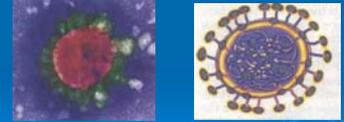


A New Era

- The most popular rapper is white
- The best golfer is black
- The tallest basketball player is Chinese
- The French call us arrogant
- The Germans don't want to go to war
- **Infectious diseases are becoming rampant again**



Severe Acute Respiratory Syndrome (SARS): Lessons Learned



Peter Katona, MD
UCLA School of Medicine



“The SARS epidemic has made clear that every serious infectious disease today is a potential issue of global importance.”

HHS Secretary Tommy Thompson

SARS: Why the fuss?

- It's new
- It's contagious
- There's no cure or vaccine
- It afflicts the healthy as well as the compromised
- It easily spreads through households, hospitals, and the community
- It devastates economies, trade, travel, even sports, religion and politics
- Provokes an ethnic panic backlash
- Is it a mutating virus that won't go away? Will it become endemic?

The Impact

- Medicine
- Commerce
- Religion
- Education
- Travel

What I'm going to talk about

- Introduction to SARS and how it has spread
- Could it have been a terrorist incident?
- Ramifications
- Local and global control measures
- Lessons learned



Why do new diseases come along?*

- Changes in human demographics and behavior
- Human susceptibility to infection
- Economic development and land use
- Changing ecosystems
- International travel and commerce
- Microbial adaptation and change
- Breakdown of public health measures
- Changes in industry practices and technology

*HSM: Molecular Threats to Health: Emergence, Detection, and Response: March 2003.

Over the past few decades >20 "new" viral infections have emerged

- Hantavirus (sin Nombre)
- HIV/AIDS
- West Nile Virus
- Ebola virus
- New influenza strains (i.e. H5N1)
- The SARS coronavirus

David Letterman's Top 10 Infection Killers*

Infection	Deaths per year worldwide
➢ Acute respiratory infection	> 4,400,000
➢ Diarrheal diseases	> 3,100,000
➢ Tuberculosis	> 3,100,000
➢ Malaria	> 2,100,000
➢ Hepatitis B	> 1,100,000
➢ HIV/AIDS	> >1,000,000
➢ Measles	> >1,000,000
➢ Neonatal tetanus	> 500,000
➢ Whooping cough	> 355,000
➢ Roundworm/hookworm	> 165,000

*1995 data

Causes of death in the US*

Heart Disease	724,859
Cancer	541,532
Stroke	158,448
Chronic Pulmonary Disease	112,584
Accidents	97,835
Pneumonia/Influenza	91,871
Diabetes	64,751
Suicide	30,575
Kidney disease	26,182
Liver Disease	25,192
Anthrax	0

*1998, National Vital Statistics Reports, Vol. 48, No. 11

A Historical Perspective: Spanish flu, 1918-1919

- Started like SARS with a manageable but largely ignored flare-up that went dormant, only to return 6 months later with a fury
- Despite a death rate of <3%, 20+ million people killed in 18 months
- Spread by our soldiers going to Europe
- Affected the old, the young and the debilitated
- More contagious than SARS

What is SARS?

- Not a cold
- Not a flu
- It's not a bacterial infection
- It's a form of atypical pneumonia like:
 - Legionnaires disease
 - Mycoplasma
 - Chlamydia



Where is SARS?



Known Facts about SARS

- It is a form of atypical pneumonia
- Less infectious than Influenza
- Incubation 2-7 days, maybe up to 12 days
- Infective period duration and asymptomatic carriage rate unknown
- Caused by a new coronavirus

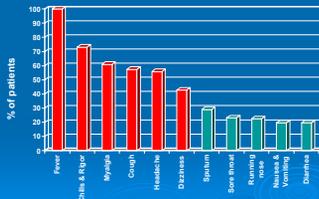
SARS Case Definition

- Respiratory illness of unknown etiology with **onset** since February 1, 2003, and the following criteria:
- Measured **temperature** greater than 100.4° F **AND**
- One or more clinical findings of **respiratory illness** (e.g. cough, shortness of breath, difficulty breathing, hypoxia, or radiographic findings of either pneumonia or acute respiratory distress syndrome) **AND**
- **Travel** within 10 days of onset of symptoms to an area with documented or suspected community transmission of SARS **OR**
- Close **contact** within 10 days of onset of symptoms with either a person with a respiratory illness who traveled to a SARS area or a person known to be a suspect SARS case.

