**Table 8. Pediatric parenteral antimicrobial dosage guidelines**

| Antibiotic | Usual Dosages[a, b] |
|---|---|
| **ANTIBACTERIAL AGENTS** | |
| *Penicillins* | |
| Ampicillin | 100-400 mg/kg/day divided q6h |
| Cloxacillin | 100-200 mg/kg/day divided q6h |
| Penicillin G Sodium | 100,000-500,000 units/kg/day divided q4-6h |
| Piperacillin ± Tazobactam | 300-400 mg/kg/day divided q6h[c] |
| Meropenem | 60-120 mg/kg/day divided q8h |
| *Cephalosporins* | |
| Cefazolin | 50-150 mg/kg/day divided q8h |
| Cefoxitin | 80-160 mg/kg/day divided q8h |
| Cefuroxime | 75-150 mg/kg/day divided q8h |
| Cefotaxime | 100-300 mg/kg/day divided q6-8h |
| Ceftriaxone | 50-100 mg/kg/day divided q12-24h |
| Ceftazidime | 100-150 mg/kg/day divided q8h |
| *Macrolides* | |
| Azithromycin | 5-10 mg/kg q24h |
| *Aminoglycosides* | |
| Gentamicin | 5-9 mg/kg/day divided q8-24h[d,f] |
| Tobramycin | 5-9 mg/kg/day divided q8-24h[d,f] |
| *Others* | |
| Clindamycin | 25-40 mg/kg/day divided q8h |
| Cotrimoxazole | 6-20 mg/kg/day divided q6-12h[e] |
| Metronidazole | 30 mg/kg/day divided q8h |
| Vancomycin | 60 mg/kg/day divided q6h |
| **ANTIFUNGAL AGENTS** | |
| Amphotericin B | 0.25-1.5 mg/kg q24h |
| Amphotericin B liposomal | 3-5 mg/kg q24h |
| Fluconazole | 3-12 mg/kg q24h |
| Micafungin | 1-3 mg/kg q24h |
| **ANTIVIRAL AGENTS** | |
| Acyclovir | 15-60 mg/kg/day divided q8h |
| Ganciclovir (induction doses) | 10 mg/kg/day divided q12h |

[a] Typical doses in infants and children. Maximum doses should not exceed typical adult doses.

[b] Does not reflect dosing in neonates; refer to Pediatric Drug Dosage Handbook (Lexi-comp) for dosing information in this patient population.

[c] Dosing based on piperacillin component only.

[d] Dosing varies with patient age. Refer to Pediatric Drug Dosage Handbook (Lexi-comp) for more comprehensive dosing information.

[e] Dosing based on trimethoprim component only.

[f] Patients with cystic fibrosis may require higher doses.

**Table 9. Pediatric dosing recommendations in renal impairment[a]**

| Drug | Creatinine Clearance ($CL_{CR}$) in mL/min/1.73 $m^2$[b] (suggested dosage adjustment based on normal dose) | | | | Supplement for Dialysis |
|---|---|---|---|---|---|
| **Penicillins** | | | | | |
| Ampicillin | > 30 (q6h) | 10-30 (q8-12h) | < 10 (q12h) | | HD |
| Cloxacillin | NO CHANGE NECESSARY | | | | NO |
| Penicillin | > 50 (q4-6h) | 10-50 (75%) | < 10 (20 - 50%) | | HD |
| Piperacillin | > 50 (q6h) | 20-50 (q8h) | < 20 (q12h) | | HD |
| Piperacillin/ Tazobactam | > 50 (q6h) | 30-50 (65% q6h) | < 30 (50% q8h) | | HD |
| **Cephalosporins** | | | | | |
| Cefazolin | > 30 (q8h) | 10-30 (q12h) | < 10 (q24h) | | HD |
| Cefotaxime | > 50 (q6-8h) | 10-50 (q12h) | < 10 (q24h) | | HD |
| Ceftriaxone | NO CHANGE NECESSARY | | | | NO |
| Cefoxitin | > 50 (q6-8h) | 30-50 (q8h) | 10-29 (q12h) | < 10 (q24h) | HD |
| Ceftazidime | > 50 (q8h) | 30-50 (q12h) | 10-29 (q24h) | < 10 (q48h) | HD, PD |
| Cefuroxime | > 30 (q8h) | 10-30 (q12h) | < 10 (q24h) | | HD |
| **Miscellaneous** | | | | | |
| Acyclovir | > 50 (q8h) | 30-50 (q12h) | 10-29 (q24h) | < 10 (50% q24h) | HD |
| Aminoglycosides[c] | Refer to Pediatric Drug Dosage Handbook (Lexicomp) for more information | | | | HD, PD |
| Azithromycin | NO CHANGE NECESSARY | | | | NO |
| Clindamycin | NO CHANGE NECESSARY | | | | NO |
| Fluconazole | > 50 (q24h) | 10-50 (50% q24h) | < 10 (50% q48h) | | HD |
| Ganciclovir (induction doses) | > 50 5 mg/kg q12h | 30-50 2.5 mg/kg q24h | 10-29 1.25 mg/kg q24h | < 10 1.25 mg/kg 3x/wk | HD |
| Meropenem | > 50 (q8h) | 30-50 (q12h) | 10-29 (50% q12h) | < 10 (50% q24h) | HD, PD |
| Metronidazole | > 10 (q8h) | < 10 (50% q8h) | | | HD |
| TMP-SMX[a] | > 50 (q6-8h) | 30-50 (q8h) | 10-29 (q12h) | < 10 (q24h) generally not recommended[a] | HD |
| Vancomycin[c] | > 50 (q6-8h) | 30-50 (q12h) | 10-29 (q24h) | < 10 dose as needed per serum concentration | NO |

