Nationwide Children's
When your child needs a hospital, everything matters.

Acute Acetaminophen (APAP) Ingestion/Overdose

Emergency Department

Center for Clinical Excellence

Ill appearing or encephalopathic? — Yes → See concern for moderate to severe hepatotoxicity

No

Extended release APAP? — Yes → **Off pathway** Discuss with Poison Control

No

Did all ingestion occur within an 8 hour period? (Does NOT need to occur within 8 hours of presentation) — No → See Non-Acute/ Supratherapeutic Ingestion Pathway

Yes

If concern for self harm ensure room safety check completed and arrange patient supervision

Did the ingestion include ≥ 10 grams or ≥ 200 mg/kg (whichever is less) or Intentional ingestion of unknown amount? — No → (skip to Rumack-Matthew Nomogram)

Signs, Symptoms & Mechanism of Toxicity

Yes

Call Poison Control 1-800-222-1222

Meets all criteria for charcoal?
- <4 hours since last ingestion
- No emesis
- Normal mental status

Yes → Administer charcoal (1 gram/kg, max 100 gram/dose)

No

Will APAP level result within 8 hours of start of ingestion? — No → Administer loading dose of N-Acetylcysteine (NAC)

Yes

All patients:
- APAP level (at least 4-hours from start of ingestion)
  Young children with exploratory ingestion may not need additional labs

If concern for intentional ingestion/self-harm add:
- EKG
- Salicylate level, Ethanol level, Beta-HCG, Chem-7, Urine Drugs of Abuse
- Serum drug abuse screen & urine drug screen (send out) if concern for other medication overdose

If **APAP level** at or above **High Risk line** at any point: Consult Poison Control Immediately

Plot APAP level on Rumack-Matthew Nomogram

Is APAP level at or above treat line on nomogram?

No →
- **NAC treatment not required**
- **Should avoid APAP for 2 months**
- **If concerns for intentional ingestion / self harm, transfer to Psychiatric Crisis Department (PCD)**

Yes → N-Acetylcysteine (NAC) therapy → Admit to Hospital Pediatrics

Signs, Symptoms & Mechanism of Toxicity

Acetaminophen toxicity can occur after one ingested overdose (acute ingestion) or as a result of repeated, supratherapeutic doses (chronic ingestion)

Typical presentation:
Clinical manifestations of acetaminophen overdose can be **gradual and nonspecific.**
Four clinical stages of acetaminophen toxicity, based on time after ingestion:

- **Stage 1: 12 to 24 hours -** anorexia, malaise, diaphoresis, nausea, and vomiting.
- **Stage 2: 36 to 48 hours -** variable clinical presentation, may include elevation of liver enzyme levels, liver enlargement, or right upper quadrant abdominal pain. Patients also may be asymptomatic.
- **Stage 3: 3 to 5 days -** recurrence of anorexia, nausea, vomiting, and malaise. Liver enzyme levels may worsen and be accompanied by signs of liver failure, including jaundice, hypoglycemia, coagulopathy, and encephalopathy.
- **Stage 4: -** Complete recovery ***or*** progression to liver failure.

Mechanism of toxicity:

- Acetaminophen is metabolized mainly in the liver by conjugation with sulfate and glucuronide.
- When an excessive amount of acetaminophen is present, it overwhelms the normal conjugation pathway, and metabolism is channeled to the cytochrome P-450 pathway, which produces the **toxic metabolite N-acetyl-p-benzoquinone imine (NAPQI)**.
- **NAPQI is detoxified by glutathione; however, when glutathione becomes depleted, NAPQI binds directly to hepatocytes, causing cellular necrosis.**

Argentieri J, Morrone K, Pollack Y. Acetaminophen and Ibuprofen overdosage. Pediatr Rev. 2012 Apr;33(4):188-9. doi: 10.1542/pir.33-4-188. PMID: 22474118.