Diagnostic definition confusion

- Asymptomatic cases
- Mild disease
- Other atypical pneumonia
- Non-uniform use of case definition
- Politics of reporting
- Recurrence rate
- What about those who haven't traveled or had contact?

Common SARS Symptoms



Reported SARS Cases*

	Total	Suspect	Probable	Deaths
➤ LA County	13	7	6	0
➤ CA	69	45	24	0
➤ USA	363	286	67	0
➤ World	7,956			666

*as of May 21, 2003

How does SARS spread?

- Droplets via close contact with an infected person > airborne virus
- Contaminated working surfaces (e.g. fomites, stainless steel, doorknobs) ~ survival up to 24 hours on surfaces
- Oral-fecal route
- Especially by super-spreaders

Paradox

- Persons sitting next to SARS cases on an airplane did not always get infected while those sitting across the aisle sometimes did (use of toilet?)
- Cases spread among HCWs in Toronto despite appropriate infection control measures (intubation incident?)

Fomite transmission

- The virus can survive for up to 24 hours on plastic surface
- Feces from a baby – 3 hrs
- Feces from an adult – 6 hrs
- Diarrhea – 4 days
- Survives longer if T<40 degrees
- Survives indefinitely at freezing (handled glassware in a frig)

Super-spreaders

- From Feb. 2 through Feb. 4, a very sick man from Zhongshan, [China](#) made the rounds of emergency rooms in Guangzhou as treatment failed to improve his condition, leaving dozens of health workers infected.
- Esther Mok, set off a chain of infection based at the Tan Tock Seng Hospital, from which over 90 people fell ill, accounting for more than half [Singapore's](#) cases. Ms. Mok has recovered, but many members of her family became ill, including her mother and father, who both died.
- On 15 Mar 2003 Flight CA-112, from which virus spread to Hong Kong, Taiwan, Beijing, and Hohhot, or the latest explosion of cases in [Taiwan](#).
- The [Toronto](#) epidemic was started by one case.

Why super-spreader?

- Genetics?
- More virulent strain?
- Co-infection with other bugs?
- Better aerosolizer?

The Cause of SARS

- Very intense work at laboratories all over the world
- Initially thought to be a Paramyxovirus (class of virus causing Measles, bronchiolitis)
- Now thought to be a **CORONAVIRUS**, a class of virus best known for causing ~30% of common colds (A KILLER COLD?)
- Laboratory tests being developed

Could SARS be a bioterror agent?

A Scenario

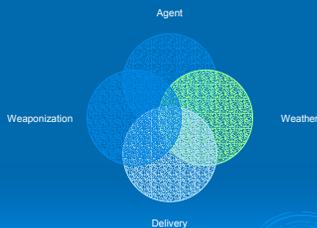
- 20 suicide bombers are intentionally infected with a contagious agent and are coughing
- 10 go to Staples Center for a basketball game – they buy food, use the toilets, they brush by thousands of people
- 10 go to LAX and mingle with people all over the American Airlines Terminal that are going to hundreds of destinations
- The terrorists then get on 10 different flights
- After an incubation period of 3-7 days, people start to get sick in LA and several other cities
- A few days later an epidemic of some kind is recognized
- A few days later a new disease syndrome is identified

What is the agent?

- SARS?
- A particularly virulent influenza strain?
- Plague or another bioterror agent?
- A new yet undiscovered contagious disease?
- Reporting artifact?