[a] Suggested dosages – for individualized dosage modifications or more information contact the Department of Pharmaceutical Services.

[b] To estimate creatinine clearance ($CL_{CR}$) (mL/min/1.73 $m^2$) use the following calculation:

$$CL_{CR} = \frac{36.5 \times \text{height (cm)}}{S_{CR}\ (\mu\text{moles/L})}$$ **(Only for patients 1–18 years old)**

[c] Monitor serum concentrations, for individualized dosage modifications contact Department of Pharmaceutical Services.

HD = Hemodialysis PD = Peritoneal Dialysis

Health Sciences Centre
Winnipeg

# Children's Hospital Antibiogram for 2021

(Based on data from 2020)


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## DISCLAIMERS

This guide is provided as an educational resource for physicians and other healthcare professionals caring for patients at the Winnipeg Children's Hospital. The authors of the guide have made every effort to ensure that the information contained in it was accurate at the time of publication. Users of the guide are encouraged to consult other references to confirm the information presented in it. The authors are not responsible for errors, omissions, inaccuracies, or the continued completeness of the information contained in the guide. The information in the guide should not be used or relied upon to replace the skill and professional judgment required to determine appropriate patient care and treatment. Also, the guide is not intended to replace or to be used as a substitute for the complete prescribing information prepared by each pharmaceutical manufacturer for their anti-infective agents. Because of possible changes in anti-infective indications, changes in dosage information, differences in patients' responses to therapy, newly described toxicities, drug-drug interactions, and other items of importance, reference to complete prescribing information is recommended before any of the anti-infective agents described in the guide are used.

## HOW TO USE THE ANTIBIOGRAM PORTION OF THE GUIDE (Tables 1-6)

- The information presented in the antibiogram is intended only to guide initial empiric anti-infective agent therapy at the Winnipeg Children's Hospital.
- Initial broad-spectrum empiric therapy should be focused to the most appropriate narrow-spectrum agent(s) based on the laboratory identification of pathogen(s) and known susceptibility patterns/results, if the situation permits.
- Consideration should be given to equally efficacious but less expensive anti-infective agents for empiric therapy or when streamlining of therapy is desired, if the situation permits.

