Emerging and Reemerging Infectious Diseases

NOVEMBER 29 - DECEMBER 4, 2019

John A. Molinari
Welcome to the Greater New York Dental Meeting

Greater New York Dental Meeting™ Executive Headquarters
200 West 41st Street, Ste. 1101, New York, NY 10036
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E-mail: victoria@gnydm.com
www.gnydm.com
Sponsored by New York County & Second District Dental Societies

All programs and exhibits are held at the Jacob K. Javits Convention Center (unless otherwise indicated)
11th Avenue between 34th and 39th Street, New York City

General Registration Hours
Friday, November 29          12:00 Noon - 4:30 P.M.
Saturday, November 30         8:00 A.M. - 4:30 P.M.
Sunday, December 1 - Tuesday, December 3 8:00 A.M. - 5:30 P.M.
Wednesday, December 4        8:00 A.M. - 4:30 P.M.

Exhibit Hall Hours
Sunday, December 1 - Tuesday, December 3 9:30 A.M. - 5:30 P.M.
Wednesday, December 4       9:30 A.M. - 5:00 P.M.

COURSE REGISTRATION
Pre-registration is required for all continuing education courses with the exception of the “Live” Dentistry and Affiliated Groups. Your seat will be held for 15 minutes after the start of the course; after that, those without tickets will be seated according to space availability. When the room is filled, no additional people will be admitted due to fire department regulations. If you have not pre-registered, please be prepared to select an alternate session to attend.

Tickets
Tickets are required for all courses excluding Live Dentistry. Tickets for all functions can be purchased at all general registration booths located in the Registration Area on the Upper Level in the Crystal Palace and online.

6 Days of Education Seminars, Hands-on Workshops & Essays
Friday - Wednesday

4 Days of Exhibits
Sunday - Wednesday

FREE “Live” Dentistry
Hi-Tech 450 Seat Arena

SUNDAY
9:45 - 11:45
VOCO America, Inc.
Drs. Ron Kaminer &
Marc Geissberger
Restorative

9:45 - 11:45
Shofu
Drs. Ron Kaminer
Restorative

MONDAY
1:30 - 2:45
First Fit
Drs. Frederick E. Solomon
Cyrus Tahmasebi
Digital

1:30 - 2:45
Align I Invisalign I Itero
Drs. Karla Soto &
Christian Coachman
Restorative

TUESDAY
9:45 - 12:00
Millennium
Drs. Sunil D. Thanik
Laser

9:45 - 12:00
Apa / CareCredit
Drs. Michael Apa
Aesthetic

9:45 - 2:45
3Shape
Dr. Sundeep Rawal
Digital

3:30 - 5:15
Shofu
Drs. Ron Kaminer
Restorative

3:30 - 5:15
First Fit
Drs. Frederick E. Solomon
Cyrus Tahmasebi
Digital

3:30 - 5:15
Align I Invisalign I Itero
Drs. Karla Soto &
Christian Coachman
Restorative

2:00 - 4:15
Glidewell
Dr. Justin Chi
Digital

WEDNESDAY
2:00 - 4:15
Benco / Vatech
Dr. Aeklayya Panjali
Implant

3D Printing & Digital Dentistry Conference
Dental Laboratory Technicians Programs
Sleep Apnea Symposium
Oral Cancer Symposium

Celebrity Luncheon Speaker
John Quiñones
Monday, December 2nd
12:00 - 2:00 - Ticket 4010
$125.00

5th Annual Global Orthodontic Conference

3rd Annual Pediatric Dentistry Summit

12th Annual INVISALIGN® - GNYDM EXPO
4 Days of Programming: Sunday - Wednesday
Botox and Facial Fillers Seminar & Workshop
Over 1,700 Exhibit Booths

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$595.00
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$895.00
entitles a dentist and their entire staff to take unlimited* seminars and essays

*Excludes Workshops, Botox & Fillers, Sleep Symposium and Invisalign
Emerging and Re-emerging Infectious Diseases: A Microbiology Perspective
John A. Molinari, Ph.D.
Professor Emeritus
University of Detroit Mercy
December 2, 2019

How Perceptions & Reality Have Changed

Advances during early to mid-20th Century, led to increased optimism and “learned” statements:
- 1962: “….. the virtual elimination of infectious disease ….”
  Sir MacFarland Burnet (Nobel Laureate)
- 1967: “…. time to close the book on infectious diseases, declare the war on pestilence won, and shift national resources to such chronic problems as cancer & heart disease.”
  Dr. William Stuart (US Surgeon General)

When In Fact: Infectious Disease Emergence Factors

Human demographics and behavior
International travel and commerce
Technology and industry
Human susceptibility to infection
War and famine
Poverty and social inequality

Microbial adaptation and change
Antibiotic resistance
Microbiomes

Emergence
Breakdown in public health measures
Vaccinations

Ecological factors
Zoonotic diseases
Economic development/land use
Climate and weather

Recent EID Threats: “and The Beat Goes On”
- Pandemic Influenza – 2009 H1N1
- Waterborne disease outbreaks – community & health care
- Norovirus
- MDR, XDR tuberculosis
- Community-acquired MRSA / “Epidemic” C. difficile
- Measles
- Pertussis (“Whooping Cough”)
- SARS
- West Nile Virus
- Ebola
- Dengue
- Zika
- Multi-drug resistant Escherichia coli and Candida auris

