

# ANTIBIOTIC OVERUSE AMONG CHILDREN WITH COVID-19 HOSPITALIZED IN A PEDIATRIC INTENSIVE CARE UNIT

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## ABSTRACT

**Background:** Antibiotic overuse has been well described among hospitalized adults with COVID-19 but similar evaluations in children are lacking. We sought to quantify bacterial infection rates and antibiotic utilization among critically ill children hospitalized with COVID-19 to identify opportunities to optimize care.

**Methods:** We performed a single center retrospective cohort study of all children hospitalized with symptomatic COVID-19 in a pediatric intensive care unit between May 16, 2020 and February 11, 2022 at a tertiary care children's hospital in the Southeastern U.S. We performed medical record review to abstract demographic and clinical characteristics. This study was approved by the institutional IRB with a waiver of consent.

**Results:** During the study period there were 92 subjects hospitalized in the intensive care unit with COVID-19. Demographic and clinical characteristics of the cohort are summarized in the **Table**. Median age was 12.4 years, median length of stay was 6 days, 32% of subjects required mechanical ventilation and 5% died. The vast majority of children had one or more comorbidities and only 1 subject was fully vaccinated against SARS-CoV-2. Thirteen (14%) subjects had bacterial growth from any clinical specimen. Eight subjects had respiratory cultures that may have represented airway colonization; when these were excluded, 5 (5%) subjects had either urinary tract or bloodstream infections. Two of the bloodstream infections were caused by drug-resistant organisms and were hospital-acquired. Despite the low number of subjects with bacterial infections, 45% received antibiotics for >3 days. The antibiotic days of therapy per subject varied widely and ranged from 0 to 61 days.

**Conclusions:** In this cohort of nearly 100 critically ill children with COVID-19, the rate of culture-confirmed bacterial infection ranged from 5-14% yet nearly half of patients received antibiotics. Limitations include the single center and retrospective study design and the fact that bacterial pneumonia may not be culture-confirmed. Despite these limitations, this work suggests that children with COVID-19 rarely have bacterial co-infections and are often prescribed unnecessary antibiotics.

## BACKGROUND

- Antibiotic resistant bacterial infections have increased globally during the COVID-19 pandemic for multiple reasons including understaffed, overburdened hospitals, high numbers of patients requiring intensive care and ventilatory support, prolonged hospitalizations, disruptions in infection control and antibiotic stewardship.
- Antibiotic overuse has been described among hospitalized adults with COVID-19, in whom up to 75% receive antibiotics but a very low proportion have bacterial co-infections.
- Similar evaluations in children are lacking.

**The OBJECTIVE of this study was to quantify antibiotic utilization and bacterial co-infection rates in children with COVID-19 who were hospitalized in the intensive care unit.**

## METHODS

- Single center retrospective cohort study
- All children hospitalized with symptomatic COVID-19 in a pediatric intensive care unit between 5/16/2020 and 2/11/2022 at Monroe Carrell Jr. Children's Hospital at Vanderbilt, Nashville, TN
- Medical records reviewed for demographic and clinical characteristics
- Multivariable logistic regression to determine predictors of antibiotic use

## RESULTS

- 112 subjects included (**Table 1**)
- 2/3 received antibiotics
- ~20% had growth of bacteria from any specimen source
- Respiratory cultures may have represented colonization
- 45% of positive cultures occurred >48h after admission
- 97 subjects included in multivariable model (**Table 2**)
- Independent predictors of antibiotic treatment were high inflammatory markers, comorbidity, or mechanical ventilation/ECMO

**Table 2. Predictors of antibiotic use**

Variable	Odds Ratio	95% CI	P-value
High CRP (>50 mg/L) or PCT (>0.5 µg/ml)	9.50	2.18-41.4	0.003
Comorbidity	4.38	1.28-14.98	0.018
Mechanical ventilation or ECMO	5.41	1.07-27.41	0.042
NIPPV	0.38	0.09-3.53	0.54

CRP, C-reactive protein; PCT, procalcitonin, ECMO, extracorporeal membrane oxygenation, NIPPV, non-invasive positive pressure ventilation

**Table 1. Cohort characteristics**

Characteristic	N (% of 112 subjects)
Median age in years (range)	9.8 (0.003 – 24.7)
Male sex	49 (43.8%)
Race	
Black	25 (22.3%)
White	72 (64.3%)
Asian	2 (1.8%)
Other	8 (7.1%)
Unknown	5 (4.5%)
Ethnicity	
Hispanic	15 (13.4%)
Non-Hispanic	92 (82.1%)
Unknown	5 (4.5%)
LOS median days (range)	7 (0-198)
Severity of illness	
Mechanical Ventilation	40 (35.7%)
ECMO	4 (3.6%)
NIPPV	76 (67.9%)
Death	8 (7.1%)
Comorbidity	90 (80.4%)
Fully COVID vaccinated	1 (0.9%)
Microbiology	
Bacterial growth in culture	24 (21.4%)
Blood	8 (7.1%)
Urine	4 (3.6%)
Urine or blood specimen	12 (10.7%)
Respiratory specimen	13 (11.6%)
Other body fluid	3 (2.7%)
Inflammatory Markers	
PCT or CRP obtained	97 (86.6%)
PCT (>0.5 µg/ml) or CRP (>50 mg/L)	43 (38.4%)
Procalcitonin, median µg/ml (range) [n=78]	0.305 (0.06 - >100)
CRP, median mg/L (range) [n=58]	25.05 (0.2 - 263)
Antibiotic Treatment	
No antibiotics	38 (34%)
Received antibiotics	74 (66.1%)
1-3 days	19 (17%)
>3 days	55 (49.1%)
Days of therapy [n=74] Median (range)	8 (1-61)

## LIMITATIONS

- Single center retrospective design
- Bacterial pneumonia may not be culture-confirmed

## CONCLUSIONS

- Children with COVID-19 rarely have bacterial co-infections yet are often prescribed unnecessary antibiotics, highlighting opportunities for antibiotic stewardship.
- Elevated CRP or PCT was independently associated with antibiotic use but may not predict bacterial co-infection in children with severe COVID-19.

