

Lead Toxicity and Outpatient Lead Screening

Jennifer Haile, MD



What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.

Why is pathway necessary?

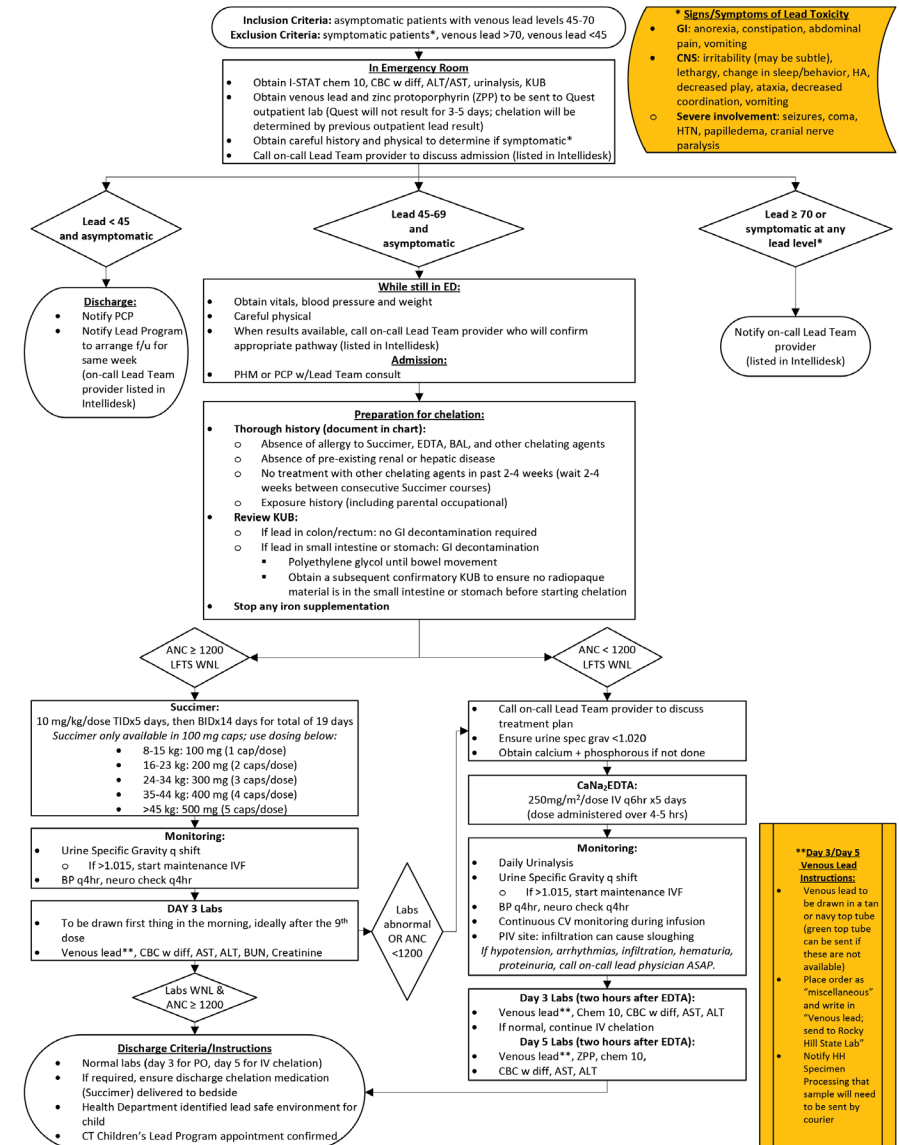
- Lead poisoning requiring chelation is a rare event
- Many providers are not familiar with treatment process
- Pathway gives opportunity for standardized care, and guidelines for those less familiar with treatment process.

Objectives of Inpatient Pathway

- Create a systematic way to manage patients with lead toxicity
- Outline the initial work up of patients with lead toxicity
- Outline the important considerations prior to starting chelation therapies, if indicated
- Identify the correct chelation therapy and appropriate monitoring during treatment
- Help facilitate discharge in a timely fashion

CLINICAL PATHWAY: Management of Lead Toxicity

THIS PATHWAY
SERVES AS A GUIDE
AND DOES NOT
REPLACE CLINICAL
JUDGMENT.