**Table 1. In vitro activity of selected anti-infective agents tested against Gram-negative bacilli[a]**

| Organism (number tested): January through December 2020 ▭ = Not tested, not routinely reported, or not recommended | Percent Susceptible | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ampicillin | Amoxicillin-Clavulanate | Piperacillin-Tazobactam | Cefazolin | Cephalexin[b] | Cefuroxime | Ceftriaxone | Ceftazidime | Ertapenem | Meropenem | Gentamicin | Tobramycin | Trimethoprim-Sulfamethoxazole | Nitrofurantoin[c] |
| *Enterobacter cloacae* complex (38) | | | 82 | | | | 82 | 82 | 89 | 97 | 97 | 97 | 82 | 47 |
| *Escherichia coli* (39) systemic | 33 | 79 | 92 | 36 | | | 87 | 87 | 100 | 100 | 90 | 87 | 59 | |
| *Escherichia coli* (414) urine | 46 | 81 | 95 | 50 | n.d. | | 94 | 94 | 100 | 100 | 93 | 94 | 72 | 97 |
| *Haemophilus influenzae* (75)[d] | 65 | n.d. | | | | 97 | | | | | | | 64 | |
| *Klebsiella pneumoniae* (48) | | 90 | 94 | 67 | n.d. | | 94 | 94 | 100 | 100 | 100 | 98 | 85 | 19 |
| *Klebsiella/Raoultella* spp. (62)[e] | | 94 | 97 | 21 | | | 97 | 97 | 100 | 100 | 97 | 97 | 97 | 81 |
| *Pseudomonas aeruginosa* (66) | | | 95 | | | | | | 95 | | 92 | 97 | 98 | | |

[a] Isolates tested and reported are from all sources combined, with the exception of *Escherichia coli* (subdivided into systemic isolates and urine isolates); isolates were collected from Jan 1 to Dec 31, 2020; data compiled according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) in their document M39-A4 (2014).

[b] Cephalexin is only indicated for the treatment of uncomplicated lower urinary tract infections.

[c] Nitrofurantoin is only indicated for acute cystitis.

[d] *H. influenzae* data obtained from isolates tested at Health Sciences Centre (adult and pediatric patients), Jan 1 to Dec 31, 2017. Sixty-one isolates were tested for Cefuroxime and 69 isolates were tested for Trimethoprim-Sulfamethoxazole.

[e] The current laboratory identification system is unable to differentiate *Klebsiella oxytoca* from *Raoultella* spp.

n.d. = no data – absence of data for certain drug-organism combinations reflects limitations of the testing method currently used by Shared Health Clinical Microbiology laboratories.

**Table 2. In vitro activity of selected anti-infective agents tested against Gram-positive cocci[a]**

| Organism (number tested): January through December 2020 ▭ = Not tested, not routinely reported, or not recommended | Percent Susceptible | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Penicillin | Ampicillin | Oxacillin[b] | Vancomycin | Daptomycin | High-Level Gentamicin[c] | High-Level Streptomycin[c] | Erythromycin[d] | Clindamycin | Trimethoprim-Sulfamethoxazole | Rifampin[e] | Linezolid | Nitrofurantoin[c] |
| *Enterococcus faecalis* (43) | | 100 | | 100 | 100 | 86 | 98 | | | | | n.d. | 98 |
| *Staphylococcus aureus* (439) | | | 61 | 100 | 100 | | | 56 | 79 | 99 | 100 | 100 | 100 |
| *Staphylococcus epidermidis* (66) | | | 29 | 100 | 100 | | | 24 | 58 | 64 | 97 | 100 | 100 |
| *Streptococcus pyogenes* (n.a.)[g] (Group A *Streptococcus*) | 100 | | | | | | | | | | | | |
| *Streptococcus agalactiae* (162)[h] (Group B *Streptococcus*) | 100 | | | 100 | | | | | 60 | | | | |

[a] Isolates tested and reported are from all sources (surveillance isolates excluded), Jan to Dec, 2020; data compiled according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) in their document M39-A4 (2014).

[b] Oxacillin accurately predicts the activity of all semi-synthetic penicillins, including cloxacillin, beta-lactam/beta-lactamase inhibitor combinations, cephalosporins, and carbapenems for *Staphylococcus aureus* and coagulase-negative staphylococci.

[c] Susceptibility to high-level gentamicin or high-level streptomycin indicates that these agents can be used in combination with a cell wall active agent (e.g., ampicillin or vancomycin) for synergy. Gentamicin and streptomycin should never be used alone as treatment for *Enterococcus* spp.

[d] Erythromycin activity predicts the activity of azithromycin and clarithromycin for staphylococci and streptococci.

[e] Rifampin should NOT be used alone as treatment for infection.

[f] Nitrofurantoin is indicated for acute cystitis only.

[g] n.a. = not applicable – Susceptibility testing of *Streptococcus pyogenes* is not routinely performed as 100% are susceptible to penicillin. If treating infection in a penicillin allergic patient, contact the lab for testing of second line agents.

