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Factors associated with respiratory pathogen panel utilization in children hospitalized with acute respiratory illness — New Vaccine Surveillance Network, Kansas City, 2017–2021

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INTRODUCTION

- Respiratory pathogen panels (RPP) are multiplex PCR platforms allowing simultaneous detection of several viruses from one sample
- Management of children hospitalized with acute respiratory illnesses (ARI) is supportive
- Use of RPP is not standardized
- Clinician discretion to obtain RPP

OBJECTIVE

- Understand factors associated with RPP utilization among pediatric patients hospitalized with ARI
- Characterize missed detections of pathogens in hospitalized pediatric patients with ARI

METHODS

From October 2017 to September 2021, participants <18 years hospitalized with ARI who were enrolled in the Kansas City site of the New Vaccine Surveillance Network (NVSN) were included in our study. NVSN is a CDC funded prospective surveillance cooperative evaluating the impact of vaccines and vaccine policy on epidemiology of ARI and acute gastroenteritis. Eligible patients were residents of Jackson County, MO, had ≥1 ARI symptom (fever, cough, earache, nasal congestion, runny nose, sore throat, vomiting after cough, wheezing, shortness of breath, rapid/shallow breathing, apnea, apparent life-threatening event, brief resolved unexplained event, myalgias), symptom duration <14 days, and were enrolled within 48 hours of admission. Parent interviews and medical chart reviews were conducted at enrollment. All participants had a research RPP (rRPP) collected and analyzed for surveillance purposes. The clinical provider did not have access to these results. Clinical providers were able to order a clinical RPP (cRPP) and/or rapid detection assays, for which they received test results. cRPP included testing for: rhino/enterovirus (Rh/Ev), respiratory syncytial virus (RSV), human metapneumovirus (hMPV), parainfluenza virus (PIV), adenovirus (AdV), SARS-CoV-2 (SARS), influenza (Flu), seasonal coronavirus (SCov) among a few others. Characteristics of NVSN enrollees hospitalized with ARI with and without a cRPP were collected including the pediatric complex chronic classifications system and analyzed via chi – square testing between groups.

Table 1. Characteristics of participants with and without clinical respiratory pathogen panels enrolled in the NVSN ARI Protocol, KC site, 2017-2021

	cRPP (N=538)	no cRPP (N=1256)	P-value
Age			
Median Age (months) [IQR]	16 [5, 47]	17 [5, 49]	0.22
0-2 mos	112 (20.8%)	179 (14.3%)	0.001
3-5 mos	37 (6.9%)	143 (11.4%)	0.004
6-11 mos	76 (14.1%)	164 (13.1%)	0.54
12-23 mos	98 (18.2%)	275 (21.9%)	0.08
24-59 mos	99 (18.4%)	226 (18.0%)	0.84
≥5yrs	116 (21.6%)	269 (21.4%)	0.95
Sex			
male	307 (57.1%)	732 (58.3%)	0.63
Parental Reported Race/Ethnicity			
White, non-Hispanic (NH)	188 (34.9%)	457 (36.4%)	0.56
Black, NH	198 (36.8%)	440 (35.0%)	0.47
Other, NH	6 (1.1%)	22 (1.8%)	0.32
Hispanic	105 (19.5%)	227 (18.1%)	0.47
Multi, NH	36 (6.7%)	103 (8.2%)	0.27
Unknown	5 (0.9%)	7 (0.6%)	0.38
Insurance Status			
Public	328 (61.0%)	729 (58.0%)	0.25
Private	154 (28.6%)	380 (30.3%)	0.49
Both	20 (3.7%)	31 (2.5%)	0.15
Self-Pay	36 (6.7%)	116 (9.2%)	0.08
Smoking Exposure			
Yes	121 (22.5%)	331 (26.4%)	0.08
Daycare, Pre-school, School Attendance			
Yes	189 (35.1%)	575 (45.8%)	<0.001
Seasonality			
Respiratory Season (November-March)	235 (43.7%)	649 (51.7%)	0.002
Non-Respiratory Season (April-October)	303 (56.3%)	607 (48.3%)	0.002
Parent Reported Conditions			
Asthma	97 (34.0%)	267 (44.5%)	0.003
Prematurity	82 (35.7%)	126 (28.6%)	0.06
Complex Care Condition[1]			
0 conditions	423 (78.9%)	1104 (88.5%)	<0.001
1 condition	65 (12.1%)	101 (8.1%)	0.007
2 conditions	16 (3.0%)	19 (1.5%)	0.04
≥3 conditions	32 (6.0%)	24 (1.9%)	<0.001
Technology dependence/assistance[2]			
yes	27 (5%)	19 (1.5%)	<0.001

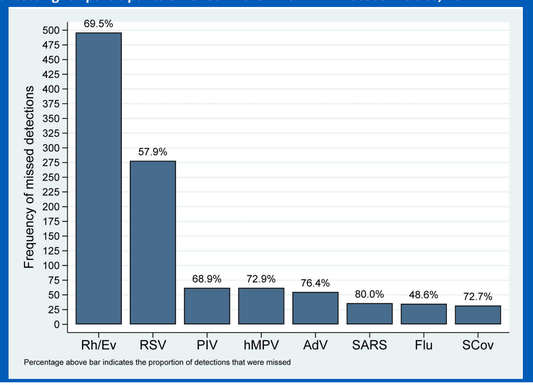
[1] Pediatric Complex Chronic Care Conditions Classification System

[2] "Forms of medical technology including medications or devices; and would, if the technology were to fail or its use be discontinued, likely suffer a sufficiently adverse health consequence that hospitalization would be required." Examples include tracheostomy, gastrostomy, CNS shunts.

