


Infection Prevention and Control in Cystic Fibrosis

Prof. Lisa Saiman, Columbia University Medical Center, New York


A Webber Training Teleclass

INFECTION PREVENTION AND CONTROL IN CYSTIC FIBROSIS

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COLUMBIA UNIVERSITY
MEDICAL CENTER
Department of Pediatrics



New York-Presbyterian
Morgan Stanley Children's Hospital

Hosted by Prof Elaine Larson
 Columbia University
 Mailman School of Public Health

www.webbertraining.com October 2, 2014

Learning Objectives

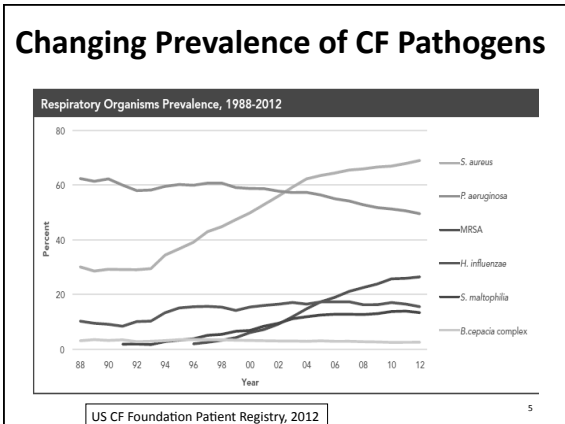
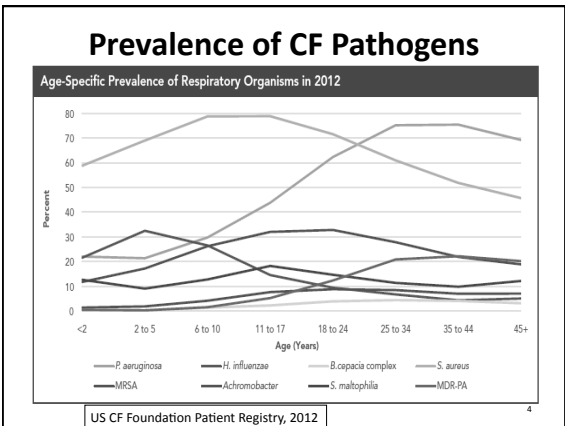
- Review routes of transmission of CF pathogens
- Discuss evidence of person-to-person transmission of CF pathogens
- Describe strategies to prevent transmission and acquisition of CF pathogens

2

Background

- While the source of CF pathogens is not always known, there is increasing evidence that people with CF acquire CF pathogens from others with CF.
- This acquisition may be associated with increased morbidity and mortality.

3



Modes of Transmission of Infectious Agents

Siegel JD, et al and HICPAC. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings (www.cdc.gov/hicpac/pubs.html, accessed 3.1.2013 or Am J Infect Control 2007; 35 (suppl 2): S65-164)

6

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Direct Contact Transmission

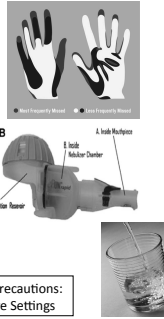
- Occurs when microorganisms are transferred from one infected person to another person **without** a contaminated intermediate object or person
- Example:** Transfer of potential pathogens from infected respiratory tract secretions directly to another person via kissing or touching



Siegel JD, et al and HICPAC. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Indirect Contact Transmission: Most Frequent

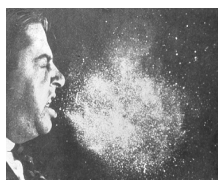
- Occurs when infectious agents are transferred through contaminated intermediate object or person
- Examples:** Transfer of infectious agents by contaminated hands of healthcare personnel or contaminated respiratory therapy equipment, eating utensils, drinking glass, toys, etc.