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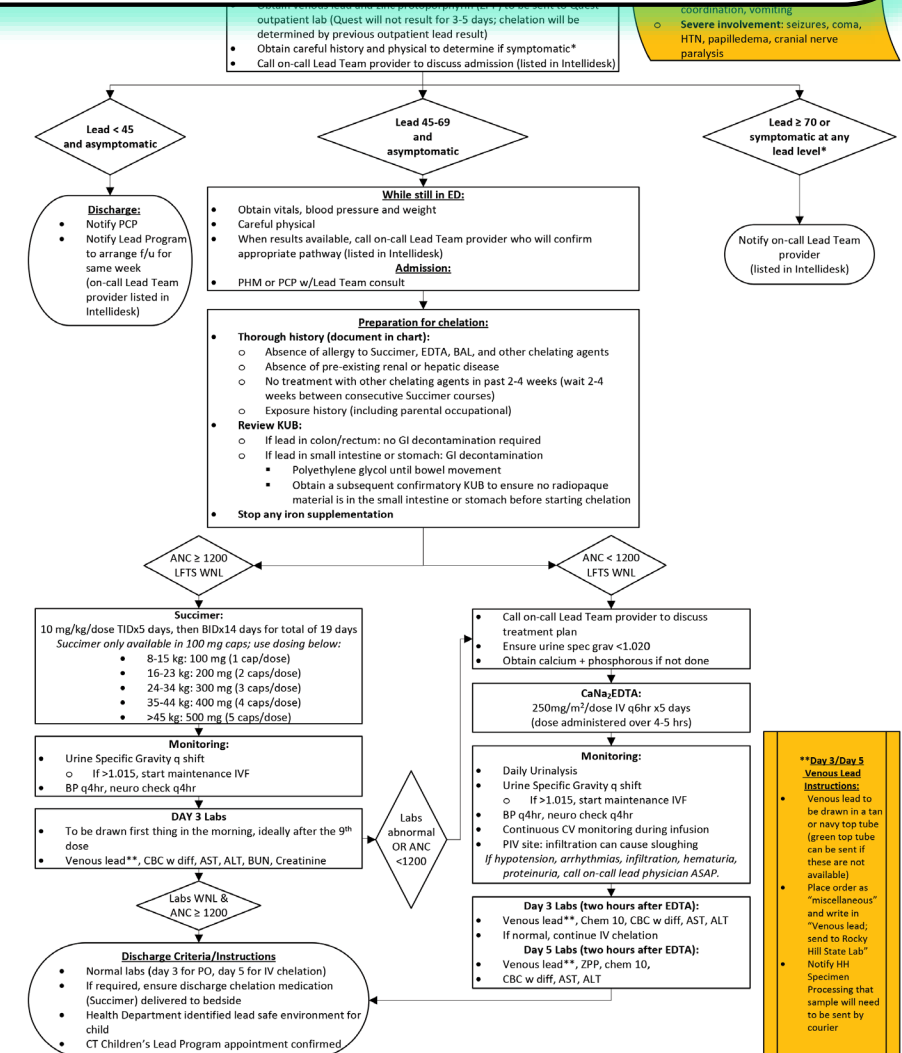
This is the Management of Lead Toxicity Clinical Pathway.

Inclusion Criteria: asymptomatic patients with venous lead levels 45-70
Exclusion Criteria: symptomatic patients*, venous lead >70, venous lead <45

Inclusion Criteria:

Inclusion criteria includes **venous** lead levels between 45-70 mcg/dL.

*Capillary samples should not be used to initiate pathway/make treatment decisions.



In the Emergency Room:

The initial work up includes:

- Labs
- Urinalysis
- KUB
- Careful history and physical to determine if the patient is symptomatic

*** Note that **chelation decisions** are made based on venous lead samples. Lead levels take 3-5 days to result, so ED providers will need to contact the on-call lead physician listed on Intellidesk to discuss each admission based on outpatient lead results.

CLINICAL PATHWAY:

Management of Lead Toxicity

In Emergency Room

- Obtain I-STAT chem 10, CBC w diff, ALT/AST, urinalysis, KUB
- Obtain venous lead and zinc protoporphyrin (ZPP) to be sent to Quest outpatient lab (Quest will not result for 3-5 days; chelation will be determined by previous outpatient lead result)
- Obtain careful history and physical to determine if symptomatic*
- Call on-call Lead Team provider to discuss admission (listed in Intellidesk)

Discharge:

- Notify PCP
- Notify Lead Program to arrange f/u for same week (on-call Lead Team)

Obtain vitals, blood pressure and weight

- Careful physical
- When results available, call on-call Lead Team provider who will confirm appropriate pathway (listed in Intellidesk)

Admission:

- PHM or PCP w/Lead Team consult

Notify on-call Lead Team provider (listed in Intellidesk)

* Signs/Symptoms of Lead Toxicity

- **GI:** anorexia, constipation, abdominal pain, vomiting
- **CNS:** irritability (may be subtle), lethargy, change in sleep/behavior, HA, decreased play, ataxia, decreased coordination, vomiting
- **Severe involvement:** seizures, coma, HTN, papilledema, cranial nerve paralysis

Preparation for chelation:

- **Thorough history (document in chart):**
 - Absence of allergy to Succimer, EDTA, BAL, and other chelating agents
 - Absence of pre-existing renal or hepatic disease
 - No treatment with other chelating agents in past 2-4 weeks between consecutive Succimer courses
 - Exposure history (including parental occupational)
- **Review KUB:**
 - If lead in colon/rectum: no GI decontamination required
 - If lead in small intestine or stomach: GI decontamination
 - Polyethylene glycol until bowel movement
 - Obtain a subsequent confirmatory KUB to ensure no radiopaque material is in the small intestine or stomach before starting chelation
- **Stop any iron supplementation**

ANC ≥ 1200
LFTS WNL

Succimer:

- 15-45 days, then BID x 14 days for total of 19 days
- Available in 100 mg caps; use dosing below:
- 8-15 kg: 100 mg (1 cap/dose)
- 16-23 kg: 200 mg (2 caps/dose)
- 24-34 kg: 300 mg (3 caps/dose)
- 35-44 kg: 400 mg (4 caps/dose)
- >45 kg: 500 mg (5 caps/dose)

Monitoring:

- Urine Specific Gravity q shift
- If >1.015, start maintenance IVF
- BP q4hr, neuro check q4hr

DAY 3 Labs

- To be drawn first thing in the morning, ideally after the 9th dose
- Venous lead**, CBC w diff, AST, ALT, BUN, Creatinine

Labs WNL &
ANC ≥ 1200

Discharge Criteria/Instructions

- Normal labs (day 3 for PO, day 5 for IV chelation)
- If required, ensure discharge chelation medication (Succimer) delivered to bedside
- Health Department identified lead safe environment for child
- CT Children's Lead Program appointment confirmed

ANC < 1200
LFTS WNL

- Call on-call Lead Team provider to discuss treatment plan
- Ensure urine spec grav <1.020
- Obtain calcium + phosphorous if not done

CaNa₂EDTA:

- 250mg/m²/dose IV q6hr x5 days (dose administered over 4-5 hrs)

Monitoring:

- Daily Urinalysis
- Urine Specific Gravity q shift
- If >1.015, start maintenance IVF
- BP q4hr, neuro check q4hr
- Continuous CV monitoring during infusion
- PIV site: infiltration can cause sloughing
- If hypotension, arrhythmias, infiltration, hematuria, proteinuria, call on-call lead physician ASAP.

