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## Concise Communication

# Antimicrobial use and opportunities for antimicrobial stewardship in pediatric postacute and long-term care settings

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**Abstract**

We performed a point-prevalence study of antimicrobial prescriptions in 9 pediatric postacute and long-term care (pPALTC) settings. Antimicrobials were prescribed for 5%–7% of residents including infectious (41%), noninfectious (24%), prophylaxis (24%), and unknown (11%) indications. Macrolides were often prescribed for noninfectious indications. Developing treatment guidelines are antimicrobial stewardship opportunities for pPALTC.

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Pediatric postacute and long-term care (pPALTC) settings provide residential healthcare for children with ongoing medical needs no longer requiring acute care.[1] Such children have unique risks for infections including the following: frequent use of medical devices, multipatient rooms, numerous contacts with staff and visitors, shared therapy equipment and toys, on-site schools, and age-related susceptibility to infections. Little is known about antimicrobial use and stewardship opportunities in pPALTC settings. We evaluated prescriptions for antimicrobials and identified potential antimicrobial stewardship opportunities in pPALCF settings.

## Methods

We conducted a retrospective point-prevalence survey of antimicrobial use on January 20 and July 20, 2016. Because a centralized database identifying pPALTC settings is lacking, we recruited sites from the Pediatric Complex Care Association (~40 sites, www.pediatriccomplexcare.org) and the Pediatric Leadership Committee of the Society of Healthcare Epidemiology of America (~30 participants). Eligible sites were in the United States and were freestanding pPALTC settings, pediatric postacute care units within acute-care settings, or PALTC settings serving both adults and children. Eligible residents were aged ≤21 years. Ineligible residents were receiving respite care or only attending daycare programs and/or on-site schools. The institutional review boards at Columbia University Irving Medical Center and the study sites approved the study with a waiver of informed consent.

Designated site staff collected data pertaining to the following site characteristics: number of beds, use of an electronic medical record (EMR), and resources for infection prevention and control and antimicrobial stewardship. On each point-prevalence date, site staff collected demographic and clinical characteristics of residents prescribed antimicrobial agents; the type of antimicrobial prescribed; route of administration including systemic (oral or intravenous) or topical (applied to the skin or via endotracheal or inhaled administration); and indications for prescription. Bacterial cultures and susceptibility testing results were collected, when available.

We used 4 parameters to identify antimicrobial stewardship opportunities. First, we considered antimicrobial use for noninfectious indications as stewardship opportunities. Second, we assessed adherence to treatment guidelines for hospital-acquired pneumonia (HAP) or ventilator-associated pneumonia (VAP),[2] otitis media (OM),[3] urinary tract infections (UTIs),[4] and skin and soft-tissue infections (SSTIs).[5] Third, we determined the proportion of prescriptions without a stated indication. Fourth, we assessed pathogen–drug mismatches, that is, treatment with an agent to which the identified organism was resistant.

Descriptive statistics included frequencies, means (standard deviations), and medians (interquartile range). We performed $\chi^2$ and Student *t* tests, as appropriate. *P* values <.05 were considered significant.

## Results

In total, 9 sites participated: 5 in the Northeast Census region, 3 in the South, and 1 in the West. Also, 3 sites had ≤50 beds, 3 sites had 51–100 beds, and 3 sites had >100 beds. All sites had an infection preventionist, of whom 5 were full time. In addition, 6 sites had an antimicrobial stewardship program with physician oversight. Of these, 4 sites had restricted formularies and 5 sites used audit and feedback. Furthermore, 8 sites had an EMR: 7 included antibiotic dosing guidelines and 4 required indications for antibiotic prescriptions. All sites had access to bacterial cultures and susceptibility testing.

On the January study date versus the July study date, systemic antimicrobial agents were prescribed to 56 (7%) of 834 residents

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PREVIOUS PRESENTATION. The preliminary data from this project were presented as a poster, "Point prevalence survey on antimicrobial use in pediatric postacute care facilities," at IDWeek 2017 on October 4–8, 2017, in San Diego, California.