Viral Hepatitis Overview + CDC Hepatitis Table

Hepatitis A (HAV) – vaccine since 1995
  - # reported hepatitis A cases declined by 90.8%; 13,397 (2000) to 1,239 (2014); more unreported U.S. cases each year
  - 10,000,000 new cases reported globally every year
  - recent outbreaks and deaths reported

Hepatitis B (HBV) – vaccine since 1982
  - est. 80,000 new infections each year; 2,953 reported cases (2014)
  - ~850,000 – 2.2 million people c chronic HBV infection in U.S.
  - 1,000 deaths a year in U. S. from HBV-related liver cancer
  - recent outbreaks and deaths reported

Hepatitis C (HCV) – no vaccine
  - est. > 30,000 new U.S. cases each year
  - 2.7 - 3.9 million people in the US chronically infected
  - 9,000 deaths a year in U. S. from HCV-related liver cancer

- CDC has assisted in multiple HAV outbreaks since July 1, 2016
  - Foodborne Transmission
    - Hawaii-Frozen Strawberries
    - Multistate- Frozen Strawberries
  - Person-to-Person Transmission
    - Homeless individuals and injection/non-injection drug users
    - Men who have sex with men (MSM)
  - >8,000 outbreak-associated cases reported since July 1, 2016

Hepatitis A Outbreaks Spread Across the United States
Tainted Strawberries Spread Hepatitis A
Hepatitis A outbreaks in multiple states among people who use drugs and/or people who are homeless

(CDC, as of 11/28/2018)

<table>
<thead>
<tr>
<th>State</th>
<th>Cases</th>
<th>Hospitalizations</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI</td>
<td>907</td>
<td>728 (80.3%)</td>
<td>28 (3.1%)</td>
</tr>
<tr>
<td>CA</td>
<td>704</td>
<td>461</td>
<td>21</td>
</tr>
<tr>
<td>KY</td>
<td>2,865</td>
<td>1,476</td>
<td>18</td>
</tr>
<tr>
<td>WV</td>
<td>1963</td>
<td>1,010</td>
<td>5</td>
</tr>
</tbody>
</table>

HBV Infections among HCP:
- 1983: 17,000 est. cases
- 2012: 139 est. cases

Belltrami (2000)/CDC (2014)

- Dramatic decline since mid-1990's
- BUT diagnoses increasing
- New cases tripled since 2010 (major problem in non-urban areas)
- HCV - high genetic diversity (55-85% carrier rate)
- Est. 2.7–3.9 million chronic HCV (mean death age = 59 yrs)
- Effective antiviral tx (2014)
- Baby boomers & HCV risks – 13.9% screened as of 2016 (AJIC, 2018)
- More screening efforts needed for certain groups

Hepatitis C in U.S.

2017: est. 42,000 new cases

- Dramatic decline since mid-1990’s
- BUT diagnoses increasing
- New cases tripled since 2010 (major problem in non-urban areas)
- HCV – high genetic diversity (55-85% carrier rate)
- Est. 2.7–3.9 million chronic HCV (mean death age = 59 yrs)
- Effective antiviral tx (2014)
- Baby boomers & HCV risks – 13.9% screened as of 2016 (AJIC, 2018)
- More screening efforts needed for certain groups
Influenza A Virus Subtypes
Aquatic birds: reservoir for all HA and NA subtypes:
• H1 - H16
• N1 - N9

Aquatic birds
Dogs
Humans
Pigs
Horses
Poultry
Cats

Influenza Virus Nomenclature
3 Influenza Virus Types:
A: epidemics & pandemics
B: epidemics only
C: rare in humans

What is an epidemic?
The occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time.

What is a pandemic?
An epidemic occurring over a very wide area (several countries or continents) and usually affecting a large proportion of the population.
Examples:
-- Black Plague
-- Cholera
-- AIDS
-- Pandemic Influenza

Seasonal Influenza: U.S. Public Health Impact
Consequences of annual epidemics (from antigenic drift):
• 5-20% of community with illness
• Significant morbidity and mortality; children highest incidence
• Est. 3,300-49,000 influenza-related deaths
  - U.S. each year (avg ~ 24,000 deaths)
  - ≥90% of deaths in those ≥65 years.
  - Est. >200,000 influenza-associated hospitalizations/year
    • 60% of hospitalizations persons ≥65 years
• Significant economic toll ($87.1 billion in U.S.)
• CDC (2/3/2018): 16 more children dead from flu; peak still to come.
  - H3N2 major strain – historically known to cause more complications, hospitalizations & deaths

Influenza Virus Transmission
- Person-to-person: respiratory droplets, coughs / sneezes
- Droplets propelled up to 3 ft; settle in noses or mouths of nearby susceptible people.
- Occasional: direct contact with person-contaminated object before washing hands.
- Viral replication in respiratory epithelium; subsequent destruction of cells.
- Viremia rare; shedding in respiratory secretions: 5-10 days.
**Influenza Clinical Features & Viral Shedding**

- **Incubation period** 2 days (range 1 - 4 days)

- **Adults infectious 1 day before symptoms thru 5 days after onset of illness** (children up to 10 days).
  - severely compromised pts can shed virus wks - months.

- Illness severity depends on prior experience c related virus variants (possible cross-reacting Ab).

- Abrupt onset of constitutional & respiratory symptoms: fever, myalgia, sore throat, malaise, nonproductive cough, headache.

- Usually resolves in days – confused with bad cold (?)