Day 3 Labs (two hours after EDTA):

- Venous lead**, Chem 10, CBC w diff, AST, ALT
- If normal, continue IV chelation
- Day 5 Labs (two hours after EDTA):**
- Venous lead**, ZPP, chem 10, CBC w diff, AST, ALT

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Toxicity abdominal (subtle), behavior, HA, decreased play, ataxia, decreased coordination, vomiting, seizures, coma, cranial nerve

10 or more at any level*

****Day 3/Day 5 Venous Lead Instructions:**

- Venous lead to be drawn in a tan or navy top tube (green top tube can be sent if these are not available)
- Place order as "miscellaneous" and write in "Venous lead; send to Rocky Hill State Lab"
- Notify H&I Specimen Processing that sample will need to be sent by courier

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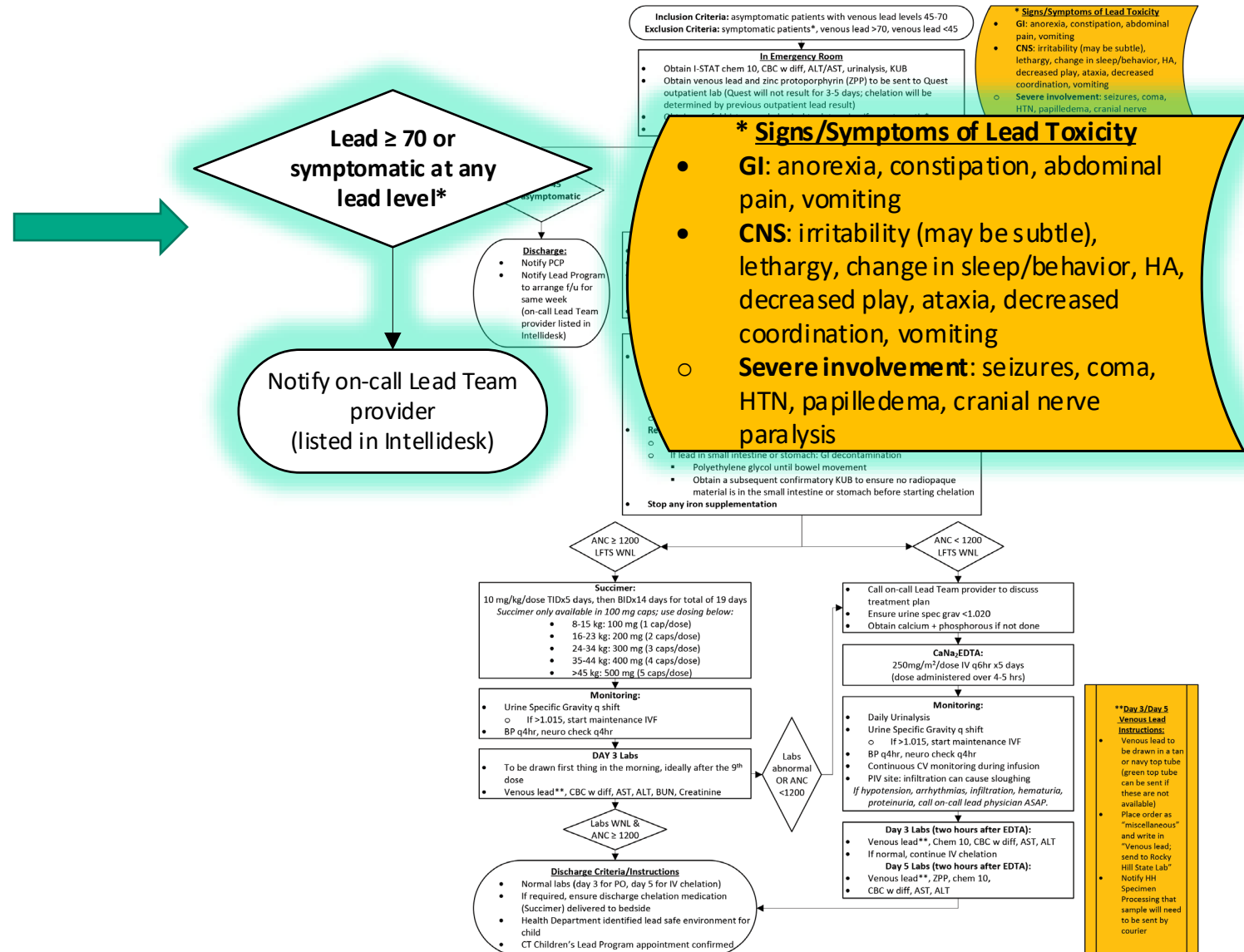
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If there are signs and symptoms of lead toxicity at any lead level or the lead level is ≥ 70 :

Immediately notify the on-call Lead physician listed in Intellidesk and treat off pathway.