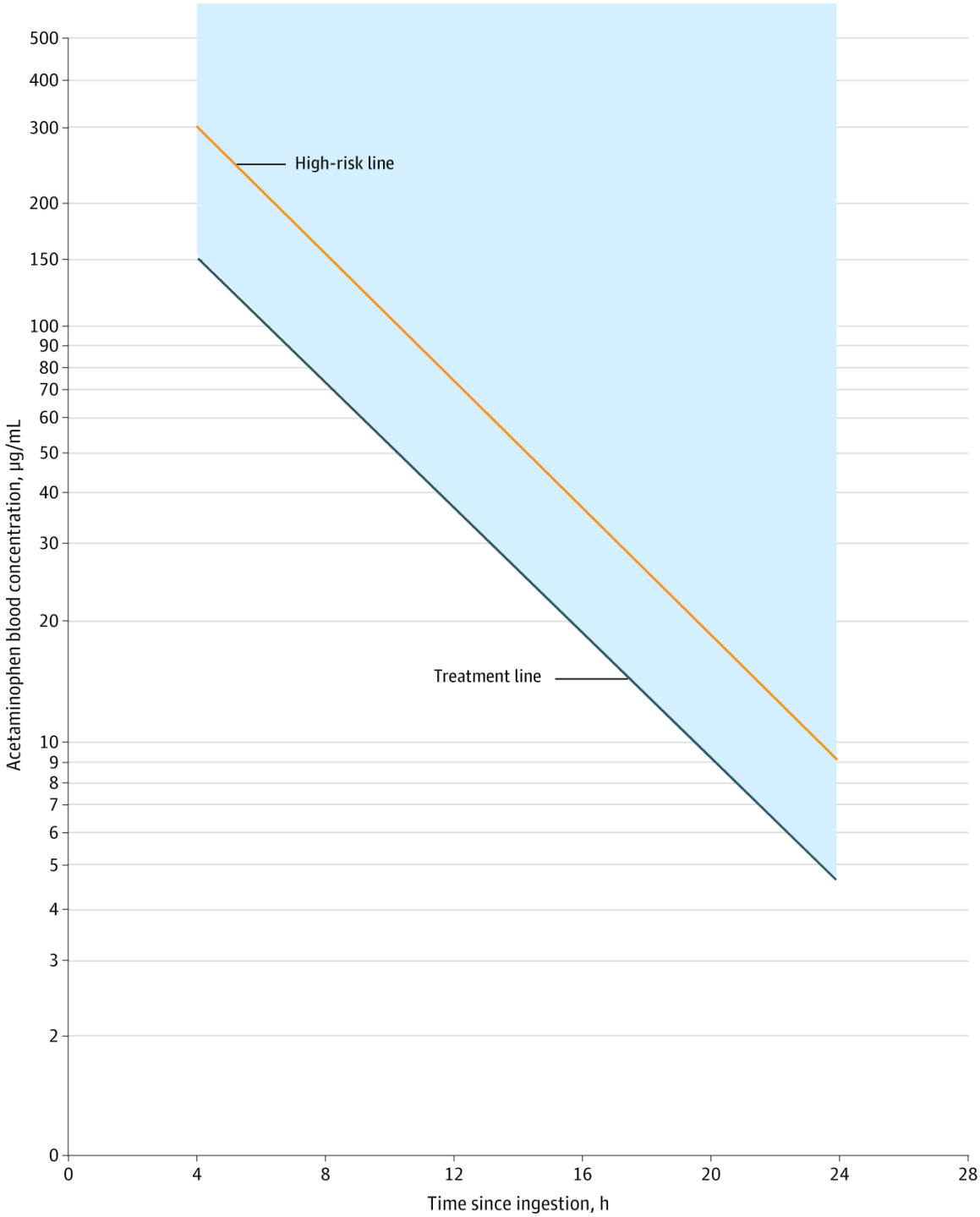
Return to Acute APAP Algorithm

Severity Assessment

Revised Rumack-Matthew Nomogram for the Acute Ingestion of Acetaminophen

Acetylcysteine should be initiated if a serum or plasma acetaminophen blood concentration drawn 4 to 24 hours after ingestion falls on or above the treatment line (blue area in nomogram).