**Peak Months of Flu Activity**

1982-1983 through 2015-2017 activity can last as late as May:

**Influenza Vaccine**

- **Strain-specific**: current year strains (“antigenic drift”)

- **High-dose vaccine** for elderly

- **Recent vaccine advance** for people c egg allergy (Flublok)

- **Goal**: reduce influenza complications and mortality variable Ab response year to year

- **Prevents death in 80% vaccinated, compromised pts**

- **Contraindications (?)**
  - Pregnancy (1st trimester)
  - Allergy to eggs (?) or thimerosal (only in multi-dose vials)

**Note**: Do not get flu from vaccine!!

**2017-2018 Influenza Vaccines**

- A/Michigan/45/2015 (H1N1) pdm09-like virus
- A/Hong Kong/4801/2014 (H3N2)-like virus, and
- B/Brisbane/60/2008-like virus (Victoria lineage)

- Quadrivalent influenza vaccines will contain these 3 viruses and an additional influenza B vaccine virus - B/Phuket/3073/2013-like virus (Yamagata lineage)

**Note:**
- **FluMist Quadrivalent not to be used during the 2017–18 season** concerns about effectiveness against influenza A(H1N1) viruses during 2013–14 and 2015–16 influenza seasons

CDC. MMWR (8/25/2017)

**2019-2020 WHO/CDC Flu Vaccine Recommendations**

- A/Brisbane/02/2018 (H1N1)pdm09-like virus;
- A/Kansas/14/2017 (H3N2)-like virus; *
- B/Colorado/06/2017-like virus (B/Victoria/2/87 lineage); and
- B/Phuket/3073/2013-like virus (B/Yamagata/16/88 lineage).

**✓ Flu-Mist available**

(2/27/2019)

Do Not Get Flu From Vaccine

**Available Flu Vaccines**

<table>
<thead>
<tr>
<th>Name</th>
<th>Manufacturer</th>
<th>Age Range</th>
<th># of Strains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afluria</td>
<td>bioCSL</td>
<td>9 years and older*</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluarix Quadrivalent</td>
<td>GSK</td>
<td>3 years and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluvirax</td>
<td>Novartis</td>
<td>18 years and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluviral Quadrivalent</td>
<td>GSK</td>
<td>3 years and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>FluMist Quadrivalent</td>
<td>Medimmune</td>
<td>2–49 years</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluogrip</td>
<td>Novartis</td>
<td>4 years and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluone</td>
<td>Sanofi Pasteur</td>
<td>6 months and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluone Quadrivalent</td>
<td>Sanofi Pasteur</td>
<td>6 months and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluone High-Dose</td>
<td>Sanofi Pasteur</td>
<td>65 years and older</td>
<td>Quadrivalent</td>
</tr>
<tr>
<td>Fluone Intradermal</td>
<td>Sanofi Pasteur</td>
<td>18–64 years</td>
<td>Quadrivalent</td>
</tr>
</tbody>
</table>

*FluMist is licensed for ages 5 and older, but ACIP recommends that it not be used in children 1 through 4 years of age because of increased reports of febrile reactions in this age group. See “Safety,” below.
Is It a Cold or the Flu?

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Cold</th>
<th>Flu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>rare in adults and older children, but can be as high as 102°F in infants and small children</td>
<td>usually 102°F, but can go up to 104°F and usually lasts 3 to 4 days</td>
</tr>
<tr>
<td>Headache</td>
<td>rare</td>
<td>sudden onset and can be severe</td>
</tr>
<tr>
<td>Muscle aches</td>
<td>mild</td>
<td>usual, and often severe</td>
</tr>
<tr>
<td>Tiredness and Weakness</td>
<td>mild</td>
<td>often extreme, and can last two or more weeks</td>
</tr>
<tr>
<td>Extreme exhaustion</td>
<td>never</td>
<td>sudden onset and can be severe</td>
</tr>
<tr>
<td>Runny nose</td>
<td>often</td>
<td>sometimes</td>
</tr>
<tr>
<td>Sneezing</td>
<td>often</td>
<td>sometimes</td>
</tr>
<tr>
<td>Sore throat</td>
<td>often</td>
<td>sometimes</td>
</tr>
<tr>
<td>Cough</td>
<td>mild hacking cough</td>
<td>usual, and can become severe</td>
</tr>
</tbody>
</table>

Global Alert: Is H5N1 Avian Flu The Next Spanish Influenza Pandemic?

Similarities:
- Both originated in birds.
- Both crossed species barrier almost intact
- Almost no one on Earth has immunity.
- Very lethal.
- Both can kill hosts quickly & directly:
  - attack deep c/in lungs, destroying tissue & inciting a massive inflammatory immune response
  - healthy tissues die & blood vessels leak, filling the lungs with fluid (chemotaxis --- acute inflammation)
- Potential for large # of deaths in healthy, young adults

Status Of Pandemic Avian Influenza?

- World public health agencies on alert watching influenza type A H5N1 virus.
- No current pandemic human influenza virus.
- Also watching for other influenza type A viruses to mutate & become threat to human health.
- WHO at Pandemic Alert Phase 3: “Human infection(s) with a new subtype, but no human-to-human spread, or at most rare instances of spread to close contact.”

How Quickly Could A Pandemic Spread?

