Outcomes of Healthcare-Associated Respiratory Viral Infections in a Pediatric Hospital: A Historical Cohort Study

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Introduction

- Healthcare-associated respiratory viral infections (HARVI) occur frequently at pediatric hospitals
- At our institution the incidence of definite HARVI from July 2013 to June 2018 was 0.62 infections per 1,000 admitted patient-days
- HARVI are typically identified in patients with pulmonary, cardiovascular, or immunocompromising conditions putting them at high risk for complications
- Preventing HARVI is a priority, but it is not clear what patient outcomes are attributable to HARVI
- Hypothesis: HARVI increase hospital length of stay compared to non-infected controls

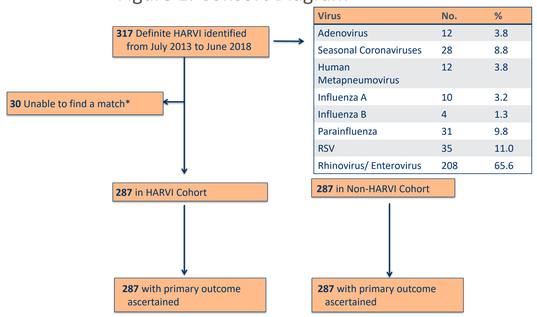
Methods

- Historical cohort study at a 490 bed pediatric hospital
- HARVI Cohort
  - Case definition
    - 1) Positive viral PCR or rapid antigen test for any of 8 viruses (see Figure 1)
    - 2) Symptoms of respiratory tract infection (see Handout)
    - 3) Onset of symptoms on hospital day > upper limit of virus specific incubation period (see Handout)
- Non-HARVI Cohort
  - Any admitted patient with no HARVI
  - Matched for:
    - 1) Exposure time (see Handout)
    - 2) Calendar year and month (+/- 1 month)
    - 3) Nearest match for age and hospital unit
  - Index time = time from admission to infection in matched member of HARVI cohort
- Data source:
  - EMR query and manual chart review
- Primary outcome: additional length of stay
  - Secondary outcomes: ICU transfer, new-onset intubation, NIPPV or IPPV days, all-cause mortality, 14-day readmission, antibiotic days, total hospital charges
- Statistics
  - Paired Student t-test for primary outcome
    - Length of stay data very skewed right, but difference between matched pairs approximately normal

Handout (Scan QR Code)

Results

Figure 1. Consort Diagram



Virus	No.	%
Adenovirus	12	3.8
Seasonal Coronaviruses	28	8.8
Human Metapneumovirus	12	3.8
Influenza A	10	3.2
Influenza B	4	1.3
Parainfluenza	31	9.8
RSV	35	11.0
Rhinovirus/ Enterovirus	208	65.6

Table 1: Baseline characteristics of the cohorts

Characteristic	HARVI (n=287)	Non-HARVI (n=287)	HARVI with no Match* (n=30)
Age, median (IQR), years	1 (2 mo. – 4)	2 (1 mo. – 13)	2 mo. (0 – 10 mo.)
Age Group			
0-1 months, no. (%)	50 (17.4)	53 (18.5)	14 (46.7)
1-12 months, no. (%)	89 (31.0)	79 (27.5)	9 (30.0)
>12 months, no. (%)	148 (51.6)	155 (54.0)	7 (23.3)
Female sex, no. (%)	125 (43.6)	131 (45.6)	15 (50.0)
Race, no. (%)			
Asian	12 (4.2)	12 (4.2)	0 (0)
Black	57 (19.9)	67 (23.3)	9 (30.0)
White or Caucasian	182 (63.4)	170 (59.2)	17 (56.7)
Ethnicity, no (%)			
Hispanic/Latinx	127 (44.3)	87 (30.3)	10 (33.3)
Not Hispanic/Latinx	155 (54.0)	194 (67.6)	20 (66.7)
CLD, no. (%)	82 (28.6)	104 (36.2)	16 (53.3)
CHD, no. (%)	38 (13.2)	42 (14.6)	7 (23.3)
Immunodeficiency, no. (%)	74 (25.8)	59 (20.6)	6 (20.0)
Malignancy	40 (54.1)	31 (52.5)	0 (0)
HSCT	18 (24.3)	11 (18.6)	1 (16.7)
Organ Transplant	13 (17.6)	9 (15.3)	3 (50.0)
Medication	1 (1.4)	8 (13.6)	0 (0)
Primary	2 (2.7)	0 (0)	2 (33.3)
Preterm, no. (%)	50 (17.4)	63 (22.0)	10 (33.3)
LOS Prior, median (IQR), days	19 (10 – 39)	19 (10 – 39)	134 (110 – 196)
Unit at Onset, no. (%)			
Non-ICU	186 (64.8)	131 (45.6)	12 (40.0)
NICU	41 (14.3)	48 (16.7)	7 (23.3)
PICU	40 (13.9)	58 (20.2)	5 (16.7)
CVICU	20 (7.0)	50 (17.4)	6 (20.0)
Intubated at Onset, no. (%)	39 (13.6)	89 (31.0)	10 (33.3)
ECMO at Onset, no. (%)	0 (0)	3 (1.1)	0 (0)
CCC score, median (IQR)	1 (1 – 2)	1 (1 – 2)	2 (1 – 3)
PELOD2 score, median (IQR)	2 (0 – 3)	2 (0 – 4)	2 (0 – 3)