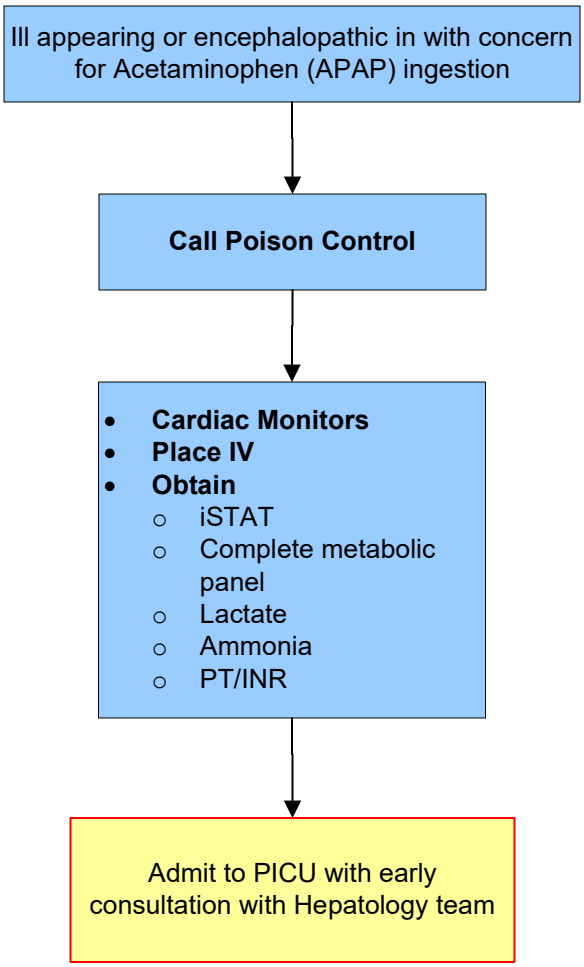
If the concentration falls on or above the **high-risk line**, discuss with Toxicology and/or COPC if High Dose acetylcysteine should be given.



Reference: Dart RC, Mullins ME, Matoushek T, et al. Management of Acetaminophen Poisoning in the US and Canada: A Consensus Statement. *JAMA Netw Open.* 2023;6(8):e2327739. doi:10.1001/jamanetworkopen.2023.27739

Return Acute APAP Algorithm

Concern for Moderate-Severe Hepatotoxicity



Return to Acute APAP Algorithm

N-Acetylcysteine (NAC) Therapy

Emergency Department

Center for Clinical Excellence

Indications for NAC Therapy
Patients that meets criteria by:
Acute APAP Ingestion/Overdose algorithm

Call Poison Control 1-800-222-1222 to confirm treatment plan

Transfers from outside hospitals:
- Complete bag of NAC that is already running
- Order subsequent doses (consult pharmacy)

If **APAP level** at or above **High Risk line** at any point: Consult Poison Control Immediately

IV access unavailable (and/or patient at Behavioral Health Pavilion/Psychiatric Crisis (BHP/PCD) or patient preference for Oral NAC therapy? (shared decision making recommended)

Yes

No

Oral NAC Therapy

Transfer to Main Campus Emergency Department if at BHP/PCD

Anaphylactoid Reaction
- Pause NAC and call Poison Control for any concerns of anaphylactoid reaction.
- Consider treatment with intramuscular epinephrine, H1/H2 blockade, and / or steroids, as indicated

IV NAC Therapy
Use ED Order Panel
(Continue 3-bag NAC Therapy if initiated at outside facility)

Loading
- 200 mg/kg (max 20 grams) IV over 4 hours

Second
- 100 mg/kg (max 10 grams) IV over next 16 hours

- **Draw APAP level and AST 2 hours prior to completion of second bag of NAC**
- Add ALT, total and direct bilirubin & PT/INR if GI symptoms **or** previously elevated AST