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**Table 1.** Indications for Systemic Antimicrobial Agents Prescribed in Pediatric Postacute and Long-Term Care Settings on Each Point-Prevalence Survey Date, January Versus July

| Indication | Overall[a] (n = 111 agents), No. % | January (n = 63 agents), No. % | July (n = 48 agents), No. % |
|---|---|---|---|
| **Infections** | 45 (41) | 30 (48) | 15 (31) |
| Skin and soft tissue | 12 (11) | 9 (14) | 3 (6) |
| Urinary tract | 10 (9) | 9 (14) | 1 (2) |
| Head, eye, ear, nose, throat | 6 (5) | 4 (6) | 2 (4) |
| Respiratory tract | 8 (7) | 4 (6) | 4 (8) |
| Bloodstream | 3 (3) | 3 (5) | . . . |
| Gastrointestinal | 3 (3) | 1 (2) | 2 (4) |
| **Noninfectious indications** | 27 (24) | 15 (24) | 12 (25) |
| Dysmotility | 17 (15) | 11 (17) | 6 (13) |
| Neurologic | 7 (6) | 4 (6) | 3 (6) |
| Other[b] | 3 (3) | . . . | 3 (6) |
| **Prophylaxis** | 27 (24) | 14 (22) | 13 (27) |
| Urinary tract infection | 10 (9) | 6 (10) | 4 (8) |
| Asplenia | 6 (5) | 3 (5) | 3 (6) |
| Skin and soft tissue infection | 3 (3) | 2 (3) | 1 (2) |
| Chronic respiratory tract infection | 2 (2) | 1 (2) | 1 (2) |
| Other[c] | 4 (4) | 2 (3) | 2 (4) |
| **Unknown** | **11 (10)** | **4 (6)** | **7 (15)** |

[a]13% of residents in January and 10% of residents in July were treated with >1 systemic agent.
[b]Other noninfectious indications: abrasion, tracheal edema, tracheocutaneous fistula, eczema.
[c]Other prophylaxis: post-transplant, neutropenia, chronic otitis media, gastrointestinal bacterial overgrowth.

versus 40 (5%) of 851 residents, respectively. For residents prescribed antimicrobials, the median length of pPALTC stay was 3.3 years (interquartile range [IQR], 0.4– 7.9) in January and 3.4 years (IQR, 0.5–8.0) in July. On both dates, neurologic, respiratory, and gastrointestinal comorbid conditions were most common; 63% of residents had ≥3 comorbidities and most had ≥2 medical devices (81% in January and 70% in July). The proportion of residents who were prescribed antibiotics with tracheostomy tubes was higher in January than in July (68% vs 48%, respectively; $P < .05$).

Similar indications for systemic agents were reported on both dates and included infectious (41%), noninfectious (24%), and prophylaxis (24%) indications; 11% lacked an indication (Table 1). SSTI was the most common infectious indication, gastrointestinal dysmotility was the most common noninfectious indication, and UTI was the most common prophylaxis indication. Macrolide agents were the most common antimicrobials prescribed on both study dates and were most often prescribed for noninfectious indications (19 of 25, 76%) (Table 2).

On each date, 36 residents (4%) were prescribed topical antimicrobial agents, of which 29% were prescribed for infectious indications, 31% were prescribed for noninfectious indications, and 10% were prescribed for prophylaxis indications, whereas 30% lacked an indication. Clindamycin, bacitracin, and mupirocin were the most common topical agents prescribed: 15 (94%) of 16 topical clindamycin prescriptions were for acne and 6 of 6 inhaled aminoglycoside prescriptions were prophylaxis for respiratory tract infections (RTIs).

Of 12 residents prescribed antimicrobials for RTIs, 8 were diagnosed with tracheitis and 4 were diagnosed with pneumonia. Of these 12 residents, 7 received a systemic agent and 5 received a topical agent. None received recommended agents for HAP or VAP.[2] Of 4 residents aged ≤12 years with OM, 3 were prescribed amoxicillin as recommended.[3] Topical agents were prescribed for 4 of 9 residents with cellulitis and 1 of 4 residents with an abscess, which is inconsistent with SSTI guidelines.[5]

Culture results were available for 19 (42%) of 45 infections: 9 of 10 UTIs; 5 of 10 RTIs; 1 of 1 BSI; and 4 of 23 SSTIs. Antimicrobial susceptibility data were available for 17 (89%) of 19 positive cultures; pathogen–drug mismatches were identified for 3 (18%) of 17 cultures.