Siegel JD, et al and HICPAC. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings

Droplet Transmission

- Respiratory droplets carrying infectious agents travel from respiratory tract of infectious individual to susceptible mucosal surfaces of another person, generally over short distances (3-6 feet)
- Droplets generated when an infected person **coughs** or sneezes, **OR** during procedures such as **pulmonary function tests** or **chest physiotherapy**



Festini F. Am J Infect Control 2010; 38: 244; Clifton JJ. Expert Rev Respir Med. 2010; Wainwright CE. Thorax 2009; 64:926

Airborne Transmission

- Dissemination of either droplet nuclei or small particles in respirable size range containing infectious agents that may remain **suspended in the air** for prolonged periods of time
- May be dispersed over long distances by air currents and may be inhaled by susceptible individuals who have **NOT** had face-to-face contact with the infectious individual

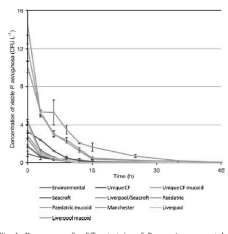
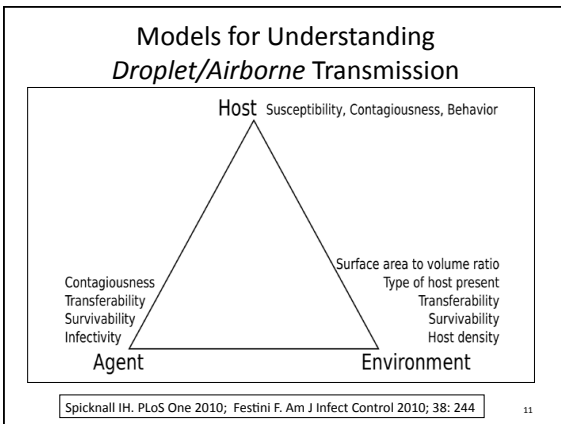


Fig. 1. Decay curves for different strains of *P. aeruginosa* generated in microbiological chamber model.
Strain variation of *Ps. aeruginosa* in ability to remain suspended in air.

Clifton JJ. JCF 2010; 9:64



Models for Understanding Droplet/Airborne Transmission

- Obligate**
 - Under natural conditions, infection initiated only through aerosols deposited in distal lung, e.g., TB
- Preferential**
 - Under natural conditions, infection initiated through multiple routes, but predominantly through aerosols deposited in distal airways, e.g., measles, smallpox
- Opportunistic**
 - Under natural conditions, cause disease through other routes, but also can initiate infection through distal lung and may use fine particle aerosols to propagate infection in 'favorable environments', e.g., SARS CoV in Amoy Gardens outbreak

Roy CJ and Milton DK. NEJM 2004; 350:1710

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Droplet Transmission: Evolving View

- Data from:
 - Epidemiologic studies of outbreaks
 - Experimental studies
 - Aerosol dynamics
- Infectious droplets can travel **3-6 ft.** and remain suspended in the air 45 min. - 2 hrs.
- Experimental data from smallpox and SARS \geq 6 ft.
- Experimental data in CF \sim 6 feet.



CDC. Isolation Guidelines 2007; Festini F. Am J Infect Control 2010; 38: 244; Clifton J. Expert Rev Resp Med.2010; Wainwright CE. Thorax 2009; 64:926; Zuckerman J 2012

Transmission of CF Pathogens

Publications Demonstrating Transmissible Strains of *P. aeruginosa* and *B. cenocepacia*

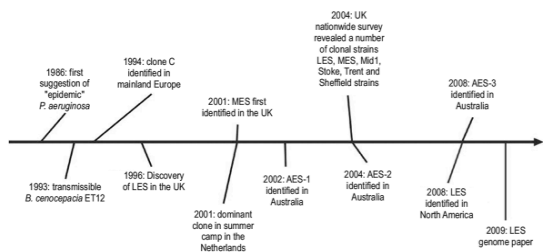


FIGURE 1. Timeline of major events reporting transmissible and putative transmissible strains of *Pseudomonas aeruginosa*, *B. cenocepacia*, *Burkholderia cenocepacia*. LES: Liverpool epidemic strain; MES: Manchester epidemic strain; AES: Australian epidemic strain; Mid1: Midlands strain.