Admit to Hospital Pediatrics

Return to Acute APAP Algorithm

Oral NAC Therapy

Loading

- 140 mg/kg (max 15 grams) PO

Maintenance

- 70 mg/kg (max 7.5 grams) PO 4 hours after loading dose and every 4 hours x 24 hours

- Obtain repeat labs 24 hours AFTER starting NAC:
  - APAP level and AST
  - Add ALT, total and direct bilirubin & PT/INR if GI symptoms or previously-elevated AST

To optimize tolerance of PO NAC

- Dilute to 5% solution in orange juice or soft drink
- Chilled/over ice
- Sip through straw poked in hole of saran wrap covering cup to reduce odor
- If normal QT on EKG, use ondansetron to prevent emesis
- No need to repeat dose if emesis > 1 hour later & does not smell like NAC

Return to NAC Therapy Algorithm

Patient at BHP/PCD

3-Bag NAC Therapy

Loading

- 150 mg/kg (max 15 grams) IV over 1 hour

Second

- 50 mg/kg (max 5 grams) IV over next 4 hours

Third

- 100 mg/kg (max 10 grams) IV over next 16 hours

- **Draw APAP level and AST 2 hours prior to completion of last bag of NAC**
- Add ALT, total and direct bilirubin & PT/INR if GI symptoms **or** previously elevated AST

Return to NAC Therapy Algorithm

Patient at Behavioral Health Pavilion/ Psychiatric Crisis Department BHP/PCD

In the instances where transport or IV access is delayed, **initiation of oral NAC should be considered at the Behavioral Health Pavilion.** Studies have shown that oral NAC is as effective as IV NAC in reducing hepatotoxicity in acetaminophen toxicity, though some patients may not tolerate the oral product due to nausea/vomiting.

Acetylcysteine 20% oral solution is now stocked in the BH1A Pyxis Station located in the PCD medication room. *This product comes as an oral solution in glass vials and should be diluted prior to administration.*

Prior to ordering NAC, physicians should assess if oral NAC would be appropriate to start in patients with **acetaminophen ingestion**. As always, contact Poison Control Center (800-222-1222) with any questions/concerns.

- When to ***emergently*** transfer patients to MCED (via ambulance) for IV treatment:
  - Altered mental status
  - "Massive" ingestion
    - Definition of "massive" may vary; generally if
      - 4-hr acetaminophen serum concentration > 300 mcg/mL **or**
      - Ingestion of greater than 32 g of acetaminophen
  - Delay in safe car transportation to main campus and patient unable to tolerate oral product
  - Any other medical instability or if recommended by Poison Control Center

Return to NAC Therapy Algorithm

Return to Oral NAC Therapy

Admission Criteria

- APAP level at or above treatment line on nomogram
- Intentional overdose not ruled out
- Unable to medically clear beyond presenting symptoms
- Consider admission to Pediatric Intensive Care Unit if there is altered mental status, respiratory failure, or signs of shock

Return to Acute APAP Algorithm

Return to NAC Therapy Algorithm

Quality Measures

Process Measure:

- Pathway Visualization
- Order set use
- Time from APAP level to start of NAC treatment

Balancing Measure:

- ED Length of stay

Return to Acute APAP Algorithm

Key References

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Clinical Pathway Development

This clinical pathway was developed using the process described in the NCH Clinical Pathway Development Manual Version 6, 2022. Clinical Pathways at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice, clinician judgment, and other relevant factors in diagnosing and treating patients remain central to the selection of diagnostic tests and therapy. The ordering provider assumes all risks associates with care decisions. NCH assumes no responsibility for any adverse consequences, errors, or omissions that may arise from the use or reliance on these guidelines. NCH's clinical pathways are reviewed periodically for consistency with new evidence; however, new developments may not be represented, and NCH makes no guarantees, representations, or warranties with respect to the information provided in this clinical pathway.

For more information about our pathways and program please contact:
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Return to Acute APAP Algorithm