Generation of pandemic influenza virus

Quail: most avian viruses replicate with reassortment between viral genetic materials

Chickens & other poultry: intermediary for transmission of avian viruses to humans

Pigs: can be infected by both avian & human influenza viruses

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How Quickly Could A Pandemic Spread?
Global Tuberculosis Incidence (2017)

- 2 billion Mtb – infected (1/4 world pop)
  - 30-60% of adults in developing countries
  - many do not develop active, symptomatic TB
- ~10 million TB cases in 2017
  - >1.3 million deaths (98% in developing areas)
- leading killer in HIV-infected people
- 1 symptomatic person infects 10-15 persons / year
- 2017: est. 330,000 new cases of multidrug-resistant TB (MDR-TB) + 100,000 people with rifampicin-resistant TB (RR-TB)

WHO (2018)

Reported TB Cases/100,000 Population (United States, 1993-2017)

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
<th>Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>84,303</td>
<td>52.6</td>
</tr>
<tr>
<td>1960</td>
<td>55,494</td>
<td>30.7</td>
</tr>
<tr>
<td>1988</td>
<td>22,436</td>
<td>9.2</td>
</tr>
<tr>
<td>1992</td>
<td>15,945</td>
<td>5.6</td>
</tr>
<tr>
<td>2001</td>
<td>14,838</td>
<td>5.1</td>
</tr>
<tr>
<td>2003</td>
<td>13,299</td>
<td>4.4</td>
</tr>
<tr>
<td>2007</td>
<td>11,540</td>
<td>3.8</td>
</tr>
<tr>
<td>2010</td>
<td>10,521</td>
<td>3.4</td>
</tr>
<tr>
<td>2011</td>
<td>9,488</td>
<td>3.0</td>
</tr>
<tr>
<td>2012</td>
<td>9,957</td>
<td>3.0</td>
</tr>
<tr>
<td>2013</td>
<td>9,372</td>
<td>2.9</td>
</tr>
<tr>
<td>2014</td>
<td>9,694</td>
<td>2.8</td>
</tr>
<tr>
<td>2015</td>
<td>9,029</td>
<td>2.8</td>
</tr>
</tbody>
</table>

CDC (2019)

Rate of TB Cases by State/Area (U.S. 2017)

California, Florida, New York, Texas
~50% US TB cases
(Same for 2018)

Mycobacterium tuberculosis (Mtb)

- not a highly contagious bacterium
- requires prolonged & close contact

Transmission Routes:
1. Respiratory: microdroplet inhalation; bypass mucociliary defenses & replicate.
2. Ingestion: contaminated liquids; prevented by pasteurization aimed at Mtb destruction.
3. Direct inoculation: lab accidents.

JAM

Airborne Mtb Transmission & Infection
Probability that TB will be transmitted depends on:
- Infectiousness of person with TB disease
- Environment in which exposure occurred
- Length of exposure
- Virulence of the tubercle bacilli

Pathogenesis
After recent Mtb infection
- 90% latent TB
  - No symptoms
  - Do not feel sick
  - Can’t spread infection to others
  - Usually PPD+ skin rx
  - Can develop active TB c/o tx for latent infection
- 5% develop active disease in 1-2 years
- 5% develop active disease much later

Mtb Transmission

TB Skin Test with PPD (48 hrs)
REMEMBER:
Infection with Mtb is NOT Synonymous with Active Tuberculosis

Interferon-Gamma Release Assays (IGRAs)
- Aid in diagnosing Mtb infection
- Do not help differentiate (LTBI) from Mtb disease
- Interpretations based on IFN-g amount released or on # cells releasing IFN-g
- Two FDA-approved tests:
  - QuantiFERON®-TB Gold In-Tube test (QFT-GIT);
  - T-SPOT®.TB test (T-Spot)

Advantages:
- Requires single patient visit to conduct the test.
- Results can be available c/in 24 hours.
- Does not boost responses measured by subsequent tests.
- No false-positive IGRA c prior BCG (bacille Calmette-Guérin) vaccination (CDC 8/2015)

Disadvantages & Limitations:
- Blood samples must be processed c/in 8-30 hours after collection
- Errors in collecting/transporting blood specimens/running /interpreting assay
- Limited data on use of IGRAs to predict progress to TB disease in future.
- Limited data on the use of IGRAs for:
  - Children younger than 5 years of age;
  - Persons recently exposed to M. tuberculosis;
  - Immunocompromised persons;
  - Serial testing.
- Tests may be expensive.

LTBI vs. TB Disease

<table>
<thead>
<tr>
<th>Latent TB Infection (LTBI)</th>
<th>TB Disease (in the lungs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive, contained tubercle bacilli in the body</td>
<td>Active, multiplying tubercle bacilli in the body</td>
</tr>
<tr>
<td>TST or blood test results usually positive</td>
<td>TST or blood test results usually positive</td>
</tr>
<tr>
<td>Chest x-ray usually normal</td>
<td>Chest x-ray usually abnormal</td>
</tr>
<tr>
<td>Sputum smears and cultures negative</td>
<td>Sputum smears and cultures may be positive</td>
</tr>
<tr>
<td>No symptoms</td>
<td>Symptoms such as cough, fever, weight loss</td>
</tr>
<tr>
<td>Not infectious</td>
<td>Often infectious before treatment</td>
</tr>
<tr>
<td>Not a case of TB</td>
<td>A case of TB</td>
</tr>
</tbody>
</table>

CDC (8/2015)
Tuberculosis: Infection vs. Active Disease

Progressive Primary TB

Symptomatic TB

Asymptomatic Infection

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Tuberculosis Symptoms

- Chronic cough — (lasting 3 weeks or longer)
- Chest pain
- Coughing up blood or bloody sputum (phlegm from deep inside lung tissues)
- Fever
- Chills
- Malaise or weakness
- No appetite
- Unexpected weight loss
- Night sweats

