavirus
- Outbreak of 3 known diseases caused by coronavirus:
  - MERS-CoV
  - SARS-CoV
  - COVID-19
- All may be traced to bats
- Revealed vulnerabilities in the global response to outbreaks
WHAT HAVE WE LEARNED?

- Massive improvement in sanitation, hygiene, nutrition
- Human population less vulnerable to illness
- Still face challenges:
  - HIV/AIDS remains a pandemic
  - COVID-19
"Pandemics are more likely to occur if the threat has not been seen before and is easily transmissible."

CONCLUSION

- We are continually learning and adapting
- Current adaptations:
  - Social distancing
  - Wearing masks
  - Quarantining
  - New vaccines
  - Geographical and statistical analyses to limit the spread

Despite the persistence of current and potential pandemics, humanity continues to move forward

Need to be aware of factors that nurture pandemics

Improvement in healthcare is a powerful tool

Public health plays an enormous role in communication

REFERENCES