General considerations for selecting blood culture bottles:
Blood cultures are commonly ordered in the investigation of patients who present with symptoms and/or signs consistent with sepsis [1]. The volume of blood obtained for culture is one of the most important factors influencing the ability to detect bacteremia (when present); the greater the volume of blood cultured, the better [2]. This is true for pediatric patients as well as adults [1,2]. It is also important to ensure there is an appropriate ratio of blood collected relative to the amount of broth culture medium in the bottle selected [1,2]. The dilution of blood by broth medium reduces the natural bactericidal activity of blood that results from the patient’s immune system [1,2]. For the investigation of a possible septic episode in adults and children weighing ≥28 kg, Diagnostic Services Manitoba (DSM) Microbiology Laboratories recommend 20 mL of blood be collected from one site (distributed equally into an adult aerobic and adult anaerobic blood culture bottle) and 10 mL of blood be collected from a second site (distributed into a second adult aerobic bottle) [4]. Collection of blood for culture is more problematic in pediatric patients, particularly those weighing less than 9 kg, related to the smaller circulating patient blood volume.

The BacT/Alert® PF Plus pediatric blood culture bottle:
For pediatric patients weighing less 9 kg, BacT/Alert® PF Plus bottles (Figure 1) are used for blood cultures. These bottles are specifically designed to provide rapid and sensitive detection of micro-organisms (bacteria and yeast) when only a small volume of blood is available [5]. They contain a smaller volume of broth, thereby still providing an optimal blood-to-broth ratio when a limited volume of blood is collected. The BacT/Alert® PF Plus blood culture bottle can accommodate up to 4 mL of blood [5]. As such, it is appropriate for blood cultures from pediatric patients weighing <9 kg. It should not be used for collection of blood from adult patients, where larger blood volumes for culture are recommended. The BacT/Alert® PF Plus bottle also contains adsorbent polymeric beads which assist in neutralizing antimicrobials that may have been administered prior to specimen collection (NB. blood cultures should be collected prior to antimicrobial therapy whenever possible) [5].

One important limitation of the BacT/Alert® PF Plus bottle that clinicians should keep in mind is the device atmosphere contains a mixture of carbon dioxide, oxygen, and nitrogen [5]. This atmosphere was selected to facilitate recovery of important aerobic and facultative bacteria and yeasts. However, related to the presence of oxygen, strict anaerobes (e.g., Bacteroides fragilis group, many Clostridium spp., Fusobacterium spp., Prevotella spp., Porphyromonas spp.) are unlikely to be recovered.

Anaerobes as a cause of bacteremia in pediatric patients:
Bacteremia with strict/obligate anaerobes is uncommon in pediatric patients [6-9]. Freedman et al. evaluated 2675 paired blood cultures (aerobic and anaerobic) collected from pediatric patients in an emergency department setting [6]. In total, 278 pathogens were recovered in this study. No obligate anaerobes were detected. Further, clinically important aerobic/facultative pathogens (Pseudomonas aeruginosa and Staphylococcus aureus) were recovered more frequently in the aerobic bottle [6]. Similarly, of 116 episodes of clinically significant bacteremia in children evaluated by Dunne Jr et al., only 1 was caused by a strict anaerobe [7]. Zaida et al. assessed 9360 paired aerobic and anaerobic blood cultures obtained from pediatric inpatients and outpatients [8]. Only 15 of 723 clinically important pathogens recovered (2.1%) were strict anaerobes. Patients with anaerobic bacteremia generally had an identifiable risk factor for infection with anaerobes (e.g., abdominal focus of infection, neutropenia) [8]. Noel et al. also observed that anaerobic bacteremia tends to occur among patients with an infection that would be expected to commonly involve anaerobes [9].

In summary, these studies suggest that routine blood cultures for anaerobes in a pediatric population are rarely helpful for clinicians. Further, distributing the limited blood volume collected from a pediatric patient into a pediatric bottle and an adult anaerobic bottle may reduce the sensitivity of the pediatric bottle for detection of more commonly recovered aerobic/facultative pathogens, related to the lower inoculated volume. Anaerobic bacteremia in the pediatric population is rare, and when it occurs it is frequently documented in patients with clinical syndromes where anaerobes would be suspected to play a role (e.g., abdominal focus of infection, chronic sinusitis, severe oral mucositis, bite...
wound injuries, etc.). In this setting, coverage with an antimicrobial that has activity against anaerobes would be appropriate irrespective of the blood culture results. Additionally, it should be recognized that the susceptibility of common anaerobes is fairly predictable (Figure 2).

**DSM recommendations for blood culture bottle selection in pediatric patients:**
The blood volumes and specific bottles recommended by DSM Microbiology Laboratories for blood culture collection in pediatric patients are presented in Table 1 [4]. Anaerobic blood cultures for pediatric patients weighing <9 kg are not routinely recommended related to the limited blood volume for culture and the rarity of anaerobic bacteremia in this population. Rather, use of the BacT/Alert® PF Plus bottle is encouraged in most settings to optimize recovery of common aerobic and facultative pathogens. This approach is endorsed by the Infectious Diseases Society of America [10]. In the rare circumstance where anaerobic bacteremia in a young child is strongly thought to be a possibility and documentation of this would change management, consideration could be given to sending a portion of the blood collected for culture in an adult anaerobic blood culture bottle. However, it must be recognized that this may compromise optimal recovery of aerobic pathogens.

**Take Home Points**
- The BacT/Alert® PF Plus pediatric blood culture bottle is recommended when obtaining blood cultures on pediatric patients weighing less than 9 kg due to the limited circulating patient blood volume.
- Strict anaerobes are unlikely to be recovered with the BacT/Alert® PF Plus blood culture bottle. However, anaerobic bacteremia in the pediatric population is rare and it typically occurs in patients with an infection where anaerobes are known to commonly play a role (who should be treated with anti-anaerobe therapy regardless of blood culture results).
- In the rare circumstance where anaerobic bacteremia in a young child is strongly thought to be a possibility and documentation of this would change management, consideration could be given to sending a portion of the blood collected for culture in an adult anaerobic blood culture bottle. However, it must be recognized that this may compromise optimal recovery of aerobic pathogens.

**References**

**Table 1. Recommended blood volume to draw and bottles to inoculate for pediatric patients, stratified by patient weight [4]**

<table>
<thead>
<tr>
<th>Patient Weight</th>
<th>Recommended Blood Volume</th>
<th>Bottles to inoculate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4 kg</td>
<td>0.5 to 1 mL</td>
<td>Distribute into 1 BacT/Alert® PF Plus pediatric blood culture bottle</td>
</tr>
<tr>
<td>4 to &lt;9 kg</td>
<td>2 to 4 mL</td>
<td>Distribute into 1 BacT/Alert® PF Plus pediatric blood culture bottle</td>
</tr>
<tr>
<td>9 to &lt;28 kg</td>
<td>10 mL</td>
<td>Distribute into 3 BacT/Alert® PF Plus pediatric blood culture bottles OR into 1 adult aerobic blood culture bottle</td>
</tr>
<tr>
<td>≥28 kg</td>
<td>30 mL</td>
<td>Distribute 10 mL into each of 2 adult aerobic blood culture bottles and 1 adult anaerobic culture bottle</td>
</tr>
</tbody>
</table>

Data obtained from the ongoing CANAEROBES study (Zhanel et al., personal communication)

![Figure 1. BacT/Alert® PF Plus pediatric blood culture bottle](image1)

![Figure 2. Antimicrobial Susceptibility of 70 B. fragilis Group Wound Isolates Obtained from Patients at the Health Sciences Centre](image2)