Fothergill JL. Eur Resp J 2012; 40: 227

Publications Demonstrating Transmissible Strains of *P. aeruginosa* and *B. cenocepacia*

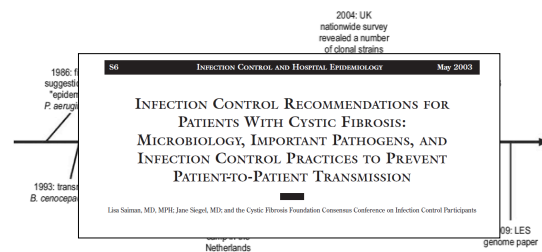


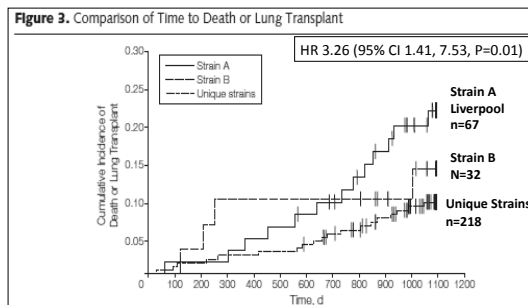
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Fothergill JL. Eur Resp J 2012; 40: 227

Pseudomonas aeruginosa



Liverpool Strain and Increased Risk of Mortality/ Transplant



Aaron S, et al. JAMA 2011

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Epidemiology of Liverpool Epidemic Strain (LES)

- Infects ~ 15% of CF patients in Ontario
 - Not associated with increased exacerbations, hospitalizations, or IV antibiotics
 - Not associated with reduced body mass index
- CF clinics in UK
 - ~ 48% of clinics
 - ~ 11% of CF patients
 - Case control study (n=12 patients) increased rate of decline of lung function
- Unknown if present in CF patients in U.S.

Aaron S, et al. JAMA 2011; Al-Aloul M, et al. Thorax 2004; Fothergill JL, et al. Eur Resp J 2012 ePublished

19

Transmission of Multi-resistant *P. aeruginosa* (MRPA), Houston

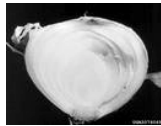
- 2006: average MRPA in U.S. 16% vs. 30.1% in Houston
- 2004-2009 PA strains: 32 of 71 (45%) patients had strains with >95% similarity, aka Houston-1
- 12 more hospital-days year before Houston-1 acquisition
- Improved IP&C practices in clinic and hospital reduced acquisition

Logistic regression for variables associated with Houston-1 strain			
	Strata	P	OR 95% CI
Age		0.66	
Days from clinic visit	≤ 60	0.33	
	61-120	0.5	
	>120	0.15	
Days from hospitalization	≤ 90	0.04*	4.02*
	91-180	0.11	1.1-14.7
	181-365	0.51	

Luna RA, et al. J Clin Microbiol 2013; 51: 1237

20

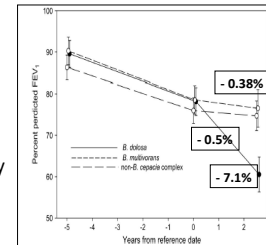
Burkholderia dolosa



21

B. dolosa: Morbidity and Mortality

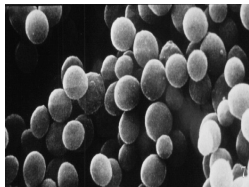
- Case-control study
 - 31 *B. dolosa*
 - 24 *B. multivorans*
 - 58 age-, sex-matched controls
- Increased decline lung function
- Increased 18-month mortality
 - 13% *B. dolosa*
 - 7% *B. multivorans*
 - 3% controls



Kalish LA, et al. Am J Resp Crit Care Med 2006;15:421-425.