Remember: PPD+ skin test in absence of symptoms is not active TB in most cases

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Tuberculosis Treatment

- For newly dx cases:
  - start 4 drugs in combination to prevent resistance - Isoniazid (INH) Rifabutin Rifampin (RIF) Streptomycin Ethambutol Pyrazinamide
- Prolonged therapy -- 6 months minimum
  - pt can feel better in few weeks & not be infectious to others (MD to determine)
  - slow bacterial growth rate (need to kill all bacteria)
  - increasing problems with drug resistance

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TB Infectiousness After TX

- Patients can be considered non-infectious when they meet all of the following criteria:
  -- Received adequate tx for 2 weeks or longer
  -- Symptoms have improved
  -- 3 consecutive negative sputum smears from sputum collected in 8-24 hour intervals (at least 1 early morning specimen)

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The Urgent Threat of TB Drug Resistance

Can occur when drugs are misused or mismanaged:

1. non-compliance c full course of treatment
2. HCP prescribe wrong tx, wrong dose, or wrong length of time for taking drugs
3. drugs not always available
4. drugs of poor quality

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The best way to stop transmission is to:
- Isolate infectious persons
- Provide effective treatment to infectious persons as soon as possible
- Respiratory protection when providing health care.

RDH with pulmonary TB.
- Likely transmitted Mtb infection to another RDH in the practice.
- Practical implications: “All dental practices should implement administrative procedures for TB identification & control as described, even if none of their patients are known to have TB.”

June 30, 2015: OSHA updates TB inspection procedures in HC settings

Mtb and Dentistry

CDC & ADA TB Recommendations
1. Dental offices perform an annual risk assessment.
2. Risk assessment involves:
   - Risk Classification—identifying number of cases of active tuberculosis (TB) encountered.
     - Low-risk setting - fewer than 3 pts c active TB seen each yr.
     - Medium-risk setting - 3 or more pts c active TB in past year.
     - Office where evidence of a transmission of TB c/in past year or one of the staff has a confirmed diagnosis of active TB is temporarily classified as potential ongoing transmission.
3. Community Awareness—being aware of the TB risk level in the surrounding community.

Recent IC Updates

CDC Updated TB Recommendations (5/16/2019)

- 2005 Recommendations
  - Screening: Recommended for all health care personnel preplacement & annually.
  - Post-exposure testing: Recommended for all health care personnel when exposure is recognized.
  - Treatment of positive TB test: Referral to determine whether latent TB infection (LTI) treatment is indicated.

- 2019 Recommendations
  - Screening: Individual baseline TB risk assessment added.
  - Post-exposure testing: Annual TB screening no longer routinely recommended for intact health care personnel unless occupational risk or ongoing exposure.
  - Treatment of positive TB test: Treatment is encouraged for all health care personnel with untreated LTI.

Global Impact of Pertussis & Resurgence of a Vaccine-Preventable Disease
- “Whooping cough” caused by Bordetella pertussis
- 2014: 140,000 reported cases, c estimates # much higher
- 89,000 est. deaths
- high burden of disease in developing countries
- among leading causes of vaccine-preventable deaths.
- case-fatality rates in developing countries 4% in infants?
- high immunization coverage with effective vaccine is mainstay of prevention
- 85% global DTP3 vaccine coverage WHO 2015

Reported NNDSS pertussis cases: 1922-2017

Number of cases

- Ages Distribution

Pertussis Epidemiology

- Reservoir: Human
- Transmission: Respiratory droplets
- Communicability: Maximum in catarrhal stage, Secondary attack rate up to 80%

- Incubation period usually 7–10 days (range 4–21 days)
- Insidious onset, similar to minor URI e non-specific cough
- Minimal fever throughout course of illness
- Coughing fits can last for up to 10 weeks or more
- Institutional outbreaks common – in schools as vaccine immunity fades

Pertussis Stages

- Stage 1: Catarrhal Stage
  - Lasts 1 to 2 weeks
  - Symptoms: runny nose, low-grade fevers, mild cough
  - Highly contagious

- Stage 2: Paroxysmal Stage
  - Lasts 4–6 weeks
  - Symptoms: fits of non-productive cough

- Stage 3: Convalescent Stage
  - Lasts about 2–3 weeks
  - Insidious onset, similar to minor URI e non-specific cough

Adults and Pertussis – HCW Tips

- Neither acquisition of the disease nor vaccination provides complete or lifelong immunity
- 1 attack usually provides immunity for many years, but immunity wanes with time
- Attack rate over 50% reported when post-immunization interval is > 12 years
- Adult disease often milder than in infants / children
- Infection may be asymptomatic, or as classic pertussis
- Older persons often source of infection for children

Pertussis Vaccines

<table>
<thead>
<tr>
<th>Pertussis-Containing Vaccines for Children</th>
<th>Brand</th>
<th>Licensed Date and Used For</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP</td>
<td>INVANCIB, DAPTACEL,</td>
<td>First licensed in 1991; used for all childhood doses</td>
</tr>
<tr>
<td>DTaP+Hb</td>
<td>Twinrix</td>
<td>Used for the fourth dose only</td>
</tr>
<tr>
<td>DTaP+IPV+Hib</td>
<td>PEDARIB</td>
<td>Used for the first three doses</td>
</tr>
<tr>
<td>DTaP+IPV+Hib</td>
<td>PENTACEL</td>
<td>Approved in 2008, used for primary four-dose series</td>
</tr>
<tr>
<td>DTaP+IPV</td>
<td>KINEL</td>
<td>Approved in 2008, used for booster dose at 4-6 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pertussis-Containing Vaccines for Adolescents and Adults</th>
<th>Brand</th>
<th>Licensed Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tdap</td>
<td>ACAMEL, BOOSTRIX</td>
<td>First available in 2005</td>
</tr>
</tbody>
</table>

