Newborn Critical Care Center (NCCC) Clinical Guidelines

Table 1. Summary of Antibiotic Recommendations for Evaluation for NEC or Diagnosed Medical NEC

	ANTIBIOTICS	
Bell's Stage 1A/B or Ruling out NEC	**Does the patient meet any of the following criteria?** 1. History of MRSA colonization 2. Current or previous MRSA infection	
	YES	**NO**
	Vancomycin + [cefotaxime or cefepime*] x 48 hours	Ampicillin + gentamicin x 48 hours
	If concern for impaired renal function, discuss dosing and levels with pharmacist prior to initiating vancomycin	Replace gentamicin with cefotaxime or cefepime* if concern for impaired renal function
	NOTE: If infant is ≥ 7 days of life, and it is equivocal whether an infant has late-onset sepsis vs. potential NEC, use the NCCC late-onset sepsis guidelines for antibiotic selection while following labs, cultures, physical exam, and imaging.	
	ANTIBIOTICS	
Bell's Stage 2A/B	**Does the patient meet any of the following criteria?** 1. History of MRSA colonization 2. Current or previous MRSA infection	
	YES	**NO**
	Vancomycin + [cefotaxime or cefepime*] + metronidazole (if portal venous gas [PVG]) x 48h	Ampicillin + gentamicin + metronidazole (if PVG) x 48h
	If concern for impaired renal function, discuss dosing and levels with pharmacist prior to initiating vancomycin	Replace gentamicin with cefotaxime or cefepime* if concern for impaired renal function
	AFTER FIRST 48 HOURS OF ANTIBIOTICS FOR NEC	
	If isolated NEC identified, change regimen to piperacillin/tazobactam monotherapy or target based on culture data for the remainder of antibiotic treatment while ensuring that adequate Gram-negative and anaerobic coverage is maintained.	

ADDITIONAL CONSIDERATIONS

- *Use cefepime if (1) cefotaxime shortage or (2) history of infection with resistant organism (discuss with ID).
- Consult ID for complex ascites, intraabdominal abscesses, complex clinical presentation, or if cultures return positive.
- In infants with NEC and positive blood cultures, do not target antibiotics to culture results alone. Ensure adequate coverage for organism(s) that grow in culture as well as NEC-related pathogens, and when relevant, more complex intra-abdominal infections.
- Fluconazole or amphotericin B (conventional) should be used if concern for fungal infection. Discuss toxicity monitoring with pharmacy.
- Consult ID for positive fungal cultures.
- Monitor gentamicin or vancomycin levels in conjunction with pharmacy recommendations.

Table 2. Summary of Antibiotic Recommendations for Severe/Surgical NEC

<table>
<tr><th></th><th colspan="2">ANTIBIOTICS</th></tr>
<tr><td rowspan="6">Bell's Stage 3A/B</td><td colspan="2">Does the patient meet any of the following criteria?
1. History of MRSA colonization 2. Current or previous MRSA infection</td></tr>
<tr><td>YES</td><td>NO</td></tr>
<tr><td>Vancomycin + [cefotaxime or cefepime*]
+ metronidazole x 48 hours</td><td>Ampicillin + gentamicin
+ metronidazole x 48 hours</td></tr>
<tr><td>If concern for impaired renal function, discuss dosing and levels with pharmacist prior to initiating vancomycin</td><td>Replace gentamicin with cefotaxime or cefepime* if concern for impaired renal function</td></tr>
<tr><td colspan="2">AFTER FIRST 48 HOURS OF ANTIBIOTICS FOR NEC</td></tr>
<tr><td colspan="2">• If isolated NEC identified, change regimen to piperacillin/tazobactam monotherapy or target based on available culture data for the remainder of antibiotic treatment while ensuring that adequate Gram-negative and anaerobic coverage is maintained.
• Fluconazole prophylaxis is recommended for the duration of antibiotic treatment for patients with a confirmed or suspected intestinal perforation.</td></tr>
<tr><td colspan="2">IF CLINICAL DECOMPENSATION WHILE ON PIPERACILLIN/TAZOBACTAM:</td></tr>
<tr><td colspan="2">Change piperacillin/tazobactam to vancomycin + cefepime + metronidazole
AND consider fluconazole at treatment dosing</td></tr>
<tr><td colspan="3">ADDITIONAL CONSIDERATIONS</td></tr>
<tr><td colspan="3">• *Use cefepime if (1) cefotaxime shortage or (2) history of infection with resistant organism (discuss with ID).
• Consult ID for complex ascites, intraabdominal abscesses, complex clinical presentation, or if cultures return positive.
• In infants with NEC and positive blood cultures, do not target antibiotics to culture results alone. Ensure adequate coverage for organism(s) that grow in culture as well as NEC-related pathogens, and when relevant, more complex intra-abdominal infections.
• Fluconazole or amphotericin B (conventional) should be used if concern for fungal infection. Discuss toxicity monitoring with pharmacy.
• Consult ID for positive fungal cultures.
• Monitor gentamicin or vancomycin levels in conjunction with pharmacy recommendations.</td></tr>
</table>