SARS: Similarities with a bioterror agent

- Contagious
- New
- Quarantine and infection control
- Int'l cooperation needed
- Fear and panic



Death Rates

- | | |
|-------------|---------|
| ➤ SARS | ➤ 4-55% |
| ➤ Pneumonia | ➤ 11% |
| ➤ Smallpox | ➤ <30% |
| ➤ Anthrax | ➤ <50% |
| ➤ AIDS | ➤ 100% |
| ➤ Influenza | ➤ <1% |

Where has the damage been done?

SARS Chronology

- In retrospect, cases started in southern China in November 2002.
- The syndrome was first recognized on February 26, 2003, in Hanoi, Vietnam, by WHO investigator Carlo Urbani, MD, who died of SARS on March 29.
- On March 15, 2003, WHO issued a global alert (Emergency Travel Advisory) of a multi-country outbreak of SARS, an atypical pneumonia of as yet unidentified etiology. CDC Emergency Operations Center was activated on March 14.
- On April 1, WHO issued a recommendation that people avoid traveling to Guangdong Province, China and Hong Kong.
- On April 16, WHO announced that a new human virus, a member of the Coronaviridae family of viruses, was the cause of SARS.

China

- Started around November 2002
- Although doctors in Guangzhou were well aware of the problem as early as January, information about an epidemic was suppressed for months, and only started dribbling out at the beginning of April, under intense international pressure.
- Fear that migrant workers would take back to hometowns – quarantine - riots

What actually happened?

- On Feb. 21, 2003, Dr. Liu Jianlun, a 64-year-old lung specialist from the Zhongshan hospital, attended his nephew's wedding in Hong Kong, even though he was running a fever.
- With what is now known about the disease, health care providers like Dr. Liu with such extensive exposure to SARS would be quarantined and forbidden to travel. But no such guidelines existed then.
- At the Metropole Hotel, where he stayed, he passed SARS on to a number of other guests, including two Canadians, an American businessman en route to Hanoi, a Hong Kong man, and three young women from Singapore.
- SARS, until then confined to the Chinese mainland, was unleashed on the world.

Epidemiological linkage



The beginning of spread

With the new corona virus silently breeding in their bodies, the nine guests at the three-star Metropole Hotel dispersed on airplanes like bees carrying a deadly pollen, seeding SARS locally and to far corners of the world

The Guangdong Infectious Disease Hospital (Guangzhou No. 8 People's Hospital) had 150 of its 400 beds occupied by SARS patients daily during the second week of February, 2003.

In China a 1,000 bed SARS hospital was constructed in 1 week in May



Jin Guohua: One man can make a difference

- Powerful official, executive of a publishing house in Jiangsu
- Accused of lying to doctors and breaking quarantine
- Traveled to Beijing in early April, refused voluntary quarantine and began a series of other trips
- Visited a military hosp 4/25 but didn't tell the physicians about his trip to Beijing
- By the time it was obvious he had SARS, he had come into close contact with 400 people in 4 cities
- Nanjing quarantined 10,000 people

Beijing

- Police, commercial and cultural officials moved to shut down
 - all movie theaters
 - billiard parlors
 - dance halls
 - discos
 - karaoke clubs
 - even chess rooms
- Internet access was cut off to Internet cafes

Where and why did SARS start in China of all places?

- Look at the origins of new flu strains
- Crowding of people
- Proximity to animals like chickens and pigs
- Poor sanitary conditions
- Minimal public health infrastructure
- Poor medical care

Why is it continuing to spread in China?

- Started by the admission in April that China actually had 10x the number of cases originally reported and firing of the Beijing mayor and the nation's health minister
- The cost of treatment is \$390/day or half a year's pay for many migrants and they have no health insurance
- There are 92 million migrant workers and these migrant workers are fleeing the cities in the rural provinces
- Guangdong province is the "world's manufacturing center"

China: What's being done about it?