IQR – interquartile range; CLD – chronic lung disease including asthma; CHD – unrepaired hemodynamically significant congenital heart disease; HSCT – hematopoietic stem cell transplant; NICU – neonatal intensive care unit; CVICU – cardiovascular ICU; PICU – pediatric ICU; LOS – Length of Stay; CCC – Pediatric Complex Chronic Conditions Classification version 2; PELOD2 – Pediatric Logistic Organ Dysfunction 2
Preterm includes very preterm and extremely preterm infants
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Figure 2. Additional Length of Stay

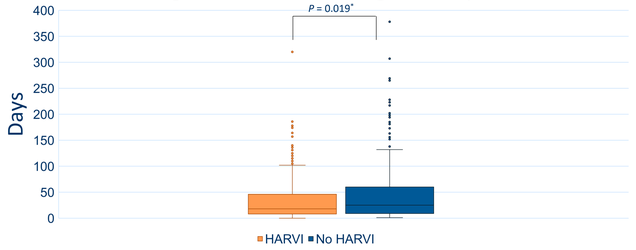


Figure 3. Additional Length of Stay by Unit of Onset

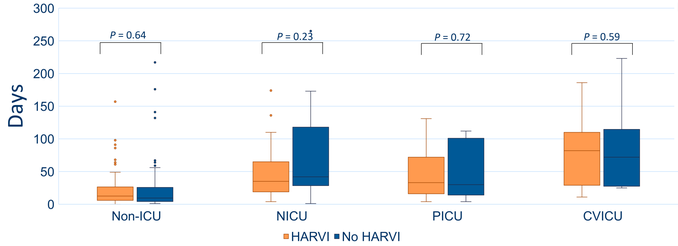


Figure 4. Secondary Outcomes

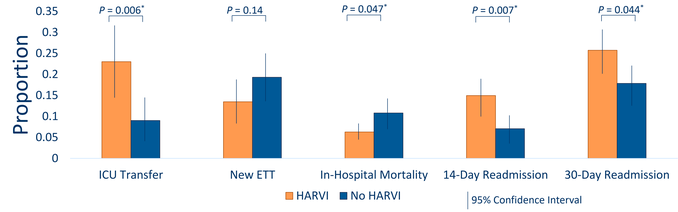


Figure 5. Additional Secondary Outcomes

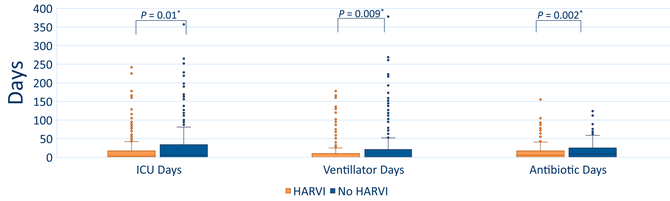
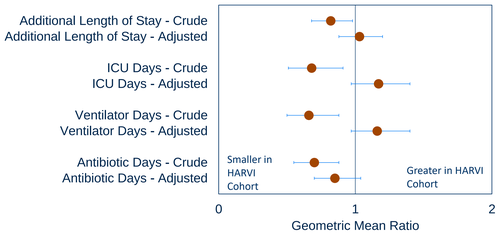
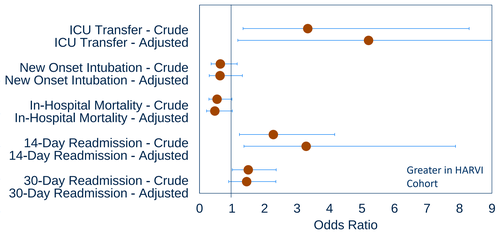


Figure 6: Crude and Adjusted Effect





Conclusions

- HARVI were not associated with a longer additional length of stay compared to hospitalized controls without HARVI
- Additional length of stay was actually greater in the Non-HARVI cohort, but after adjusting for baseline differences in the cohorts there was no significant difference in outcome
- HARVI were associated with increased odds of transfer to the ICU within 7 days of infection/index time, but the strength of this conclusion is limited by a possible chance association due to multiple comparisons

Future Directions

- Collect data from a larger non-HARVI cohort and use a propensity score matched sample in the analysis
- Study ICU transfer and total hospital charges as primary outcomes of HARVI
- Evaluate the effect of infection prevention interventions to reduce the incidence and impact of HARVI