Definitions and Equations

**BMI** = \(\frac{weight}{height^2 (m^2)}\)

<table>
<thead>
<tr>
<th>WHO BMI Classification</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese Class I and II (obese)</td>
<td>BMI 30-40 kg/m²</td>
</tr>
<tr>
<td>Obese Class III (morbidly obese)</td>
<td>BMI ≥ 40 kg/m²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body Weight</th>
<th>Equation¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBW (kg)</td>
<td>Male: 50.0 + 2.3 × (number of inches over 5 ft)</td>
</tr>
<tr>
<td></td>
<td>Female: 45.5 + 2.3 × (number of inches over 5 ft)</td>
</tr>
<tr>
<td>ABW (kg)</td>
<td>IBW + C × (TBW – IBW)</td>
</tr>
<tr>
<td></td>
<td>C = either 0.3 or 0.4 (ABW₀.₃ or ABW₀.₄)</td>
</tr>
<tr>
<td>LBW₂₀₀₅ (kg)</td>
<td>Lean body weight</td>
</tr>
<tr>
<td>Male:</td>
<td>(\frac{9270 \times TBW}{6680 + 216 \times BMI})</td>
</tr>
<tr>
<td>Female:</td>
<td>(\frac{8780 + 244 \times BMI}{9270 \times TBW})</td>
</tr>
</tbody>
</table>

**LBW for antituberculosis medications:**
- Lean Body Weight (men) = \((1.10 \times Weight(kg)) - 128 \times \left(\frac{Weight^2}{100 \times Height(m)^2}\right)\)
- Lean Body Weight (women) = \((1.07 \times Weight(kg)) - 148 \times \left(\frac{Weight^2}{100 \times Height(m)^2}\right)\)

**TBW (kg)**
- Total/actual body weight

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**Table 1:** Recommended Antibiotic Dosing in Obesity (BMI ≥ 30 kg/m²)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Maximum Dose²</th>
<th>Study Type³</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Case studies</td>
<td>PK/PD studies</td>
</tr>
<tr>
<td><strong>β-lactams</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>No Data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>Insufficient data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nafcillin</td>
<td>Insufficient data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Piperacillin-tazobactam⁴³⁴</td>
<td>Up to 4.5 g q8h (prolonged infused over 4 hours) or 4.5 g q6h (30 min infusion)</td>
<td>● ● ●</td>
<td>● ●</td>
</tr>
<tr>
<td>Cefazolin¹⁵⁻²¹</td>
<td>Insufficient data</td>
<td>-</td>
<td>● ●</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>No data</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>Administration</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td><strong>Cefepime, ceftazidime</strong>&lt;sup&gt;14,24,25&lt;/sup&gt;</td>
<td>Up to 2g q8h prolonged infusion</td>
<td>Prolonged infusion if critically ill, CF, FN, obese with CrCl &gt; 100 ml/min, infections with less susceptible pathogens (i.e. MIC ≥8)</td>
<td></td>
</tr>
<tr>
<td><strong>Ceftazidime/avibactam</strong>&lt;sup&gt;26,27&lt;/sup&gt;</td>
<td>No change</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ceftolozane/tazobactam</strong>&lt;sup&gt;28&lt;/sup&gt;</td>
<td>No change</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Doripenem</strong>&lt;sup&gt;14,29-31&lt;/sup&gt;</td>
<td>No change</td>
<td>- Consider extended infusion if targeting a higher PD endpoint of 100% fT&gt;MIC or with less susceptible pathogens (i.e. MIC ≥ 2)</td>
<td></td>
</tr>
<tr>
<td><strong>Ertapenem</strong>&lt;sup&gt;13,18,35&lt;/sup&gt;</td>
<td>No change</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Imipenem</strong></td>
<td>No data</td>
<td>- Use caution in renal impairment and with high doses (1g q6h): increased risk of seizures</td>
<td></td>
</tr>
<tr>
<td><strong>Meropenem</strong>&lt;sup&gt;14,18,30,36-42&lt;/sup&gt;</td>
<td>Same dose: consider prolonged infusion for critically ill patients</td>
<td>Prolonged infusion if critically ill, FN, CF, obese with CrCl &gt; 100 ml/min, if targeting a higher PD endpoint of 100% fT&gt;MIC, or infections with less susceptible pathogens (i.e. MIC ≥ 2)</td>
<td></td>
</tr>
</tbody>
</table>

**Monobactam**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Administration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aztreonam</strong></td>
<td>Insufficient data</td>
<td>- Single case report suggests higher dosing needed&lt;sup&gt;43&lt;/sup&gt; - Consider upper end of normal dosing in severe infections, e.g. 2g q6-8h</td>
</tr>
</tbody>
</table>