- Allocation of domestic money
- Calling for outside expertise
- UN families being called out
- A greater awareness of the discrepancy of rapid economic expansion without adequate medical care support

Hong Kong

- One of the world's most efficient financial centers → global health hazard
- Schools closed
- Sporting events scrapped
- Trade fairs and exhibitions postponed
- Concerts concealed
- Oral exams concealed at HK University because they were judged impossible to conduct with both students and instructors wearing face masks

Hong Kong's Amoy Gardens cluster

- Involved residents of a single 33-floor building
- 300 cases and 15 deaths and some had no contact with one another
- Predominance of gastrointestinal symptoms (60% had diarrhea vs. 10% in other cases)
- Possible environmental sources investigated - rodents, cats, cockroaches → faulty sewage system found that aerosolized liquid or cockroaches

Singapore's Draconian Measures

- a high-tech thermal scanner picks up temperatures >100
- Masked soldiers are there to escort away those with fever into a 10-day quarantine
- Video cameras are installed in the home by a security firm, to make sure patients do not stray. Those few who do are tagged with an electronic wristband that records their movements
- A program of elaborate contact tracing was established
- The Health Department instituted a strict policy that every patient at every hospital be considered a potential SARS patient. Nurses are always masked when seeing patients, who are allowed only one visitor a day. Nurses may not work on more than one unit and patients may not transfer from hospital to hospital

Singapore (con't)

- the ministry closed all schools for two weeks to halt potential transmission of the virus.
- All cab drivers must take their temperatures twice a day.
- Temperature checks and health questionnaires are standard for those entering buildings.

A large outbreak occurred in Toronto in March 2003 originating from a single traveler who returned from Hong Kong in late February.



Toronto

Even professional baseball players were told to avoid crowds, wash their hands a lot, and use their own pens when signing autographs



Devastating Global Effects

- Rocked Asian markets
- Ruined the tourist trade of an entire region
- Nearly bankrupted airlines
- Spread panic through some of the world's largest countries

Int'l Measures

- Improve screening of travelers @ int'l departure points
- Prohibit travel by people with SARS symptoms
- Require health forms for visitors from affected areas

Religion – Catholic Church

- Singapore suspended confessions in booths and instead granted "general forgiveness" to believers
- In Ontario, worshippers are asked to refrain from kissing icons, dipping their hands in holy water, or sharing Communion wine.

There have been political firings in China and Taiwan

UC Berkeley issued a travel ban policy and then modified it

By May 1, 2003, the economic impact of SARS was ~\$30 billion.

- > N. American airline bookings to HK down 85%
- > Visitor arrivals to Singapore down 61% in first 2 weeks April
- > Feb-Mar hotel business to Asia down 25%
- > Cathay Pacific cut flights 45%
- > Costing Canada \$30 million/day
- > Retail sales in HK down 50%

Why have we in the US been spared?

- > Luck
- > Preparedness measures taken
- > More time to acquire knowledge
- > Publicity & public awareness
- > Better medical facilities
- > Good planning and timely communication between federal and local officials
- > A more open society?
- > God's will

With anthrax they were slow to mobilize, in terms of this being a national crisis.

With SARS, no time was lost in adopting that crisis-response mentality. One almost wonders, if they had that intensity and focus and central coordination, whether they might not have put the pieces together sooner during the anthrax outbreak.

Dr. Peggy Hamburg
Health official in the Clinton administration.

Risks and perspective

- > **Each year, more than 35,000 people die in the United States alone from influenza and 114,000 need to be hospitalized**
- > **76 million people develop foodborne illness, with 325,000 hospitalizations and 5,000 deaths**
- > **Concern is appropriate; panic is not!**

Lessons to be learned: the who

- > The general population – keep cool
- > Law enforcement – handling of quarantine
- > The physician and the medical office - masks, screening, accused of misdiagnosis & not reporting
- > The hospital – infection control, handling of specimens
- > The local health department - alerts
- > The Feds -homeland security, intelligence, CDC working with the locals
- > The Media – appropriate sound bites
- > Others
 - Entry points (airport, seaport, train station)
 - Think tanks
 - Universities

The patient not the visitor should be wearing the mask.