22

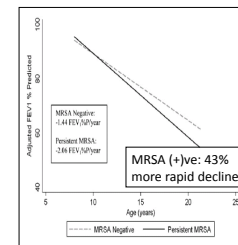
MRSA



23

MRSA Impact: CFF Patient Registry, 1996-2003

- Mean 5.3 years follow-up
 - 1,732 persistently (+)ve
 - 13,922 never MRSA
- 8-21 year olds
 - (+)ve MRSA FEV₁ 71.0%
 - Never MRSA FEV₁ 79.6%

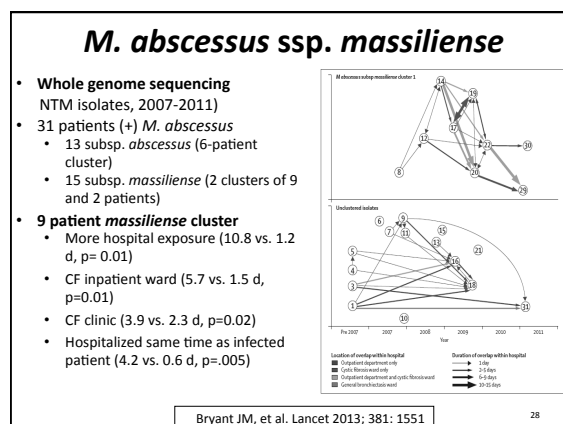
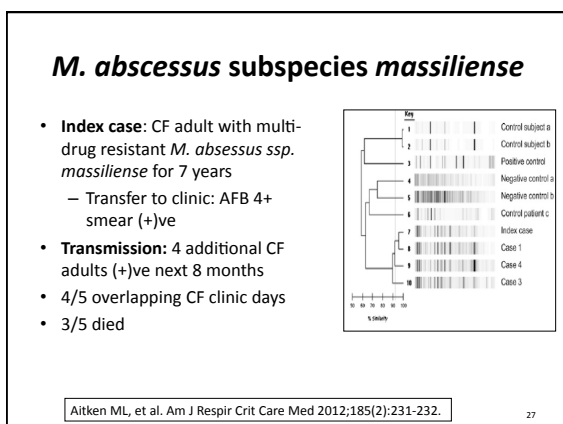
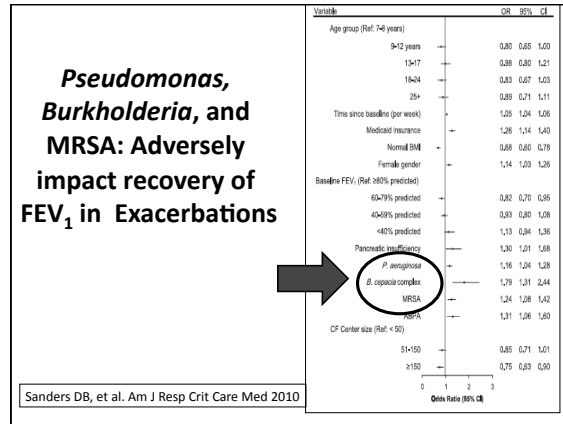
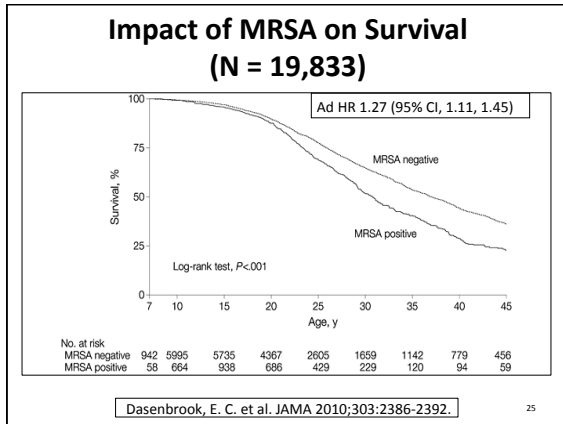


Dasenbrook EC et al. Am J Resp Crit Care Med 2008

24

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Environment of Hospitalized Children

Microbiological characteristics of air samples from patient bedrooms	Wake-up		
	Wake-up	After physiotherapy	After cleaning
Number of samples	121	81	9
Germs CFU/m ³ average	583.4	709.2	278
(Min-Max)	(52-2096)	(28-2240)	(112-656)
Number of <i>P. aeruginosa</i> -positive samples	7	11	0
Number of <i>P. aeruginosa</i> CFU/m ³ average	154.3	40.7	-
(Min-Max)	(8-976)	(4-188)	-
Number of <i>S. aureus</i> -positive samples	11	7	3
Number of <i>S. aureus</i> CFU/m ³ average	33.8	153.1	17.3
(Min-Max)	(8-80)	(8-800)	(12-24)

- P. aeruginosa*** in room air samples of 12/22(55%) infected patients
 - 6/12 genetically identical to sputum strains
- S. aureus*** in air samples of 6/17 (35%) infected patients.
 - None identical to sputum strains.