**Fluoroquinolones**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Administration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ciprofloxacin</strong>&lt;sup&gt;44-47&lt;/sup&gt;</td>
<td>In critically ill, septic patients on CRRT with organisms with MICs &gt; 0.5mg/L (e.g. <em>P.aeruginosa, A.baumannii</em>): &gt; 90kg: 400 mg IV q8h</td>
<td>Prolonged infusion except as noted in critically ill, septic patients on CRRT, - Consider upper end of normal dosing in severe infections, e.g. up to 400 mg IV q6-8h</td>
</tr>
<tr>
<td><strong>Levofloxacin</strong>&lt;sup&gt;48-51&lt;/sup&gt;</td>
<td>750 mg q24h</td>
<td>PK reportedly unaltered by obesity, however, serum levels may be sensitive to CrCl: 1,000 mg q24h has been suggested for CrCl&lt;sub&gt;IBW&lt;/sub&gt; &gt; 110 ml/min to target gram negative pathogens</td>
</tr>
<tr>
<td><strong>Moxifloxacin</strong>&lt;sup&gt;52-54&lt;/sup&gt;</td>
<td>No change</td>
<td></td>
</tr>
</tbody>
</table>

**Aminoglycosides**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Administration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amikacin</strong>&lt;sup&gt;55-57&lt;/sup&gt;</td>
<td>Use adjusted body weight (ABW&lt;sub&gt;0.4&lt;/sub&gt;) for initial dose</td>
<td>Adjust by TDM</td>
</tr>
<tr>
<td><strong>Gentamicin</strong>&lt;sup&gt;58-61&lt;/sup&gt;</td>
<td>Use adjusted body weight (ABW&lt;sub&gt;0.4&lt;/sub&gt;) for initial dose</td>
<td>Adjust by TDM</td>
</tr>
<tr>
<td><strong>Tobramycin</strong>&lt;sup&gt;58-61,62&lt;/sup&gt;</td>
<td>Use adjusted body weight (ABW&lt;sub&gt;0.4&lt;/sub&gt;) for initial dose</td>
<td>Adjust by TDM</td>
</tr>
</tbody>
</table>

**Polymyxins**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Administration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Colistin methanesulfonate</strong>&lt;sup&gt;63-67&lt;/sup&gt;</td>
<td>Use IBW</td>
<td>Maximum dose of 360 mg daily to limit the risk of nephrotoxicity</td>
</tr>
<tr>
<td><strong>Polymyxin B</strong>&lt;sup&gt;67-70&lt;/sup&gt;</td>
<td>Limited data. Consider adjusted body weight (ABW&lt;sub&gt;0.4&lt;/sub&gt;), especially in upper end of dosing range</td>
<td>Consider maximum dose 200 mg or 2 million units daily to limit risk of toxicity</td>
</tr>
</tbody>
</table>

**Anti-MRSA agents**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Administration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ceftaroline</strong>&lt;sup&gt;71-73&lt;/sup&gt;</td>
<td>No change</td>
<td>Consider q8h if targeting 50% fT&gt;MIC for MRSA</td>
</tr>
<tr>
<td>Drug</td>
<td>Dosage</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Clindamycin**      | IV: 600 mg q6h or 900 mg q8h PO: 450 - 600 mg q6h or 600-900 mg Q8H     | ● ● - Studies from prosthetic joint infection and SSTI suggest increased doses warranted  
- Manufacturer maximum: 2,700 mg/day in severe infections; 4,800 mg/day given by intermittent or continuous infusion for life-threatening infections[^77] |
| Dalbavancin[^76-81]   | No change                                                              | ● ● - Caution in renal insufficiency, dialysis. Monitor CKs and signs of myopathy                                                   |
| Daptomycin[^8,61,81-91] | Same weight-based dose but use adjusted body weight (ABW[^0.4])       | ● ● ● - Caution in renal insufficiency, dialysis. Monitor CKs and signs of myopathy                                                   |
| Linezolid[^8,37,81-100] | No change                                                              | ● ● ● - Caution in renal insufficiency, dialysis. Monitor CKs and signs of myopathy                                                   |
| Oritavancin[^81]      | No change                                                              | ● ● ● - Caution in renal insufficiency, dialysis. Monitor CKs and signs of myopathy                                                   |
| Sulfamethoxazole/trimethoprim[^76,101] | SSTI or severe/complicated UTI: up to 320 mg PO BID or 8-10 mg/kg/day/day in divided doses | ● ● ● - Limited data to guide optimal dosing weight  
- Consider adjusted body weight when using high doses (e.g. >8 mg/kg/day) |
| Tedizolid[^81,102,103] | No change                                                              | ● ● ● - ACP guidelines recommend monitoring of creatine kinase (CK) levels.                                                            |
| Telavancin[^81,104,105] | Same dose; consider a maximum of 1,000 mg/dose                         | ● ● ● - Increased systemic exposure may be related to AKI  
- These are tentative pending results of an ongoing Phase I trial (NCT02753855) |
| Tigecycline[^81,83,106,107] | No change                                                              | ● ● ● - Increased systemic exposure may be related to AKI  
- These are tentative pending results of an ongoing Phase I trial (NCT02753855) |
| Vancomycin[^8,37,61,108-132] | See Vancomycin Per Pharmacy Protocol (Appendix C)                     | ● ● - Alternative approach using ABW[^0.4]:  
- Loading dose 25-30 mg/kg_TBW, initial maintenance dose approximately 15 mg/kg_TBW q12h*, then adjust by TDM  
- Loading doses commonly ranged from none to 3g; daily doses commonly ranged 2-4g or 20-30 mg/kg_TBW/day  
- Adjust doses by TDM (peak and trough) using software utilizing Bayesian methods and AUC targets.  
- If calculating without software, see Hong et al for equations[^119]  
- If only measuring troughs, more cautious and frequent initial monitoring of levels may be warranted |