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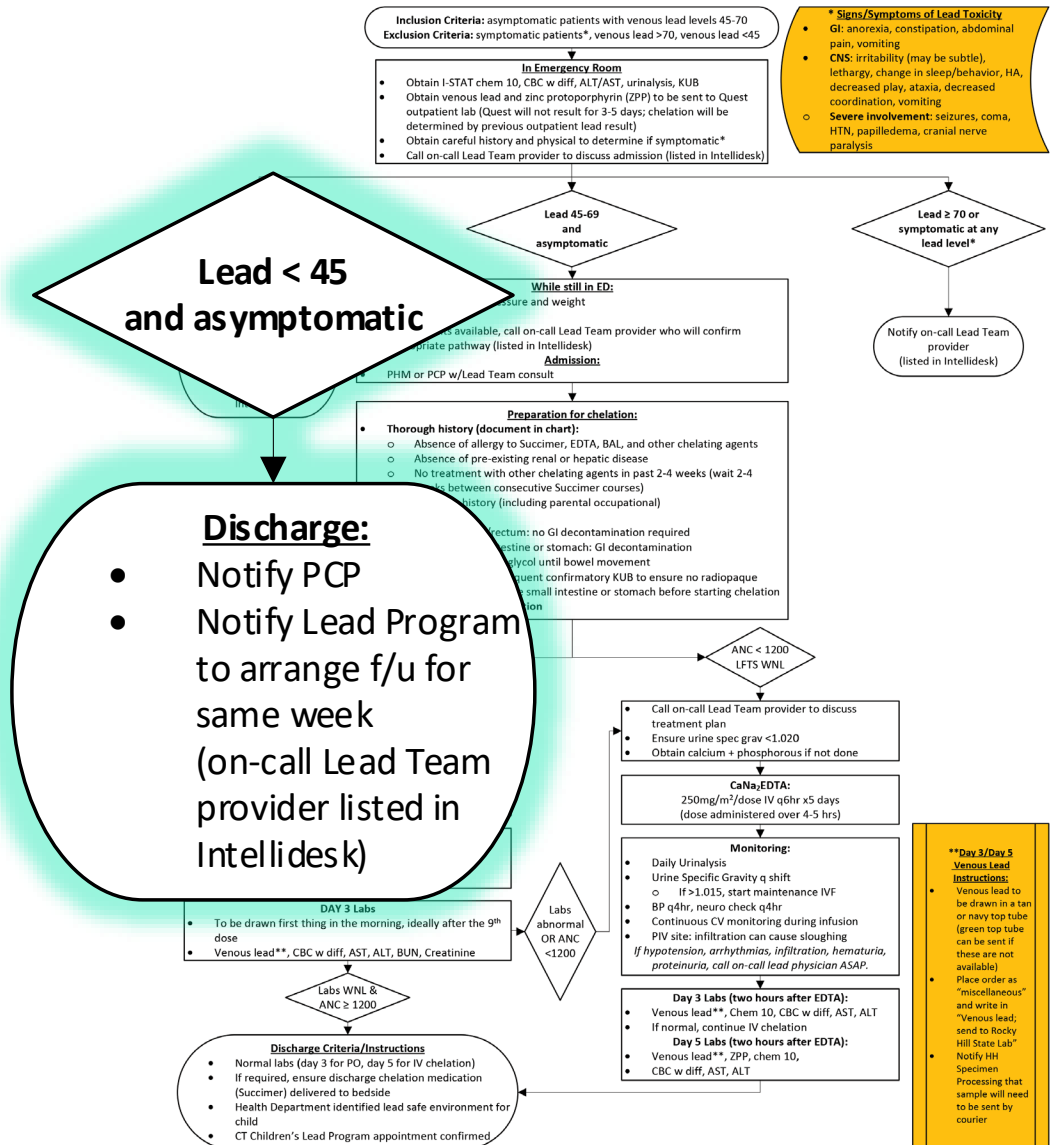
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Lead less than 45 and asymptomatic:

If the lead level is <45 and patient has NO symptoms of lead toxicity:

Patient can be discharged from the Emergency Room with close follow up.



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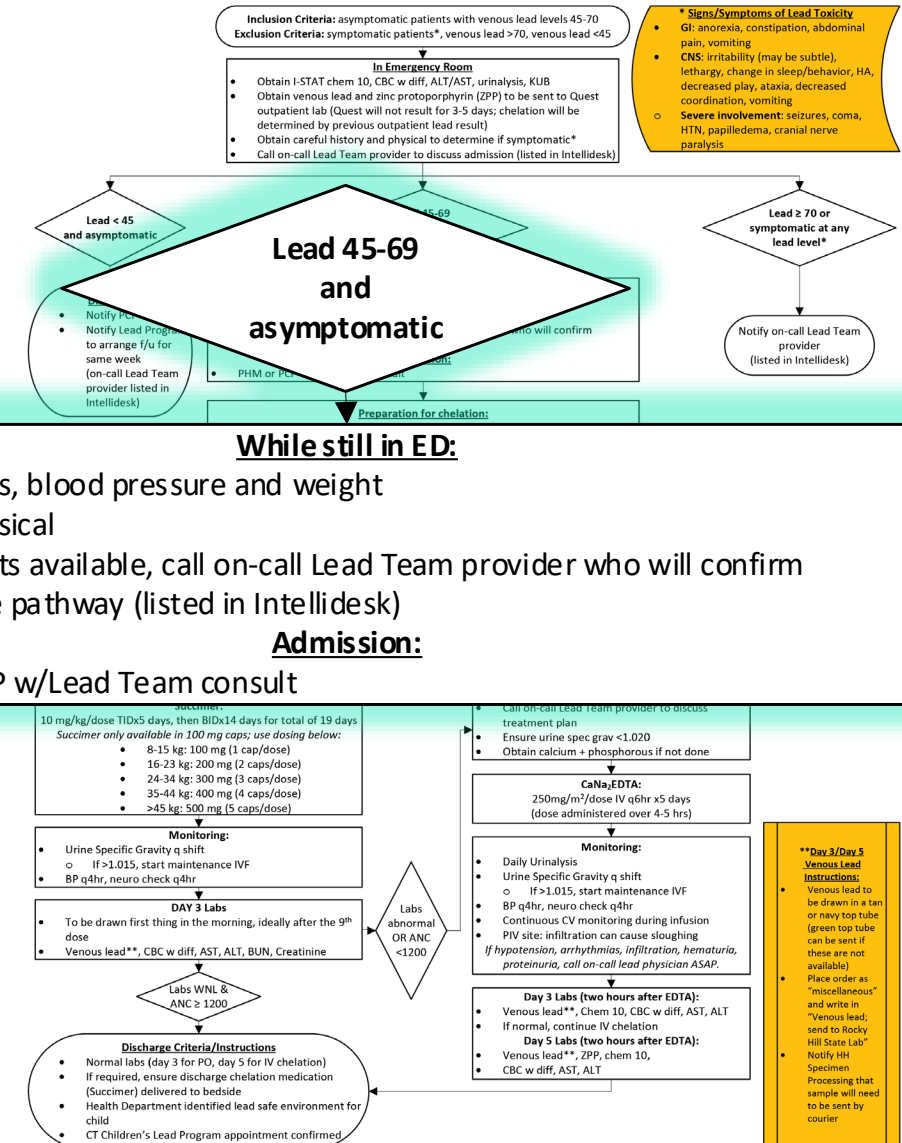
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Lead between 45-69 and asymptomatic:

If asymptomatic and lead level of 45-69, proceed with the pathway and treatment recommendations.

- Patient will be admitted to PHM with a Lead Team consult.



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Preparation for Chelation:

1. Obtain a thorough history:

- Must document exposure history, including parental occupational exposures
- Must document that patient meets chelation requirements:
 - absence of allergy to chelating agents
 - absence of pre-existing renal or hepatic disease
 - No treatment with other chelating agents in the past 2-4 weeks (should wait 2-4 weeks between consecutive Succimer courses)

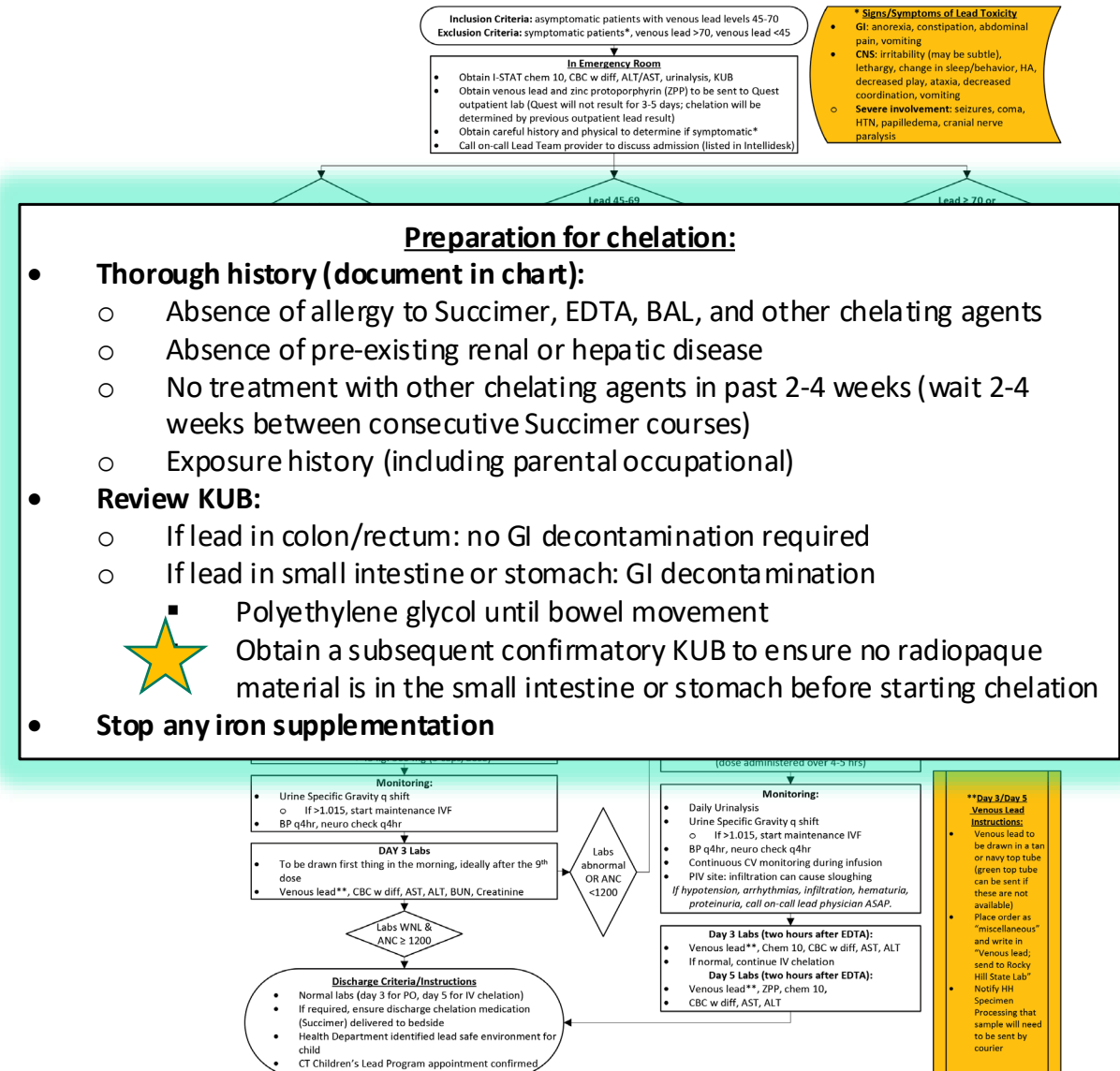
2. Review the findings of the abdominal X-ray:

- Lead is not absorbed in the colon or rectum.
 - No GI decontamination if required if lead is found in these areas.
- If lead is in the small intestine or stomach, GI decontamination must be done prior to chelation.