Ferroni A., et al. J Cystic Fibrosis 2008; 7: 477.

Contamination of Healthcare Environment with *Pseudomonas*, including LES

Sites Cultured	Tested #	Positive Epidemic Strain (LES)	Positive Non-epidemic Strains
Staff hands/clothes	12	0	0
Patients hands	8	2	0
Patients clothes/linens	16	3	0
Sink, bathtub, showers drain, toilets	22	1	15
PFT machine surface	15	0	3
Air out-patient clinic*	8	5	0
Total	81	11 (14%)	18 (22%)

* corridor strain

Panagea S. et al., J Hosp Infect 2005;59:102-107

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Bacterial Contamination of 7 CF Clinics

- **Part I:** 97 patients, 55 clinic sessions, 1,887 cultures of hands, air, surfaces
 - **13.6% contamination rate:**
PFGE matches for *Pseudomonas* and *S. aureus* hands (7%), exam room air (8%), environmental surfaces (1%)
 - **No differences** in adults vs. children; routine vs. sick visit
- **Part II:** 74 patients performed hand hygiene with alcohol start of clinic visit
 - Hand hygiene reduced hand contamination
 - Subsequent hand contamination at visit end


Zuckerman JB, et al. J Cystic Fibrosis 2009; 8:186

UPDATE FOR IP&C GUIDELINES FOR CF: RATIONALE

- New molecular methods and new knowledge about transmission
- **New data demonstrated adverse outcomes associated with transmission.**
- Improved understanding of **implementation strategies, barriers to implementation, effectiveness of audits with feedback.**
- Relevant IP&C guidelines published since 2003
 - ✓ Prevention of MRSA Transmission (IDSA/SHEA 2008)
 - ✓ Isolation Precautions (CDC 2007)
 - ✓ Management of MDROs in Healthcare Settings (CDC 2006)
 - ✓ Prevention of *Mycobacteria tuberculosis* Transmission in Healthcare Settings (CDC 2005)

Process: Executive Committee

- **CF Foundation (CFF):** commissioned update of IP&C guideline
- **Co-chairs:** Lisa Saiman MD MPH, Jane Siegel MD, John LiPuma MD
- **Interdisciplinary Committee Members**
- **Two face to face meetings:** 11/2011, 1/2013
- Guideline **endorsed** by Society of Healthcare Epidemiology of America (SHEA) and the Association for Professionals in Infection Control and Epidemiology (APIC)
- **Published Infection Control and Hospital Epidemiology 2014**



Saiman L et al. Infect Control Hosp Epidemiol 2014;Aug;35 Supp 1:S1-S67.

DATA SUPPORTING RECOMMENDATIONS

- Person-to-person Transmission
- Healthcare environmental contamination
- Droplet vs. airborne transmission
- Role of natural environment


CF IP&C GUIDELINES COMMITTEE

• Rebekah Brown	• Gail Potter-Bynoe
• Elizabeth Bryson	• Siobhan Reid
• Mary Jo Chambers	• Karen Robinson
• Veronica S. Downer	• Kathryn Sabadosa
• Jill Fliege	• Lisa Saiman
• Leslie Hazle	• Joel Schmidt
• Manu Jain	• Jane Seigel
• John LiPuma	• Elizabeth Tullis
• Bruce Marshall	• Jennifer Webber
• Catherine O'Malley	• David Weber
• Suzanne Pattee	



RECOMMENDATION KEY MESSAGES

- Whenever feasible, provided **choices** for implementation strategies in healthcare settings.
- Emphasized treating all people with CF the same... **regardless of respiratory tract cultures.** Assume all people with CF could have transmissible pathogens in respiratory tract secretions.
- No longer recommending different care practices for those infected with *Burkholderia cepacia complex*
- Recommendations for non-healthcare settings and for healthcare professionals with CF intended to **provide education to help make informed choices.**



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KEY RECOMMENDATIONS



37

IP&C Education

1. Provide to all healthcare personnel caring for people with CF, e.g., the CF care team, inpatient staff, environmental services staff, research staff, and staff in diagnostic and therapeutic areas including pulmonary function test laboratories. Provide booster education.
2. Develop strategies to monitor adherence to IP&C practices by healthcare personnel and provide feedback.