Table 2. Parent reported clinical features of participants with and without clinical respiratory pathogen panels enrolled in the NVSN ARI Protocol KC site, 2017-2021

	cRPP (N=538)	no cRPP (N=1256)	P-value
Fever			
Yes	336 (62.5%)	777 (61.9%)	0.81
Max temperature at home			
Tactile	39 (11.6%)	120 (15.4%)	0.09
<39°C	162 (48.2%)	375 (48.3%)	0.99
≥39°C	114 (33.9%)	225 (29.0%)	0.10
Unknown	21 (6.3%)	57 (7.3%)	0.52
Cough			
Yes	435 (80.9%)	1164 (92.7%)	<0.001
Congestion			
Yes	442 (82.2%)	1115 (88.8%)	<0.001
Vomiting			
Yes	122 (22.7%)	251 (20.0%)	0.20
Skin Rash			
Yes	72 (13.4%)	137 (10.9%)	0.13
Irritability			
Yes	383 (71.2%)	911 (72.5%)	0.56
Red/Pink Eyes			
Yes	107 (19.9%)	254 (20.2%)	0.87

Figure 1. Pathogens detected on research surveillance testing, but missed by clinical testing for participants enrolled in the NVSN ARI Protocol KC site, 2017-2021



Percentage above bar indicates the proportion of detections that were missed

Table 3. Pathogen detection based on testing platform for participants enrolled in the NVSN ARI Protocol, KC site, 2017-2021

	2017-2018	2018-2019	2019-2020	2020-2021
	N = 427	N = 390	N = 277	N = 700
rRPP				
Flu	23 (5.4%)	7 (1.8%)	36 (13.0%)	6 (0.9%)
RSV	119 (27.9%)	87 (22.3%)	98 (35.4%)	176 (25.1%)
AdV	22 (5.2%)	18 (4.6%)	7 (2.5%)	25 (3.6%)
hMPV	17 (4.0%)	27 (6.9%)	17 (6.1%)	24 (3.4%)
Rh/En	195 (45.7%)	168 (43.1%)	78 (28.2%)	273 (39.0%)
SCov	14 (3.3%)	17 (4.4%)	6 (2.2%)	7 (1.0%)
SARS			2/90 (2.2%)	43/652 (6.6%)
PIV	24 (5.6%)	24 (6.2%)	11 (4.0%)	31 (4.4%)
Multiple pathogens	48 (11.2%)	50 (12.8%)	23 (8.3%)	67 (9.6%)
Negative	62 (14.5%)	88 (22.6%)	47 (17.0%)	178 (25.4%)
cRPP	n=99	n=101	n=81	n=257
Flu	3 (3.0%)	3 (3.0%)	2 (2.5%)	0 (0.0%)
RSV	15 (15.2%)	20 (19.8%)	14 (17.3%)	25 (9.7%)
AdV	2 (2.0%)	3 (3.0%)	2 (2.5%)	11 (4.3%)
hMPV	3 (3.0%)	7 (6.9%)	3 (3.7%)	12 (4.7%)
Rh/En	42 (42.4%)	40 (39.6%)	27 (33.3%)	144 (56.0%)
SCov	5 (5.1%)	4 (4.0%)	4 (4.9%)	5 (1.9%)
SARS	n/a	n/a	3/30 (10%)	7 (2.9%)
PIV	8 (8.1%)	7 (6.9%)	1 (1.2%)	13 (5.1%)
Multiple pathogens	6 (6.1%)	10 (9.9%)	1 (1.2%)	20 (7.8%)
Negative	27 (27.3%)	26 (25.7%)	29 (35.8%)	69 (26.8%)
Rapid Influenza[1]				
Not performed	356 (83.4%)	328 (84.1%)	178 (64.3%)	673 (96.1%)
Negative	63 (14.8%)	60 (15.4%)	78 (28.2%)	25 (3.6%)
Positive	8 (1.9%)	2 (0.5%)	21 (7.6%)	2 (0.3%)
Rapid RSV[1]				
Not performed	382 (89.5%)	349 (89.5%)	205 (74.0%)	540 (77.1%)
Negative	24 (5.6%)	27 (6.9%)	37 (13.4%)	77 (11.0%)
Positive	21 (4.9%)	14 (3.6%)	35 (12.6%)	83 (11.9%)
Rapid SARS-CoV-2[1]				
Not performed	n/a	n/a	0/30 (0.0%)	93 (13.3%)
Negative	n/a	n/a	27 (90.0%)	567 (81.0%)
Positive	n/a	n/a	3 (10.0%)	40 (5.7%)

[1] Stand alone rapid detection assays available to the clinician

RESULTS

- Medical complexity (6% vs 1.9%), age less than 2 months (20.8% vs 14.3%) had a larger proportion of participants who received cRPPs
- Daycare, pre-school or school attendance had a larger proportion of participants not receiving a cRPP (35.1% vs 45.8%)
- During respiratory season a larger proportion did not receive a cRPP (43.7% vs 51.7%) as opposed to a higher proportion of participants receiving a cRPP in the non-respiratory season (56.3% vs 48.3%)
- A higher proportion of participants with parental identified asthma did not receive a cRPP (34% vs 44.5%)
- Cough and congestion were the only parent reported clinical features associated with a difference in cRPP usage
- There are many pathogens that are undetected by clinical testing alone; 69.5% of Rhino/enterovirus, 57.9% of RSV, 48.6% of Flu

CONCLUSIONS

- Medical complexity, young age (0-2 months), technological dependence, and non-respiratory seasonality were predictors of cRPP use
- Many viruses are missed with only clinical testing including flu (opportunity for antiviral use) and RSV
- The missed detections with clinical testing illustrate the importance of surveillance testing to know the true burden of disease
- Plan to assess management differences between patients with and without positive cRPPs including antibiotic usage

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