[h] *Streptococcus agalactiae* isolates were obtained from vaginal/rectal swabs submitted for Group B *Streptococcus* detection to the Health Sciences Centre, St. Boniface Hospital, and Westman Laboratory in 2012.

n.d. = no data – absence of data for certain drug-organism combinations reflects limitations of the testing method currently used by Shared Health Clinical Microbiology laboratories.

**Table 3. In vitro activity of selected anti-infective agents tested against *Streptococcus pneumoniae*[a]**

| Infection Type (number tested) ▭ = Not tested, not routinely reported, or not recommended | Percent Susceptible | | | | | |
|---|---|---|---|---|---|---|
| | Penicillin (oral) | Penicillin (intravenous) | Ceftriaxone | Vancomycin | Clarithromycin | Trimethoprim-Sulfamethoxazole |
| Systemic Isolates (Blood + CSF)[b] | | | | | | |
| Meningitis (180) | | 83 | 96 | 100 | | 86 |
| Non-Meningitis infection (180) | 83 | 98 | 99 | 100 | 68 | 86 |
| Respiratory Isolates[c] | | | | | | |
| Non-Meningitis infection (40) | 78 | 95 | 98 | 100 | 68 | 80 |

[a] For *Streptococcus pneumoniae*, different susceptibility breakpoints for penicillin and ceftriaxone exist depending on whether meningitis or a non-meningitis infection is being treated [CLSI, M100, 30th edition]. For penicillin, when treating a non-meningitis infection different breakpoints exist for oral and intravenous dosing. For non-meningitis infections, susceptibility to oral penicillin predicts susceptibility to amoxicillin. Oral agents are not appropriate for the treatment of bacterial meningitis.

[b] Systemic isolates were obtained from patients across Manitoba as part of the SAVE Study between January and December, 2017 (adult and pediatric data). CSF = cerebrospinal fluid.

[c] Respiratory isolates were obtained from patients (adult and pediatric) at the Health Sciences Centre (HSC) and St. Boniface Hospital (SBH) between January and December, 2018.

**Table 4. In vitro activity of selected anti-infective agents tested against Methicillin-Susceptible and Methicillin-Resistant *Staphylococcus aureus* isolates[a]**

| Organism (number tested) ▭ = Not tested, not routinely reported, or not recommended | Percent Susceptible | | | | | | |
|---|---|---|---|---|---|---|---|
| | Oxacillin[b] | Vancomycin | Trimethoprim-Sulfamethoxazole | Erythromycin | Clindamycin | Linezolid | Daptomycin |
| Methicillin-Susceptible *Staphylococcus aureus* (277) | 100 | | 99 | 72 | 77 | | |
| Methicillin-Resistant *Staphylococcus aureus* (182) | 0 | 100 | 99 | 30 | 82 | 100 | 100 |

[a] Isolates tested and reported are from all sources (surveillance isolates excluded), Jan to Dec, 2020; data compiled according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) in their document M39-A4 (2014).

[b] Oxacillin accurately predicts the activity of all semi-synthetic penicillins, including cloxacillin, beta-lactam/beta-lactamase inhibitor combinations, cephalosporins, and carbapenems for *Staphylococcus aureus*.

**Table 5. In vitro activity of selected anti-infective agents tested against anaerobic isolates collected from hospitals in Winnipeg[a]**

| Organism (number tested) ▭ = Not tested, not routinely reported, or not recommended | Percent Susceptible | | | | | | |
|---|---|---|---|---|---|---|---|
| | Penicillin | Amoxicillin-Clavulanate | Piperacillin-Tazobactam | Cefoxitin | Clindamycin | Meropenem | Metronidazole |
| *Bacteroides* spp. (256) | | 91 | n.d. | 83 | 48 | 95 | 99 |
| *Bacteroides fragilis* (74) | | 94 | 97 | 91 | 57 | 96 | 99 |
| *Bacteroides ovatus* (37) | | 80 | n.d. | 64 | 51 | 89 | 97 |
| *Bacteroides thetaiotaomicron* (37) | | 97 | n.d. | 56 | 24 | 100 | 100 |
| *Bacteroides fragilis* group (74) | | 88 | n.d. | 92 | 45 | 95 | 100 |

[a] Isolates were obtained from WRHA hospitals between Jan 2015 and July 2016; data compiled according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) in their document M39-A4 (2014).

n.d. = no data – absence of data for certain drug-organism combinations reflects limitations of the testing method currently used by Shared Health Clinical Microbiology laboratories.