38


Use Principles of Adult Education

- **Increase Knowledge**
 - Perceive relevance of information to their personal situation
 - Flexible
 - Encourage networking, critical analysis, self-reflection on practice, opportunities for open questioning
 - Increase awareness
 - **Repeated exposures to information**
 - Educational materials that include “WHY”
- **Increase Skills**
 - Observations
 - Return demonstrations
- **Acknowledge Impact of Attitudes**
 - Reflect individual beliefs, professional and personal life experiences
 - Must believe practice change directly benefits themselves or patients

Matlow AG. AJIC 2012; 40: 260 [environmental service workers]; Ferguson PE. BMT 2010;45:656 [pt./families]; (Miroballi Y, Pediatric Pulm 2012;47:144 [CF patients and families].

39


Partner with Local IP&C Teams



- **Goal:** develop *synergy* between CF and IP&C teams
- **Expertise of IP&C Teams**
 - Implementation, including prioritization and staging of recommendations, if appropriate
 - Identifying appropriate stakeholders, especially C suite
 - Monitoring adherence to practices and providing feedback
 - Apply experience with improving hand hygiene, respiratory hygiene, environmental cleaning, transmission precautions, and collaborations with microbiology lab
- **Both teams** are data analysis/data driven

40

Use Existing Methodology to Monitor Cleaning Effectiveness in Healthcare Facilities



- **Methods**

www.cdc.gov/HAI/toolkits/Evaluating-Environmental-Cleaning.html

- Direct observation ± immediate feedback
- Objective measurement with fluorescein powder/gel, ATP detection + feedback

Eckstein BC. BMC ID 2007; 7: 61; Hayden MK 2006; CID 2006; 42:1552; Otter JA. ICHE 2011; 32: 687; Harris A. CID 2008; 46:686; Boyce JM. ICHE 2011; 32: 1187.

41

Avoid Socialization

- People with CF who do not live in the same household should **avoid activities and risk factors** associated with transmission of CF pathogens in non-healthcare and healthcare settings, including:
 - Social contact between people with CF
 - Physical contact between people with CF, (e.g., handshakes, kissing, intimate contact)
 - Car rides, sharing hotel rooms, or fitness class with another person with CF
- **Activities that all people with CF, including those who live in same household, should avoid include:**
 - Sharing personal items (e.g., toothbrush or drinking utensils)
 - Sharing respiratory therapy equipment




42

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Recommendations for Transmission Precautions

- Practices by healthcare personnel (HCP)
- Practices by people with CF

43

Hand Hygiene (HH)

- Improve HH among HCP:
 - Decontaminate hands prior to patient contact or after contact with body fluids or inanimate objects, e.g., equipment
 - Make improvement institutional priority
 - Make supplies readily accessible
- Improve HH among people with CF and families

CDC HH Guidelines 2002; WHO HH Guidelines 2003;

44

Respiratory Hygiene/Cough Etiquette

- Widely implemented , especially during flu season
- Contain respiratory secretions of patients in healthcare settings
 - Post signs
 - Provide tissues and no-touch receptacles
 - Hand hygiene resources and instructions
 - Offer masks to coughing patients during increased community-onset respiratory infections

Thomas C Guys Hosp Rep 1961; Downie AW Bull World Health Organ 1965; MMWR 1994; 43: RR-13; Capps JA JAMA 1918; Riley RL Am J Med 1974

45

Use of Gowns, Gloves, Masks

- Gowns and gloves
 - Staff wear gloves and gowns when caring for all people with CF in hospital and ambulatory care areas, esp. CF clinic
 - Patients and families do **not** wear gowns and gloves
- Masks
 - All people with CF wear surgical masks (if tolerated)
 - Staff **only** wear surgical masks if suspected pathogen spread by droplet route, e.g., influenza or pertussis
 - Staff **only** wear N95 masks if suspected pathogen spread by airborne route, e.g., TB or measles

46

Transmission Precautions: Non-tuberculous Mycobacteria

Insufficient evidence to place people with CF who are infected with NTM on Airborne Precautions, i.e., negative pressure room.

