

Reduction in Rate of Nosocomial Respiratory Virus Infections Associated with Enhanced Isolation Precautions in a Children's Hospital

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Lorry G Rubin MD^{1,2}, Nina Kohn MBA MA³, Susan Nullet RN MS CIC¹, Margaret Hill RN MS CIC¹

¹Cohen Children's Medical Center of New York of Northwell Health, New Hyde Park, NY

²Hofstra-Northwell School of Medicine, Hempstead, NY

³Feinstein Institute for Medical Research of Northwell Health, New Hyde Park, NY

L. Rubin
269-01 76th Avenue
New Hyde Park, NY 11040
P (718) 470-3415
F (718) 470-0887
lrubin4@northwell.edu



Abstract (Revised)

Background. Nosocomial respiratory viral infections (NRVIs) cause morbidity in pediatric patients. Optimal measures for prevention have not been established. In this study we evaluated the impact of enhanced isolation precautions (contact & droplet) on the incidence of NRVIs.

Methods. NRVIs caused by adenovirus, human metapneumovirus (hMPV), influenza, parainfluenza (PIV), respiratory syncytial virus (RSV), and rhinovirus/enterovirus (R/E) were prospectively monitored using laboratory-based surveillance with viral detection by nucleic acid amplification-based assay and standardized clinical definitions. The study period was 4 consecutive 12 month periods (July-June) 2012-2016. During years 1-2 special isolation precautions were as follows: hMPV, PIV, RSV, contact precautions; influenza, droplet precautions; adenovirus, contact & droplet precautions; R/E, droplet precautions during Nov through March, standard precautions April through October. During year 3, droplet precautions were in place for influenza and contact & droplet precautions were used for all other virus categories. During year 4, contact & droplet precautions were used for all virus categories. The percent of single bedded rooms increased from 22% during year 1 to 39% during years 2-4, with the opening of a new pavilion with all single bedded rooms. A severe restriction on visitation by young children was in place November through March in years 2-4, but not during year 1. Comparisons of nosocomial infection rates were made using the incidence density ratio method.

Results. The rate of NRVI was 0.904 and 0.565/1,000 patient days during the pre- and enhanced precautions periods, respectively, a 38% decrease during enhanced precautions (P=0.0011). For each virus category the rate of nosocomial infection was lower during the enhanced precautions period except for influenza; the reductions were significant for adenovirus and PIV. The number of hospitalized children with community-acquired infection with one of the 6 virus categories was 39.2% higher during year 3-4 compared to years 1-2.

Conclusion. The use of both contact and droplet precautions for inpatients with viral respiratory tract infections was associated with a reduction in the incidence of NRVIs.

Introduction

- Nosocomial viral respiratory infections cause morbidity.
- There are limited data on prevention of nosocomial viral respiratory infections (NVRIs).
- The aim of this study was to compare the rate NVRIs at a children's hospital before and after implementation of more stringent isolation precautions.

Methods

Study periods:

Pre-enhanced precautions (years 1-2): July 2012 - June 2014 (129,428 patient-days)

During enhanced precautions: (years 3-4): July 2014 - June 2016 (141,685 patient-days)

- Site: Cohen Children's Medical Center of New York
- Surveillance: active, lab detection-based
- Viruses surveyed: adenovirus, human metapneumovirus (hMPV), influenza A and B viruses, parainfluenza viruses (PIV) types 1, 2, 3, & 4, respiratory syncytial virus (RSV), and rhinovirus/enterovirus (R/E).

Nosocomial Viral Respiratory Infection Definition:

1. A positive test for a respiratory virus by nucleic acid amplification or enzyme immunoassay (for RSV only). AND,
2. Presence of ≥ 1 new respiratory tract symptoms and/or fever, AND,
3. A minimum time from hospital admission to onset of symptoms that varied with the viral pathogen as follows: adenovirus, PIV, RSV, and R/E, 3 days; hMPV, 4 days; influenza, 2 days.

Special Isolation Precautions:

- Years 1-4: contact & droplet while viral test pending.
- Years 1 & 2: hMPV, PIV, RSV, contact precautions; influenza, droplet precautions; adenovirus, contact & droplet precautions; R/E, contact precautions during November through March, standard precautions April through October.
- Year 3: influenza, droplet precautions; all other virus categories, contact & droplet precautions.
- Year 4: all virus categories, contact & droplet precautions

Potential Confounding Factors:

- The percent of single bed rooms increased from 22% during year 1 to 39% during years 2-4, with the opening of a new pavilion comprised of single bedded rooms.
- A severe restriction on visitation by young children was in place November through March in years 2-4, but not during year 1.

Statistical Methods:

- Comparisons of nosocomial infection rates were made using the incidence density ratio method.

Results

Table 1. NVRI Rate per 1,000 hospital days (Number of Cases) by Virus and Year

Respiratory Virus	Prior to Enhanced Isolation Precautions		Enhanced Isolation Precautions		P-value (Years 2-3 vs 3-4)
	Year 1	Year 2	Year 3	Year 4	
Total Cases	0.930 (57)	0.881 (60)	0.478 (32)	0.643 (48)	0.0011
Total Cases excluding rhinovirus/enterovirus	0.391 (24)	0.396 (27)	0.179 (12)	0.201 (15)	0.0018
Adenovirus	0.082 (5)	0.0145 (1)	0.00 (0)	0.0134 (1)	0.044
hMPV	0.082 (5)	0.059 (4)	0.045 (3)	0.0268 (2)	NS
Influenza A and B	0.016 (1)	0.044 (3)	0.075 (5)	0.0268 (2)	NS
PIV	0.163 (10)	0.132 (9)	0.030 (2)	0.0670 (5)	0.0097
RSV	0.049 (3)	0.147 (10)	0.030 (2)	0.0670 (5)	NS
Rhinovirus/enterovirus	0.538 (33)	0.485 (33)	0.299 (20)	0.442 (33)	NS

- The overall NRVI rate during years 3-4 was 38% lower than the mean rate of years 1 and 2. Excluding rhinovirus/enterovirus the NRVI was 52% lower during years 3-4.
- The rate of nosocomial infection was lower during year 3-4 than during years 1-2 for all viruses except influenza viruses
 - Lower rates were significant for adenovirus and RSV.

Results

Table 2. Burden of Hospitalizations with Respiratory Virus Infection (number of cases per year) by Virus

Respiratory Virus	Hospital Admissions with Respiratory Virus Infection				% Increase Years 3-4 vs. Years 1-2
	Prior to Enhanced Isolation Precautions		Enhanced Isolation Precautions		
	Year 1	Year 2	Year 3	Year 4	
All Viruses	1,238	1,395	1,734	1,932	39.2%
Adenovirus	42	41	64	140	145%
hMPV	89	135	106	103	-6.70%
Influenza A and B	135	121	91	183	7.03%
PIV	124	135	172	130	16.6%
RSV	290	346	385	429	28.0%
Rhinovirus/enterovirus	558	617	916	947	58.6%

- The burden of hospitalized children with viral respiratory infection increased 39.2% during years 3-4, and increased 23.7% higher if patients admitted with rhinovirus/enterovirus infection are excluded.

Limitations

- Single center study
- Potential for confounding variables

Conclusions

- The use of both contact and droplet precautions for inpatients with viral respiratory tract infections was associated with significant reductions in the incidence of nosocomial respiratory virus infections.