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a. Does not include dose adjustments for renal and/or hepatic impairment. Doses listed are within usual safety margins. Lower doses may be sufficient in mild infections (e.g. UTI). Dosages are based on the provided references and/or the authors’ opinion, and should not replace clinical judgment. CrCl assumes calculation using ABW[^0.4] unless specified in table.
b. Dots represent types of studies available and not quantity  
c. Dosing recommendations are for severe or deep-seated infections based on similarities in PK profile and dosing recommendations with other antibiotics of the same class when there is insufficient or no data in obese patients.
Table 2. Recommended Antifungal Dosing in Obesity (BMI ≥ 30 kg/m²)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Maximum Dose</th>
<th>Study Type</th>
<th>Comments</th>
</tr>
</thead>
</table>
|                    |              |            | **Case studies**
|                    |              | **PK/PD studies**
|                    |              | **Clinical outcomes**
| Caspofungin        | 70 mg x1, then 50-70 mg daily | ● ● ●        | - Retrospective study from 9 clinical studies found no significant difference in favorable responses in invasive candidiasis between obese and non-obese groups  
- PK studies showed no correlation with BMI and PK parameters, but did find negative correlation between caspofungin peak levels and body weight, suggests increased doses needed for higher TBW  
- In clinical trial of invasive candidemia, no safety concerns found with caspofungin 150mg daily
|                    |              |            |                                                                                                                                                                                                          |
| Fluconazole        | Candidiasis: 12mg/kg x1 load, then 6mg/kg q24h (TBW) | ● ● ● ●     | - Doses up to 1200 mg daily have been reported in the literature for Cryptococcus meningitis  
- In critically ill, esp with CrCl > 50, higher doses may be warranted to achieve PK/PD target of IAUC/MIC > 100, esp if MIC > 2 Candida spp  
- Consider TDM for severe infections
|                    |              |            |                                                                                                                                                                                                          |
| Flucytosine        | IBW          | ● ● ●     | - Single case report.  
- adjusted body weight has been suggested in life-threatening infections
|                    |              |            |                                                                                                                                                                                                          |
| Liposomal Amphotericin | Use total or adjusted body weight | ● ● ●     | - No PK data in obese humans; in general pop PK studies, linear increase in Vd and CL with weight  
- Safety data: at doses 7.5-15mg/kg/day, similar discontinuation rates; PK became non-linear (max Cmax and AUC at 10mg/kg/day)
|                    |              |            |                                                                                                                                                                                                          |
| Voriconazole,      | Use adjusted body weight or LBW<sub>2005</sub> | ● ● ●     | - Adjust dosing based on TDM  
- Retrospective TDM studies frequently showed supratherapeutic levels in obese subjects when dosed by TBW  
- Steady state plasma PK of voriconazole did not suggest weight-based dose adjustments necessary
|                    |              |            |                                                                                                                                                                                                          |
Table 3. Recommended Antiviral Dosing in Obesity (BMI ≥ 30 kg/m²)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Maximum Dose*</th>
<th>Study Typeb</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Case studies</td>
<td>PK/PD studies</td>
</tr>
<tr>
<td>Acyclovir146-148</td>
<td>Use ideal or adjusted body weight</td>
<td>●●</td>
<td>PK study: 5mg/kg IV x1 showed that dosing based on IBW in obese patients led to lower AUC than dosing by TBW in normal-weight patients. Authors suggest using ABW. Renal function may be a more important consideration than weight-based dosing in obese patients.</td>
</tr>
<tr>
<td>Cidofovir149</td>
<td>Use adjusted body weight</td>
<td></td>
<td>No data</td>
</tr>
<tr>
<td>Foscarnet149</td>
<td>Use adjusted body weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ganciclovir149</td>
<td>Use adjusted body weight</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DOCUMENT INFORMATION**

A. **Original Author/Date**
   Lina Meng, PharmD, BCPS, BCCCP: 12/27/2016

B. **Gatekeeper**
   SASS Program

C. **Review and Renewal Requirement**
   This document will be reviewed every three years and as required by change of law or practice

D. **Revision/Review History**
   Lina Meng, PharmD, BCPS, BCCCP: 07/24/2017
   Emily Mui, PharmD, BCPS: 03/27/2017, 07/24/2017
   Marisa Holubar MD MS: 03/27/2017, 07/24/2017
   Stan Deresinski MD: 03/27/2017, 07/24/2017

E. **Approvals**
   Antimicrobial Subcommittee: 3/30/2017, 8/17/2017
   Pharmacy and Therapeutics Committee: 4/21/2017, 9/15/2017

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Stanford, CA 94305
References:


126. Rybak M, Lomaestro B, Rotschafer JC, et al. Therapeutic monitoring of vancomycin in adult patients: a consensus review of the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, and the Society of