Pertussis Vaccines

<table>
<thead>
<tr>
<th>Other Vaccines</th>
<th>Brand</th>
<th>Licensed Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pertussin Only</td>
<td>Not available in the U.S.</td>
<td></td>
</tr>
<tr>
<td>DTaP+</td>
<td>INVANCIB,</td>
<td>Do not contain pertussis; DT used for primary series when pertussis vaccination was not desired. Td used in persons aged ≥7 years</td>
</tr>
</tbody>
</table>

Legionella & Non-tuberculous Mycobacterium Water Quality Concerns

Legionnaires’ Disease in VA Hospital:
Source was Shower Heads

P. aeruginosa Infections due to Hospital Water Sources

Dental Respiratory Infection Risks from DUWL?

Legionnaires’ Disease: Deaths
Mycobacteria chimaera Infections Associated with Heater-Cooler Unit Use During Cardiopulmonary Bypass Surgery — Los Angeles County, 2012–2016

87 cases, 10 fatal, of Legionella bacteria found in Flint area; connection to water crisis unclear

Status of Dental Water?
Legionnaires’ Disease (2000-2017)

2017: > 7,500 reported cases
est. 25,000 undiagnosed cases

Factors: older U.S. population, more at-risk people, aging plumbing infrastructure, climate; also result of increased use of dx testing or better reporting.

LEGIONELLA HISTORY

1947: 1st isolation of L. pneumophila (from blood)
1975: 1st documented outbreak (Pontiac Fever)
1976: Legionnaires’ disease, Philadelphia - 221 cases, 34 deaths
2003: CDC DUWL IC recommendations
2012: 1st case Legionnaires’ disease from DUWL
2013: 58 dx cases Milwaukee County (6/1/13–9/30/13)
2014–ongoing outbreak in Flint, MI
2015: NYC disease outbreak; >100 cases, 10 deaths
2016: Updated CDC IC Guidelines for Dentistry
2019: Legionnaires’ outbreak in New Hampshire

Reports of Infectious Agent Spread in Dental Settings (2001-2016)

Setting Year Pathogen # Inf. Comments
OMS Practice 2001 HBV 1 Pt-to-Pt
Dental clinic in school gym 2009 HBV 5 5 cases: 3 pt/2 volunteers; multiple IC breaches identified
OMS Practice 2013 HCV 1 Pt-to-Pt; multiple breaches identified including injection safety
General Dental 2010 M. tuberculosis 1 DHC-to-DHC; Misdiagnosis of TB disease
General Dental 2011 L. pneumophila 1 82 yr old woman; DUWL; unknown if waterlines were treated
Pediatric Dental Clinic 2015 M. abscessus 20+ ? Children; potentially linked to untreated DUWL
Pediatric Dental Clinic 2016 M. abscessus/chelonae group 72+ ? Children; ongoing investigation; treated water for DUWL kept in holding tank before put in bottles (?)

Cleveland. OSAP (2015); Junger. OSAP (2016); Zahn. OSAP (2017); JAM (2017)

Percentage Outbreaks & Legionnaires’ Disease Cases (by environmental source) — North America, 2000–2014

4% of reported cases outbreak-associated

Health Facility Reservoirs as Potential Sources of Waterborne Infections

- Potable & hospital water systems
- Showers
- Sinks
- Faucet aerators
- Nebulizers
- Ice and ice machines
- Eyewash stations
- Dialysis water
- Hydrotherapy tubs
- Endoscopes

hospitals outbreaks predominantly linked to water sources
Eyewash Stations

Health Effects from Contaminated Water in Eyewash Stations

Eyewash stations used in workplaces must be maintained to prevent injury and illness to workers. This infographic provides updated information on eyewash station hazards.

- Improper maintenance contain MO’s
- Activated weekly (15 mins)
- Reduce microbial contamination
- Follow manufacturer’s IFUs

HC Electronic Faucets & Contamination

- Frequently contaminated compared to handle-operated faucets (Ps. aeruginosa & Legionella sp. common)
- Low water flow
- Favorable growth conditions (35 C; plumbing materials)
- Waterline materials (rubber, plastic, PVC)
- Difficult to decontaminate (hyperchlorination)
- Reduced line flushing
  - no hosp. guidelines for water quality

Key HC Waterborne Infection Issues

- All water, except for sterile water & filtered water, is contaminated with microbes (eg, potable water, tap water, showers, ice)
- Healthy persons - only rare infections from ingestion/contact
- Immune compromised persons - greater risk
- Many HC-associated infections linked to contaminated potable/tap water & hospital water systems
  - especially among immunocompromised & severely ill pts
- Common pathogens: gram-negative bacilli (eg, Pseudomonas, Stenotrophomonas, Legionella) & NTM
- What is “safe” microbial level in HC water supplies/systems?