## Discussion

This multicenter study is the first to assess antibiotic use in pPALTC settings. Overall, 5%–7% of residents were prescribed a systemic antibiotic on the study dates. This rate is similar to prescribing prevalence rates in adult PALTC (aPALTC) settings, which have ranged from 6% to 10%.[6] SSTIs were the most common infection in these pPALTC facilities, whereas UTIs and RTIs were most common in aPALTC facilities.[6]

We identified several stewardship opportunities. Prescriptions for narrow-spectrum systemic agents were relatively common, but nearly half were for noninfectious indications and prophylaxis, which may be associated with adverse outcomes. For example, when used for gastrointestinal dysmotility, erythromycin can be associated with resistance and adverse impacts on the gastrointestinal microbiome; thus, alternative prokinetic agents should be used, when feasible.[7] Prescriptions for topical antimicrobials were nearly as common as prescriptions for systemic agents. We speculate that the use of topical prophylaxis for SSTIs reflects staff and family concerns about maintaining skin integrity because this population can develop skin breakdown and subsequent complications. However, staff and family should be provided education given reports of the emergence of mupirocin-resistance in aPALTC associated with decolonization.[8]

This study had several limitations. We included a small number of sites, and data collection was restricted to 2 days; thus, the findings may not be generalizable to other pPALTC settings. Many of the treatment guidelines we used to assess appropriateness of prescriptions do not target pPALTC residents. Treatment guidelines for HAP and VAP are intended for adults in acute care.[2] UTI treatment guidelines address children aged <24 months.[4] In this study, 90% of residents with UTIs were ≥24 months old. OM treatment guidelines address children aged ≤12 years.[3] In this study, 33% of residents with OM were aged >12 years. In fact, lack of treatment guidelines was a recognized barrier for antimicrobial stewardship by pPALTC staff.[9] Furthermore, we did not assess additional metrics of prescribing, such as dosing or duration, nor assess the frequency of infections with multidrug-resistant organisms or *Clostrioides difficile*.

This study was performed before the implementation of the Centers for Medicaid and Medicare Services' rule requiring antimicrobial stewardship programs in aPALTC settings as a condition of reimbursement.[10] Future studies evaluating the implementation

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**Table 2.** Administration Route and Types of Systemic Antimicrobials Prescribed for Infections, Noninfectious Indications, and Prophylaxis in Pediatric Postacute and Long-Term Care Settings

| Administration Route Antimicrobial Type | Infections, No. % | Noninfectious, No. % | Prophylaxis, No. % | Unknown, No. % | Total, No. % |
|---|---|---|---|---|---|
| **Oral** | 37 (20) | 27 (15) | 27 (15) | 10 (5) | 101 (54) |
| Macrolide agent | 1 (0.5) | 19 (10) | 3 (2) | 2 (1) | 25 (14) |
| Amoxacillin, amoxicillin-clavulonate | 10 (5) | 1 (0.5) | 7 (4) | 2 (1) | 20 (11) |
| Cephalexin, cefdinir | 8 (4) | . . . | 2 (1) | 1 (0.5) | 11 (6) |
| Amantadine | . . . | 7 (4) | . . . | 3 (2) | 10 (5) |
| Nitrofurantoin | 2 (1) | . . . | 6 (3) | . . . | 8 (4) |
| Trimethoprim-sulfamethoxazole | 4 (2) | . . . | 3 (2) | 1 (0.5) | 8 (4) |
| Fluoroquinolone agent | 6 (3) | . . . | . . . | . . . | 6 (3) |
| Other[a] | 6 (3) | . . . | 6 (3) | 1 (0.5) | 13 (7) |
| **Intravenous** | 5 (3) | . . . | . . . | 1 (0.5) | 6 (3) |
| Ceftriaxone | 2 (1) | . . . | . . . | 1 (0.5) | 3 (2) |
| Ampicillin | 1 (0.5) | . . . | . . . | . . . | 2 (1) |
| Vancomycin | 1 (0.5) | . . . | . . . | . . . | 1 (0.5) |
| Meropenem | 1 (0.5) | . . . | . . . | . . . | 1 (0.5) |

[a]Other (n): clindamycin (4), acyclovir (4), metronidazole (2), fluconazole (1), linezolid (1), vancomycin (1).

of this rule in pPALTC settings could identify successful stewardship strategies for these resource-challenged settings. Additionally, creating definitions for infections applicable to pPALTC settings and better understanding of pathogens and their susceptibility patterns would facilitate the development of treatment guidelines for pPALTC.

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