47

Benefits and Risks of CF Clinic

- CF clinics critically important part of CF care with obvious benefits:
 - facilitate care by interdisciplinary team
 - CF care team highly motivated and knowledgeable
- *But...* CF clinics bring CF patients together in close proximity and some:
 - are coughing
 - harbor transmissible pathogens
 - have variable understanding of IP&C

48

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Scheduling CF Clinics

Insufficient evidence to routinely scheduling CF clinics based on specific pathogens isolated from respiratory tract cultures.

49

PFT Laboratories

- **Perform PFTs** in one of the following ways:
 - In exam room at beginning of clinic visit
 - In a negative pressure room (Airborne Infection Isolation Room = AIIR)
 - In PFT lab with either portable or integrated high-efficiency particulate [HEPA] filters
 - In PFT lab without HEPA filtration, allowing 30 minutes to elapse before next person with CF enters PFT lab.

50

CFF or CF Center Sponsored Indoor Events

- Only one person with CF attend CF Foundation-sponsored, healthcare-sponsored or CF Center-sponsored **indoor events** (e.g., CF Education Days) unless they live in the same household.
- **Develop and utilize alternative CF education programs**, (e.g., videotapes, video-conferencing, CD-ROM web-based learning, Apps), that do not require face-to-face meetings among people with CF.

51

Cross-infection Policy

Guidance for people with cystic fibrosis at events and meetings

- ✓ **UK CF Trust** "...it is our policy for only one person with CF to be present...at an indoor event organised by Trust staff or its volunteer branches, groups, and committees..."
www.cysticfibrosis.org.uk/about-cf/living-with-cystic-fibrosis/cross-infection.aspx



- ✓ **CF Canada** "For indoor events, a provision has made for organizers to invite one person with CF to attend."
www.cysticfibrosis.ca/en/aboutUs/infectionControlPolicy

***CHEST JOURNAL**

- ✓ Sponsored Pro-Con debate on this recommendation
 Jain M et al. and Shephard SL et al. Chest 2013, Oct 17

52

BALANCING INFECTION PREVENTION AND CONTROL WITH QUALITY OF LIFE



53

Summary and Conclusions



- New knowledge mandated new guidance for IP&C practices for CF.
- To be effective at preventing transmission of CF pathogens, IP&C has to be understood and practiced by everyone.
- Additional educational material and toolboxes are being developed.
- Research directions suggested by recommendations with **insufficient evidence**.

54

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**QUESTIONS?
CONCERNS?
SUGGESTIONS?**



55

Coming Soon

October 8 (Free WHO Teleclass – North America)

**PUBLIC REPORTING AND DISCLOSURE OF HAI RATES:
POSITIVE IMPACT OR CONFUSION?**

*Dr. Marianne McGuckin and John Govednik, McGuckin Methods International
Sponsored by the World Health Organization Patient Safety Agency*

October 9 **ENHANCED ENVIRONMENTAL CLEANING IN CONTROLLING
CLOSTRIDIUM DIFFICILE INFECTIONS IN THE HOSPITAL
SETTING: DOES IT MATTER?**

Prof. Farrin A. Manian, Harvard Medical School

October 16 **HEALTHCARE LAUNDRY: EPIDEMIOLOGY AND MICROBIOLOGY
ISSUES**

*Dr. Lynne Schulster, Division of Healthcare Quality Promotion, Centers for Disease
Control and Prevention*

October 23 **INFECTION PREVENTION IN OUTPATIENT ONCOLOGY SETTINGS**

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