- GI decontamination is done with polyethylene glycol
- ★ A repeat KUB should be obtained before starting chelation

3. STOP any iron supplementation prior to proceeding with chelation therapies.

Updated 2024



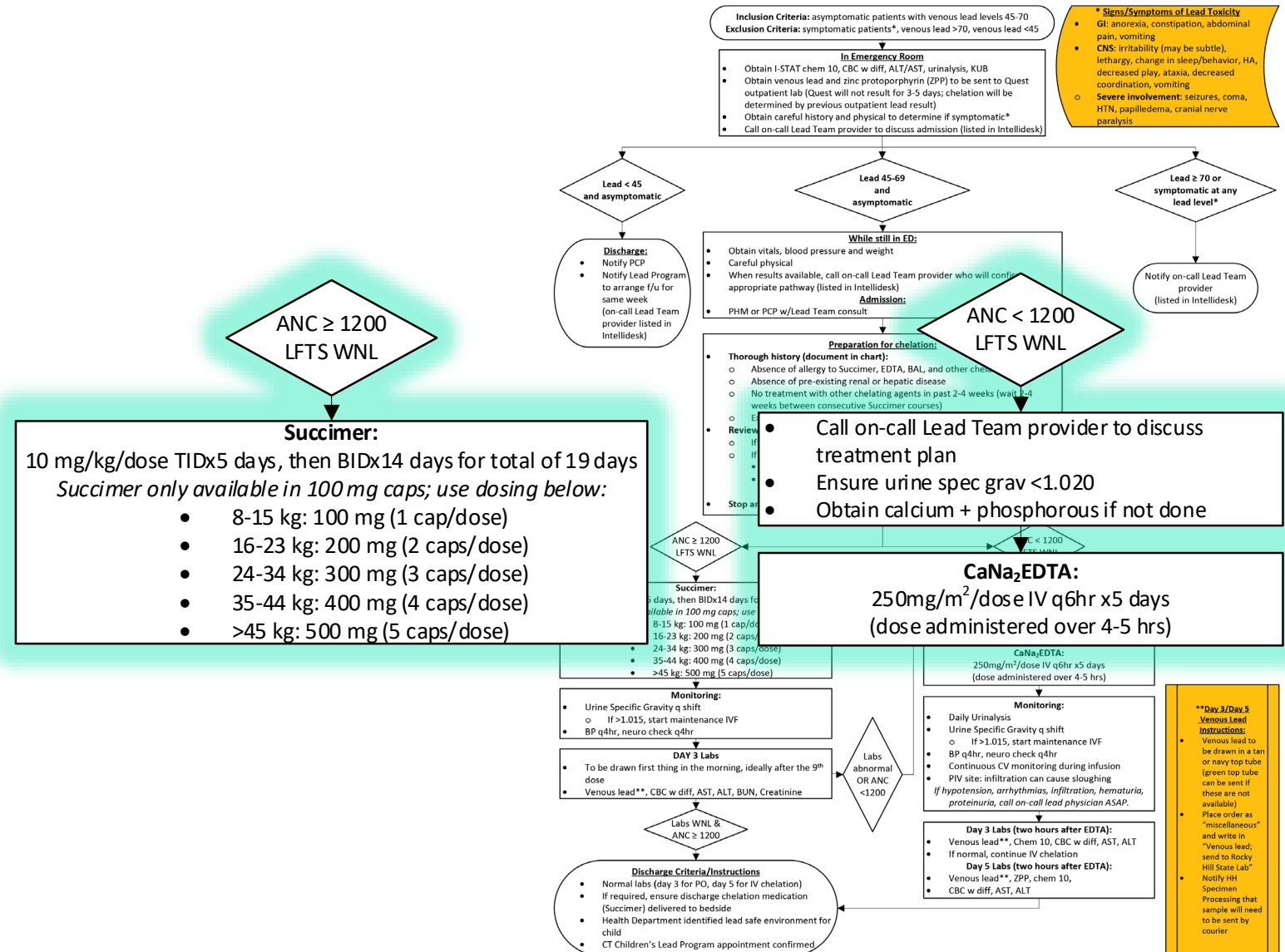
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The type of chelation is determined by Absolute Neutrophil Count (ANC) and Liver Function Tests (LFTs).

Chelation agents are:

- Oral Chelation = Succimer PO
- IV Chelation = Calcium Disodium EDTA (CaNa₂EDTA)



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Oral Chelation - Succimer:

If the ANC is greater than 1200, and LFTs are normal, you can proceed with **oral** chelation.