L. pneumophila: Sources & Transmission

- natural, freshwater environments
- health care concern for man-made water systems
- most dx disease -- L. pneumophila serogroup 1.
- transmission:
  1. inhalation (aerosols)
  2. less common: micro-aspiration of Lp-contaminated drinking water
- usually NOT transmitted person-to-person
- most exposed people do not become ill

JAM

Legionella & Legionellosis

Infection:
- inhalation of contaminated aerosols; possible aspiration
- Pontiac Fever & Legionnaires’ Disease
- LD: ~1-5% hospitalized pts with community-acquired pneumonia
  - incidence/dx U.S. outbreaks increasing (?)
- Dx: urine Ag-testing
- LD tx: azithromycin & levofloxacin most effective
- Prevention: proper water environmental design & maintenance

JAM

Lp Life Cycle

- Lp able to multiply within phagolysosome.
- Macrophage lyses releasing many Lp
- Survival but no replication within PMNs
- Kills cells; causes tissue damage & inflammation
Epidemiologic Risk Factors for Legionellosis

- Recent travel with an overnight stay outside of the home
- Exposure to whirlpool spas
- Recent repairs or maintenance work on domestic plumbing
- Renal or hepatic failure
- Diabetes
- Systemic malignancy
- Smoking
- Immune system disorders
- Age

Legionellosis: 2 Forms

<table>
<thead>
<tr>
<th></th>
<th>Legionnaires’ disease</th>
<th>Pontiac fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical features</td>
<td>Pneumonia, cough, fever</td>
<td>Flu-like illness (fever, chills, malaise) without pneumonia</td>
</tr>
<tr>
<td>Radiographic pneumonia</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Incubation period</td>
<td>2-14 days after exposure</td>
<td>24-72 hours after exposure</td>
</tr>
<tr>
<td>Etiologic agent</td>
<td>Legionella species</td>
<td>Legionella species</td>
</tr>
<tr>
<td>Attack rate</td>
<td>&lt; 5%</td>
<td>&gt; 90% develop symptoms</td>
</tr>
<tr>
<td>Isolation of organism</td>
<td>Possible</td>
<td>Never</td>
</tr>
<tr>
<td>Outcome</td>
<td>Hospitalization common</td>
<td>Hospitalization uncommon</td>
</tr>
<tr>
<td></td>
<td>Case-fatality rate: 5-30%</td>
<td>Case-fatality rate: 0%</td>
</tr>
<tr>
<td></td>
<td>Most cases never diagnosed</td>
<td></td>
</tr>
</tbody>
</table>

Treatment

- Macrolides;
- Fluoroquinolones
- No antibiotic therapy

Staphylococcus aureus

- highly adaptable - most successful parasite
- relatively resistant to drying on contaminated fomites & chemical antimicrobials
- common in normal flora - skin, oropharynx, GI, GU
- pyogenic & toxin-mediated diseases
- among most common causes of nosocomial & community - acquired infections worldwide.
  #1 surgical wound infections.
  #2 nosocomial blood infections.

Staphylococcal Infection

- classical infection - acute, localized pyoderma
- predominant tissue manifestation - suppuration
- increasing severity of pyodermas:
  - Folliculitis - "pus pimple"
  - Furuncle - multiple hair follicles involved
  - Caruncle (boil) - deeper, more extensive
  - Bullous impetigo - highly contagious
- tissue areas of friction and chronic irritation most susceptible to staph pyodermas

Staphylococcal Pyoderma: Furuncle

- extension of infection process involving multiple hair follicles
- often bacterial spread from initial folliculitis
- tx: moist heat; no antibiotics
Staphylococcal Pyoderma: Carbuncle (“boil”)
- deep seated infection of several follicles into non-elastic subcutaneous tissues
- predilection for face, neck, axillae, buttocks -- very painful
- drainage + antibiotics

S. aureus Nasal Colonization
- Persistent carriers -- ~20% healthy people
  - higher S. aureus loads & higher staph infection risk
- Intermittent carriers – 30%
- Non-carriers – 50%
- 2% MRSA rate, but increasing
- Primary carrier nares; other sites (skin)
- Imp't for persistence/spread of multi-resistant strains

Methicillin-Resistant Staphylococcus Aureus (MRSA)
A NOSOCOMIAL & COMMUNITY INFECTION
- 1975 -1981: major increase in US isolates
- major nursing home & hospital pathogen:
  elderly pt admissions; transfer pts; HCWs
- difficult to eradicate once introduced
- chronic care facilities common reservoirs
- HC facility infection control successes!!

Factors that Facilitate Transmission
- Contaminated Surfaces and Shared Items
- Compromised Skin
- Cleanliness
- Antimicrobial Use
- Frequent Contact

S. aureus & MRSA Incidence
- 2004: >75% purulent skin/soft tissue infections in ER’s
  - MRSA = 78% of the infections
- Invasive MRSA inf. ~ 94,000 people/yr (19,000 deaths)

Encouraging results:
- 2005-2012: MRSA bloodstream infection rate decreased 17.1% each year.
- 2013-2016: rate decline slowed
- Improved diligent IC practices + early detection

JAMA (2010)/CDC(2017, 2019)
MRSA SSTI Treatment

- Skin infections can develop into more serious infections
- I & D primary therapy for purulent skin infection
- Empiric antibiotics based on clinical assessment?
- MRSA susceptibility profile
  - Resistant to all currently available beta-lactams
- Fluoroquinolones (e.g., ciprofloxacin, levofloxacin) and macrolides (erythromycin, clarithromycin, azithromycin) not optimal for treatment of MRSA SSTI's - rapid resistance.
- Culture and susceptibility testing useful, for:
  1. More severe infections;
  2. Those who fail to respond adequately to initial tx.