However, if the people around you are wearing masks, you might feel better.



Chance prepares the prepared mind.

Louis Pasteur

Lessons to be learned: the what

- > Quarantine
 - Too little
- > Intl issues
 - Cooperation (or lack of)
 - Spread to the 3rd world
- > Public policy with limited information
 - Asymptomatic carriage rate
 - Number of organisms it takes to cause disease
 - Fatality
 - Travel Advisories
- > Infection control and contact tracing
- > Handling panic
 - Not in my backyard – riots in China
 - Misinformation and the media
- > Coordinating resources
- > Epidemic or endemic

Key Objectives of SARS Prevention

- Early detection of infection
- Containment of infection
- Protection of personnel and the environment of care
- Hand hygiene

Infection Control Considerations

- Some patients are highly infectious
- Hospitals must protect vulnerable patients, staff, visitors, and prevent spread to the community
- Until SARS epidemiology is better understood, infection control measures must target all possible modes of transmission

What people want most from the state is protection, not freedom

Thomas Hobbs

Contact tracing

- Cases linked to contacts like family members, health care workers
- Cases not linked to people who have been to events
- Very few cases caught on airplanes
- Immunocompromised, elderly, etc. are at risk

The Psychology of Fear & Anxiety*

- The public
- The media
- The politicians
- First responders

*post-traumatic panic disorder is only the tip of the iceberg

Addressing the Threat of SARS

- Enhancing **global response capacity**
- Improving **global infectious disease surveillance**
- Rebuilding **domestic public health capacity**
- Developing vaccines, **diagnostics and therapeutics**
- **Educating and training** multidisciplinary workforce
- A **law enforcement plan**

ICM: Microbial Threats to Health: Emergency, Detection, and Response, March 2003

SARS: *What we need to know*

- Future course of outbreak
- Source of virus
- Mode of transmission in community, households, on airplanes and ships
- Environmental persistence/decontamination
- Period of infectiousness
- Explanation for age distribution
- Importance of super-spreaders
- Role of co-infection

Perhaps the most lasting lessons of anthrax attacks are the importance of a clear news media message and public trust in health officials -- ingredients experts say are essential if people are to follow orders that help curb the spread of disease.

NY Times
May 2, 2003

Why are only ~50% of reportable diseases actually reported?

- Hard to keep track of reportable diseases
- Reporting systems are awkward
- Doctors don't trust that the reports are received and acted upon
- Laziness, other commitments and the belief that someone else like the lab will do the reporting
- Fear of retribution in China

Public Confidence*

- 83 percent of Americans know SARS is a disease that requires quarantine to keep from spreading
- 94 percent would agree to be isolated for two or three weeks if they had SARS
- 62 percent believed, incorrectly, that SARS could be contracted from a blood transfusion.

*a poll released by Harvard University as reported in the NY Times 5/2/03

I'll leave you with two last thoughts:

“It is not just the Health Ministry that should be studying SARS...After all, the way that viruses like SARS spread can tell us how to spark an epidemic of ideas.”

Chua Mui Hoong
Let Ideas Spread – the SARS Way
The Straits Times (Singapore)
April 5, 2003

Factors that govern epidemics* also govern the spread of ideas

- The stickiness or noteworthy factor, and the medium used to spread the message must both be memorable
- The role of super-infectors with wide networks and charisma
- The power of context which determines how fast a virus (or idea) spreads from a small group into the larger population

*The Tipping Point: How Little Things Can Make A Big Difference
By former Washington Post science reporter Malcolm Gladwell

The Last Lesson

and possibly most important of all, SARS might shed added light on the fact that regimes that hide information from their own people as well as the world community are ultimately doomed to destroy themselves!



~ The End ~