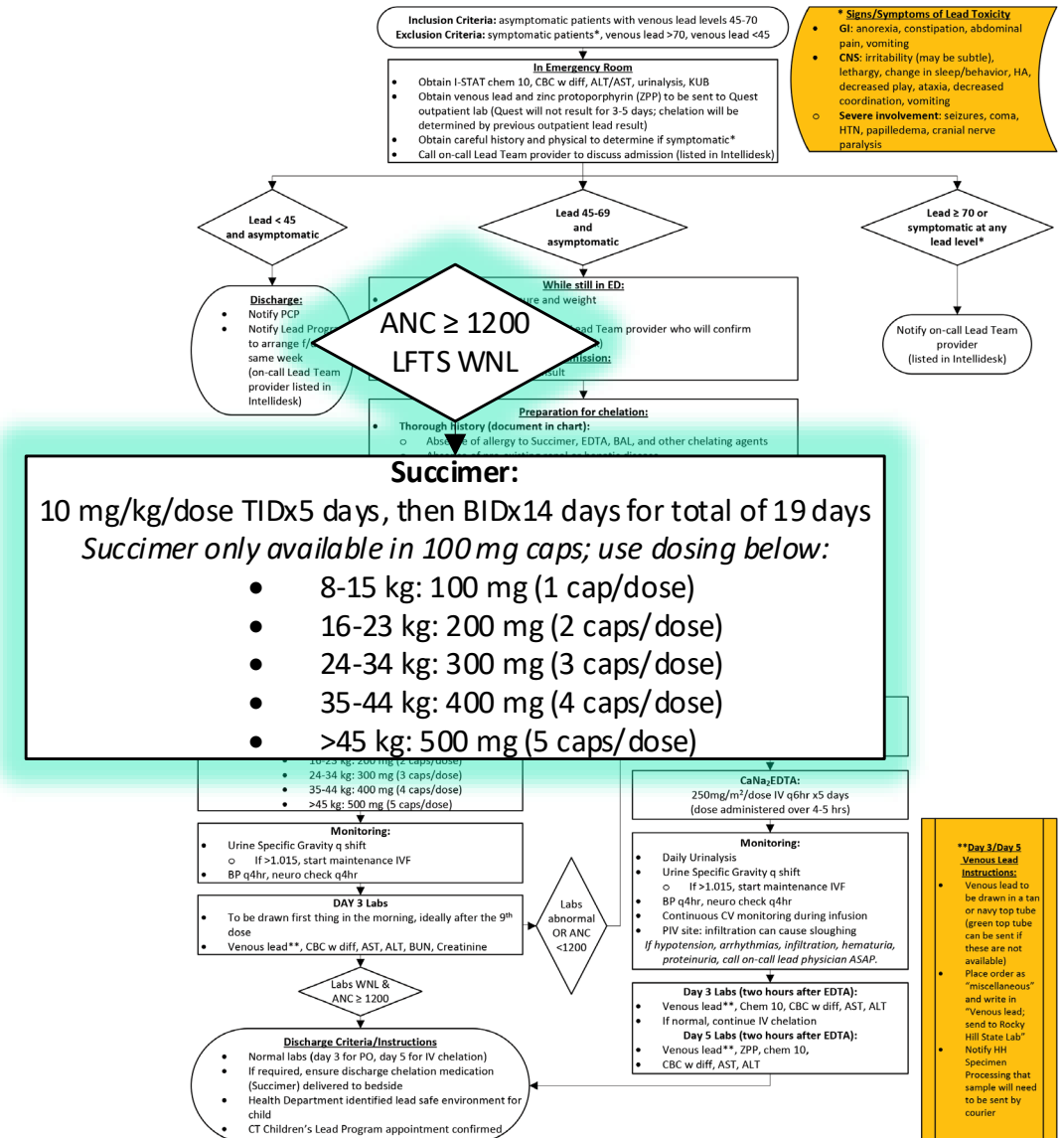
- Succimer is only available in 100 mg caps, so use this chart for the appropriate dosing.
- If the patient cannot tolerate PO Succimer (due to side effects or poor taste), may need to change over to IV chelation.

Some **side effects** can exacerbate lead poisoning-related organ dysfunction:

- GI upset: vomiting, abdominal pain
- Neutropenia
- Transaminitis
- Acute renal injury
- Rash

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Oral Chelation Monitoring:

- Ensure adequate hydration by:
 - monitoring urine output and specific gravity every shift
 - If the specific gravity >1.015, maintenance IVF should be started.
- Vitals should include blood pressures.
- Labs are repeated on Day 3
 - After 9 total doses of succimer

Succimer:
10 mg/kg/dose TIDx5 days, then BIDx14 days for total of 19 days
Succimer only available in 100 mg caps; use dosing below:

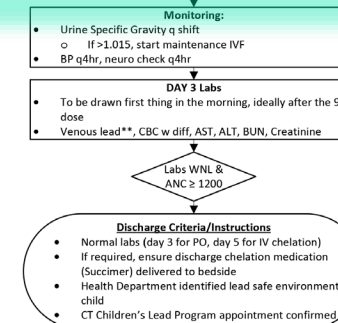
- 8-15 kg: 100 mg (1 cap/dose)
- 16-23 kg: 200 mg (2 caps/dose)
- 24-34 kg: 300 mg (3 caps/dose)
- 35-44 kg: 400 mg (4 caps/dose)
- >45 kg: 500 mg (5 caps/dose)

Monitoring:

- Urine Specific Gravity q shift
 - If >1.015, start maintenance IVF
- BP q4hr, neuro check q4hr

DAY 3 Labs

- To be drawn first thing in the morning, ideally after the 9th dose
- Venous lead**, CBC w diff, AST, ALT, BUN, Creatinine



Inclusion Criteria: asymptomatic patients with venous lead levels 45-70
Exclusion Criteria: symptomatic patients*, venous lead >70, venous lead <45

In Emergency Room

- Obtain I-STAT chem 10, CBC w diff, ALT/AST, urinalysis, KUB
- Obtain venous lead and zinc protoporphyrin (ZPP) to be sent to Quest outpatient lab (Quest will not result for 3-5 days; chelation will be determined by previous outpatient lead result)
- Obtain careful history and physical to determine if symptomatic*
- Call on-call Lead Team provider to discuss

*** Signs/Symptoms of Lead Toxicity**

- GI: anorexia, constipation, abdominal pain, vomiting
- CNS: irritability (may be subtle), lethargy, change in sleep/behavior, HA, decreased play, ataxia, decreased coordination, vomiting
- Severe involvement: seizures, coma, HTN, papilledema, cranial nerve paralysis

****Day 3/Day 5 Venous Lead**

Instructions:

- Venous lead to be drawn in a tan or navy top tube (green top tube can be sent if these are not available)
- Place order as "miscellaneous" and write in "Venous lead; send to Rocky Hill State Lab"
- Notify HH Specimen Processing that sample will need to be sent by courier