Table 3. Extended Guidelines for the Diagnosis and Treatment of Medical Necrotizing Enterocolitis

Modified Bell's Stage		Systemic Signs	Intestinal Signs	Radiologic Signs	Duration of Antibiotics	Feeding/ Nutrition	Antibiotics
Diagnosis for Stages 1A & 1B should be "Rule-out NEC" ** Please do not refer to as "NEC" in Epic*	**1A**	• Temp instability • Apnea and/or bradycardic events	• Emesis • Abdominal distension	WNL or mild ileus	48 hours post diagnosis	• Upon initial NEC evaluation: NPO & begin IVF ▪ Place replogle to LCWS ▪ Order TPN ▪ Feeds may be restarted at volume prior to evaluation or increased step-wise as determined by clinical evidence of normalization of bowel function	Please refer to **Table 1.**
	1B	Same as 1A	Same as 1A **PLUS** bloody stool	Same as 1A	48 hours post diagnosis		
2A		Same as 1A	Same as 1A **PLUS** abdominal tenderness and absent sounds	Definite pneumatosis	7 days post diagnosis	▪ Upon initial NEC evaluation: NPO & begin IVF ▪ Place replogle to LCWS ▪ Order TPN ▪ Reinitiate unfortified trophic feeds upon completion of antibiotic course and resolution of pneumatosis ▪ Confirm feeding plan with surgery for cases where they are consulted ▪ Start unfortified donor or maternal breastmilk at 10 – 20 mL/kg/day for 3 days ▪ Monitor closely for tolerance, and advance feeds at max of 20 mL/kg/day after initial 3 days of feeds	Please refer to **Table 1.**
2B		Same as 1A **PLUS** mild acidosis and thrombocytopenia	Same as 2A **PLUS** abdominal cellulitis	Same as 2A **PLUS** portal venous gas (PVG)	10 days post diagnosis		

Radiological follow-up for Stage 1 NEC Rule-out and Stage 2 NEC

- In the first 24 hours: AXR every 6-8 hours based on clinical symptoms
  - Consider concomitant decubitus view based on the extent of pneumatosis, severity of illness, and clinical concern for perforation
  - Immediate AXR with decubitus for any clinical change
- After the first 24 hours:
  - If PVG: 2 view AXR every 12 hours until PVG resolves
  - If no PVG: Daily radiographs until pneumatosis resolves
- Once the radiograph has normalized, no more radiographs are necessary unless there is a clinical change.
- In select cases, abdominal US with doppler may be beneficial ("possible pneumatosis" or paucity of gas on AXR).
- If pneumatosis is only visible on US and not AXR, it is not necessary to follow serial US until resolution of pneumatosis, and the need for repeat AXR and US can be based on clinical assessment.

Table 4. Extended Guidelines for the Diagnosis and Treatment of Surgical/Severe Medical NEC

Modified Bell's Stage	Systemic Signs	Intestinal Signs	Radiologic Findings	Antibiotic Duration	Feeding/ Nutrition	Antibiotics
3A	• Temperature instability • Apnea/ bradycardia • Hypotension • Acidosis • Neutropenia • DIC	• Emesis • Abdominal distension/ tenderness • Absent bowel sounds	Pneumatosis/ portal venous gas (PVG) **PLUS** ascites	14 days post diagnosis	▪ Initiate NPO status and IVF upon NEC evaluation. ▪ Place replogle to LCWS. ▪ Order TPN. ▪ Pay close attention to GIR, acid base status, fluid status, and renal function when placing fluid orders. ▪ Reinitiate unfortified trophic feeds upon completion of antibiotic course and resolution of pneumatosis. ▪ Confirm feeding plan with surgery for cases where they are consulted. ▪ Start unfortified donor or maternal breastmilk at 10 – 20 ml/kg/day for 3 days. ▪ Monitor closely for tolerance, and advance feeds every day or every other day at 10 – 20 ml/kg/day after initial 3 days of feeds.	Please refer to **Table 2.**
3B	Same as 3A	Same as 3A	Free air	14 days post diagnosis *If concern for persistent intra-abdominal infection without source control, longer courses may be necessary.*		

Radiological follow-up for Stage 3 NEC

- In the first 24 hours: 2 view AXR every 6-8 hours based on severity of symptoms
  - Immediate AXR with decubitus view for any clinical change
- After the first 24 hours:
  - If PVG: AXR every 12 hours for 24h until PVG resolves
  - If no PVG: Daily radiographs until pneumatosis resolves
- Once the radiograph has normalized, no more radiographs are necessary unless a clinical change.
- In select cases, abdominal US with doppler may be helpful in aiding a NEC diagnosis ("possible pneumatosis" or paucity of gas on AXR).
- If pneumatosis is only visible on US and not AXR, it is not necessary to follow serial US until resolution of pneumatosis, and the need for repeat AXR and US can be based on clinical assessment.
- Post-surgical X-rays should be determined based on discussions with surgery and the severity of clinical illness.