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Pseudomembranous colitis
- Antibiotic-associated colitis
- C. difficile-associated disease (CDAD)
- C. difficile infection (CDI)

500,000 cases/yr
15,000 deaths

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Clostridium difficile

- Anaerobic spore-forming bacillus
- In water, soil, meats, vegetables, animals
- HC environments common reservoirs - spores difficult to eradicate
- Fecal-oral transmission thru contaminated environment & HC personnel hands
- Antimicrobial exposure major disease risk factor
  - Acquisition & overgrowth of C. difficile
  - Suppression of normal flora in colon
- Increasing C difficile resistance to many drugs
- Diarrhea 1st manifestation of bacterial overgrowth
- Pseudomembranous colitis, toxic megacolon, sepsis, & death

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Clostridium difficile

- Normal colonic component in some persons – minor, non-toxigenic strains
- Host homeostasis: indigenous GI microflora normally control C. difficile -- "colonization resistance"
- Spores survive/persist on hospital & home fomites (20 weeks)
  - Repeated pt diarrhea episodes & spore resistance
  - Important HAI pathogen
  - Resistant to alcohol-hand antiseptics (sanitizers)!!
  - Resistant to cleaners/disinfectants – bleach effective
- Majority of infections in persons > 65 yrs & among pts in HC facilities (hospitals, long-term care facilities)

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Clostridium difficile

- Mid 1970's: clinical importance first noted
- Prolonged antibiotic regimens – 1st reported c clindamycin
- Can outgrow other commensal flora during antibiotic tx
- Disruption of GI microflora:
  - Ingested spores resistant to stomach acids
  - Germination/proliferation/overgrowth in colon
  - Produce 2 major toxins ((TcdA & TcdB)
  - Extensive PMN inflammatory response
- Diarrhea 1st manifestation from c mucosa erosion
- Pseudomembrane formation, toxic megacolon, sepsis, death

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Colonization resistance” exerted by indigenous flora against C. difficile


90

15
**Clostridium difficile Transmission**

**Endogenous infections:**
- People frequently ingest spores, but remain asymptomatic —
  - Spores in water, soil, meats (beef, pork, turkey), vegetables, swimming pools, animals (dogs, cats, pigs, etc.)
- Overgrowth of toxin-producing strain during antibiotic tx

**Exogenous infections:**
- Hospitals & long-term care facilities high risk
- Person-to-person spread
- Recent information implicating contaminated surfaces
- Exogenous infections more common than endogenous ones

---

**Risk Factors for Development of C. difficile Infection**

- Any antibiotic vs no antibiotic
- Number of antibiotics (risk increases with number)
- Antibiotic days
- Antibiotic type:
  - Highest risk: clindamycin, fluoroquinolones, 2nd generation & higher cephalosporins
- Proton-pump inhibitors & histamine type 2 blockers
- Patient age (older pts increased risk)
- Prior/duration hospitalization
- Underlying illness severity
- Residency in long-term care facility

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**Risk Factors for Recurrent C. difficile Infection**

- Prior CDI episodes
- Antibiotic use (concomitant &/or post-CDI tx)
- Advanced age
- Prolonged or recent hospital stay
- Proton-pump inhibitor use
- Infection with C. difficile NAP1/B1/027 strain
- Absence of Ab response to antitoxin A

---

**C. Difficile in HC Facilities**

- Increased incidence & severity
  - Changes in underlying host susceptibility
  - Changes in antimicrobial prescribing
  - New strain with increased virulence
  - Changes in infection control practices
- 94% related to HC exposures
- 52% of CDI pts treated in hospitals present on admission
  - Potential source for intra-hospital transmission
- Good News: CDI's reduced by >20% over ~21 months (71 hosps)
  - Prevention programs focused primarily on infection control strategies (e.g. early reliable detection, isolation, enhanced environmental cleaning).

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**Emerging Disease Issue: Metronidazole Ineffectiveness**

- Metronidazole primary antibiotic for tx of CDI
- C. difficile becoming less responsive to therapy.
- Frequency increasing in recent years.
- Case reviews looking for disappointing responses:
  - 1991-2002: 66 / 688 pts (9.6%)
  - 2003-2004: 112 / 435 (25.7%)
- Bacterial resistance
- Increasing % resistant C. difficile - infections
- Implications for dentistry & tx of anaerobic infections

---

**C. difficile Control**

IC practices:
1. Prevent transmission to pt
2. Reduce CDI potential pt encounters C difficile or spores
   - HCW hand hygiene (alcohol hand rubs INEFFECTIVE)
   - Gloves when handling pt body fluids — significant CDI reduction
3. Reduce unnecessary antibiotic use — stewardship
   - Most effective: restrict pt access to specific antibiotics
4. Careful cleaning / disinfection of hospital rooms after pt discharge / bleach

**C. difficile Control 2**

- stool transplants – to replace normal fecal flora
  - but, human fecal matter may contain unknown pathogens
  - also synthetic “poop” transplants (super probiotic)
- fecal transplantation (or bacteriotherapy) --- transfer
  of stool from healthy donor into the GI tract for purpose
  of treating recurrent *C. difficile* colitis
- delivered by colonoscopy, endoscopy, sigmoidoscopy, or
  enema
- research on fresh vs freeze-dried material

We must constantly remain aware of impending
infectious disease threats which may challenge our current
infection control precautions

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**THANK YOU**