EXPOSURE TO INFLUENZA AEROSOLS DURING ROUTINE PATIENT CARE
Background

- Millions have lost their lives to influenza in pandemics
- Epidemics of varying severity occur worldwide each year.
- Influenza A H7N9 is the latest threat

Current Recommendations (CDC, WHO):
- Droplet/Contact Precautions since Influenza transmission has been thought to primarily occur by large-particle respiratory droplets.
- Only during aerosol-generating procedures such as bronchoscopies are fit-tested respirators required.
- Influenza A H7N9 – airborne plus contact plus eye-protection
Objective

- This study examines:
  - the spatial distribution of influenza aerosols generated by symptomatic patients in a healthcare setting

- and identifies:
  - clinical features associated with high levels of influenza release.
Setting

- 2010/11 Influenza Season
- WFBMC is an 885 bed tertiary care teaching hospital
- Mandatory vaccination policy for all healthcare providers (HCPs) since 2009.
- During the study season 247 influenza positive patients identified (115 inpatients, 67 clinic patients, 65 ED patients)
- All test rooms: Turbulent airflow (6 air changes/hour); ANSI/ASHRAE 52.2 compliant endfilters (MERV 15)
Methods

- Patients >2 years of age admitted to the ED or an inpatient care unit with ILI. (documented fever [≥37.8° C] or patient-reported in the past 12 hours, cough/sore throat, and suspected influenza)
- Demographics, medical/vaccination history, and treatments recorded.
- Nasopharyngeal swabs obtained from each subject. (bedside rapid testing [BinaxNOW Influenza A&B] and inoculation [BD Diagnostics] for rRT-CR analysis; air samples not obtained from participants negative for influenza by rapid testing)
Methods

Air Sampling
- Six-stage Andersen air-samplers (AS)
- 20 minute runs
- rRT-PCR testing
- No face/oxygen masks on participants
- No aerosol generating procedures performed

Measures of Illness
- Symptoms at admission (Likert scale), and days sick
- Severity of illness and interference with daily life by ILI (VAS)
- Patient’s coughs/sneezes during air sampling
Methods

- Statistical Analysis
  - Categorical variables - chi square and fisher exact tests
  - Continuous variables - t-tests and Wilcoxon rank sum tests
  - Spatial aerosol distribution - generalized estimating equation model for Poisson distribution with log link function
  - Significance level was set at 0.05
Results

- **Influenza Positivity**
  - Ninety-four patients with ILI symptoms enrolled
  - Sixty-one (65%) positive for influenza, 31 carrying influenza A and 30 influenza B
  - Thirty-five subjects underwent air sampling as inpatients, and 26 in the ED
  - Aerosolized influenza detected in 26 (43%) subjects (13 inpatients, 13 ED patients)
  - Rapid testing matched rRT-PCR results of nasopharyngeal and air samples
Results

- **Patient Characteristics**
  - Influenza-negative vs. positive patients:
    - younger
    - receiving less antiviral therapy
    - more likely enrolled in the ED
  - No significant differences between emitters and non-emitters

- **Influenza specific variables during air sampling**
  - Emitters:
    - higher nasopharyngeal viral loads
    - Increased virus release by coughing and sneezing among patients with increased nasopharyngeal viral load only
    - higher severity of illness and interference with daily lives (ED only)
  - Three ED patients admitted to the hospital (sickle cell syndrome (1x), sickle cell with asthma (1x), and foot injury (1x) - none were emitters)
Results

Total Influenza Aerosol Concentrations Emitted by Individual Subjects
**Results**

Spatial Distribution of Average Influenza Aerosol Concentrations in Patient Rooms

*Number of emitters exceeding the low or high HID$_{50}$ by distance:
Low HID$_{50}$ (>90 RNA copies): 1ft – 13 (50%) out of 26 subjects; 3ft – 11(42%); 6ft – 9(35%)
High HID$_{50}$ (>1,950 RNA copies): 1ft – 3 (12%) out of 26 subjects; 3ft – 2(8%); 6ft – 1(4%)
(one emitter can exceed the HID$_{50}$ at more than one distance)
Limitations

- Study of exposure to influenza aerosols NOT transmission
- PCR versus virus culture
- Cross-sectional design – dispersal routes over illness progression?
- Convenience samples using CDC ILI criteria/rapid test:
  - Exclusion of asymptomatic emitters?
  - Over-enrollment of patients with high amounts of influenza
- No differentiation of larger particle sizes (>7um)
- Potential of Influenza aerosols generated by other sources (e.g. HCPs):
  - Type match of swab results with air samples
  - Mandatory vaccination campaign
  - Shedding associated with influenza emission
Summary of Key Findings

- 43% of influenza-infected patients released virus into room air
- Influenza virus was detected up to 6ft from the patients
- Virus was predominantly contained in small particles <4.7µm
- All tests done during non-aerosol-generating patient care activities
- Dispersal linked to high nasopharyngeal viral load, severity of illness, and impact on daily life
- Five of the 26 emitters released influenza in exceptionally high concentrations
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- Publications:
  - Bischoff WE, Reid T, Russell GB, Peters TR. Trans-ocular Entry of Seasonal Influenza Attenuated Virus Aerosols and the Efficacy of N95 Respirators, Surgical Masks, and Eye Protection in Human Subjects. J Infect Dis. 2011;204:193-9
Thanks:

...I DON'T KNOW, I THOUGHT HE'D BE TALLER

PESTILENCE