**Table 6. In vitro activity of selected anti-fungal agents tested against *Candida* species collected from hospitals in Winnipeg[a]**

| Organism (number tested) | Percent Susceptible | | |
|---|---|---|---|
| | Fluconazole[b] | Voriconazole | Micafungin |
| *Candida albicans* (33) | 100 | 100 | 100 |
| *Candida glabrata* (34) | 91 | n.d. | 97 |

[a] Data obtained by testing a random sample of *C. albicans* and *C. glabrata* isolates from Health Sciences Centre and St. Boniface Hospital, collected between Jan 2017 and Dec 2018. Susceptibility interpretations are based on updated CLSI breakpoints (M60, 1st Edition). Isolates tested and reported are from blood only.

[b] For fluconazole, there is only a susceptible-dose dependent (SDD) breakpoint for *C. glabrata*. The percentage of *C. glabrata* isolates that tested SDD to fluconazole was 91%. Susceptibility of SDD isolates to fluconazole is dependent on achieving the maximum blood level possible (i.e., should use the maximum dosage regimen). Consultation with infectious diseases is recommended for further guidance.

n.d. = breakpoints have not been defined for voriconazole versus *C. glabrata*.

**Table 7. Pediatric oral antimicrobial dosage guidelines**

| Antibiotic | Usual Dosages[a, b] | Cost ($) per day[c] |
|---|---|---|
| **ANTIBACTERIAL AGENTS** | | |
| *Penicillins* | | |
| Amoxicillin | 25–100 mg/kg/day divided bid-tid[d,g] | 1.05–2.10 |
| Amoxicillin-Clavulanate | 25–100 mg/kg/day divided bid-tid[e,h] | 3.10 |
| Cloxacillin | 50–100 mg/kg/day divided qid | 0.65–1.30 |
| Penicillin V | 25–50 mg/kg/day divided tid-qid | 0.40–0.80 |
| *Cephalosporins* | | |
| Cefprozil | 15–30 mg/kg/day divided bid | 2.25–4.50 |
| Cephalexin | 25–100 mg/kg/day divided tid-qid | 0.9–1.80 |
| *Macrolides* | | |
| Azithromycin | 5–10 mg/kg once daily | 1.25–2.05 |
| Clarithromycin | 15 mg/kg/day divided bid | 1.60–3.20 |
| *Others* | | |
| Clindamycin | 20–40 mg/kg/day divided tid | 1.50–3.00 |
| Cotrimoxazole | 6–12 mg/kg/day divided bid[f] | 0.10–0.25 |
| Nitrofurantoin | 5–7 mg/kg/day divided qid | 0.70–1.50 |
| Metronidazole | 30–40 mg/kg/day divided tid | 0.30–0.60 |
| **ANTIFUNGAL AGENTS** | | |
| Fluconazole | 6–12 mg/kg once daily | 5.55–25.00 |
| Itraconazole | 3–10 mg/kg once daily | 4.20–8.40 |
| Ketoconazole | 3.3–6.6 mg/kg once daily | 1.30–2.60 |
| **ANTIVIRAL AGENTS** | | |
| Acyclovir | 30–80 mg/kg/day divided 3-5x/day | 7.60–12.60 |
| Valacyclovir | 40 mg/kg/day divided bid | 1.70–7.00 |

[a] Typical doses in infants and children. Maximum doses generally should not exceed typical adult doses.

[b] Does not reflect dosing in neonates; refer to Pediatric Drug Dosage Handbook (Lexicomp) for dosing information in this patient population.

[c] Approximate cost per inpatient day excluding dispensing costs as of February 2010 based on the Manitoba Drug Interchangeability Formulary and Manufacturer's List Prices. Prices have been rounded and are based on typical adult daily doses.

[d] Use 25-50 mg/kg/day for infants ≤ 3 months

[e] Dosing based on amoxicillin component only

[f] Dosing based on trimethoprim component only

[g] BID dosing only for acute otitis media

[h] Use 30 mg/kg/day divided BID for infants ≤ 3 months