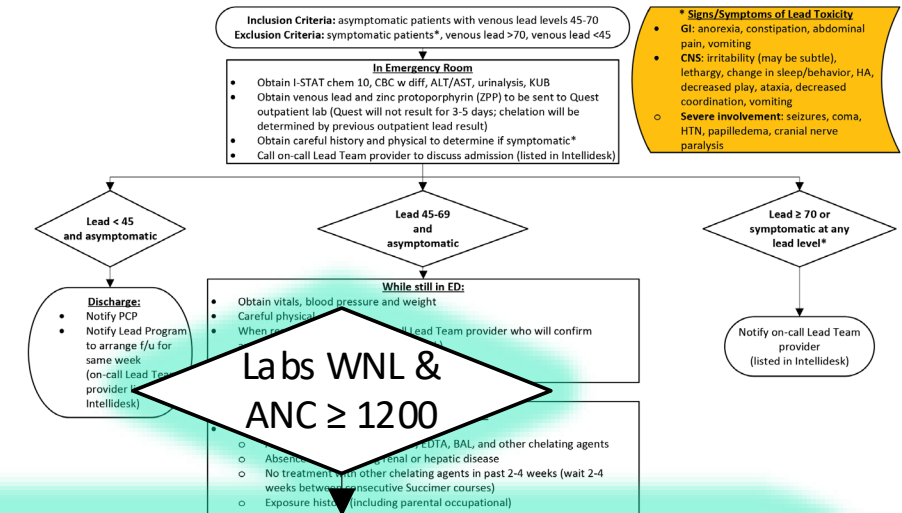
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Oral Chelation Discharge:

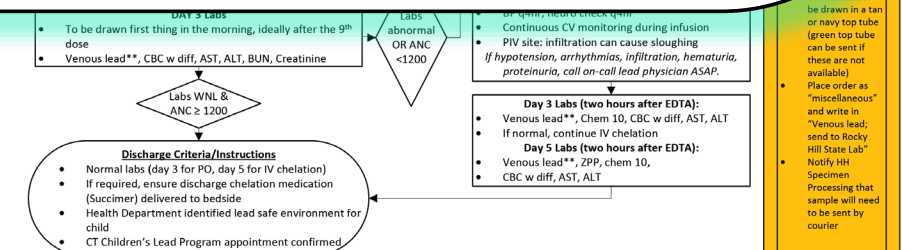
If Day 3 labs are normal and ANC continues to be ≥ 1200 , patient is nearing discharge criteria.

- Note: lead levels drawn day of discharge will not result for 24-36 hrs and should not hold up discharge.
- Discharge medications must be delivered to bedside in order for patient to go home
- The Health Department will identify a safe environment for the patient.
- Ensure that the Connecticut Children's Lead Program appointment is confirmed.



Discharge Criteria/Instructions

- Normal labs (day 3 for PO, day 5 for IV chelation)
- If required, ensure discharge chelation medication (Succimer) delivered to bedside
- Health Department identified lead safe environment for child
- CT Children's Lead Program appointment confirmed



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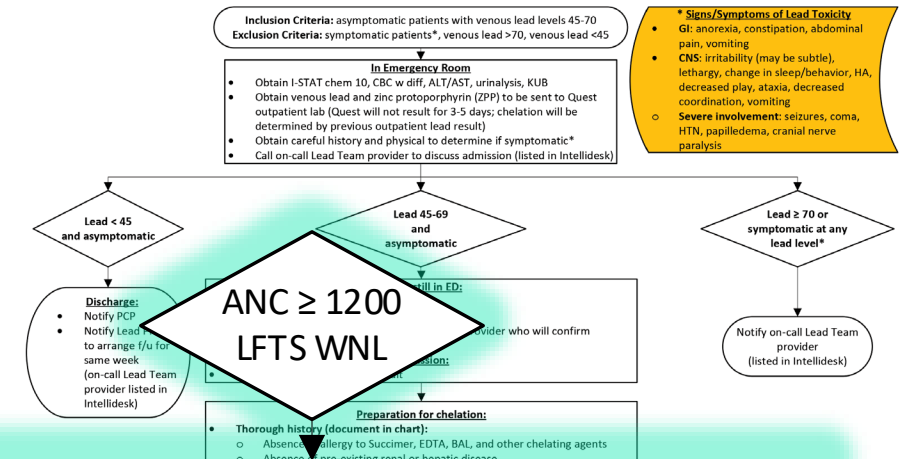
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Oral Chelation - Succimer:

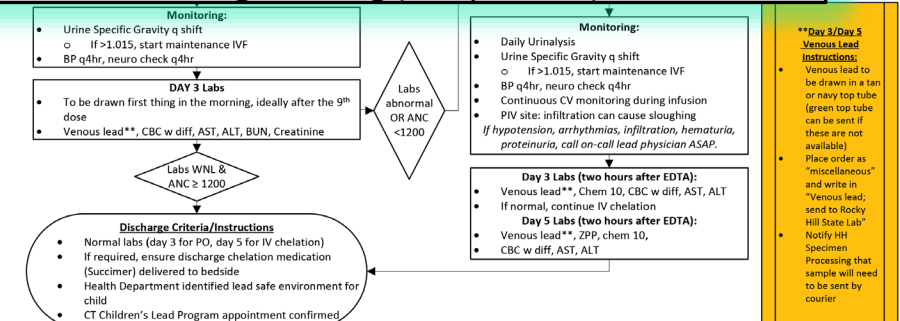
Succimer is difficult to find! Call outpatient pharmacy for bedside delivery once patient is tolerating PO Succimer. If pharmacy doesn't have enough in stock, have them order it. It must be delivered to bedside for the patient to be discharged home.



Succimer:

10 mg/kg/dose TIDx5 days, then BIDx14 days for total of 19 days
Succimer only available in 100 mg caps; use dosing below:

- 8-15 kg: 100 mg (1 cap/dose)
- 16-23 kg: 200 mg (2 caps/dose)
- 24-34 kg: 300 mg (3 caps/dose)
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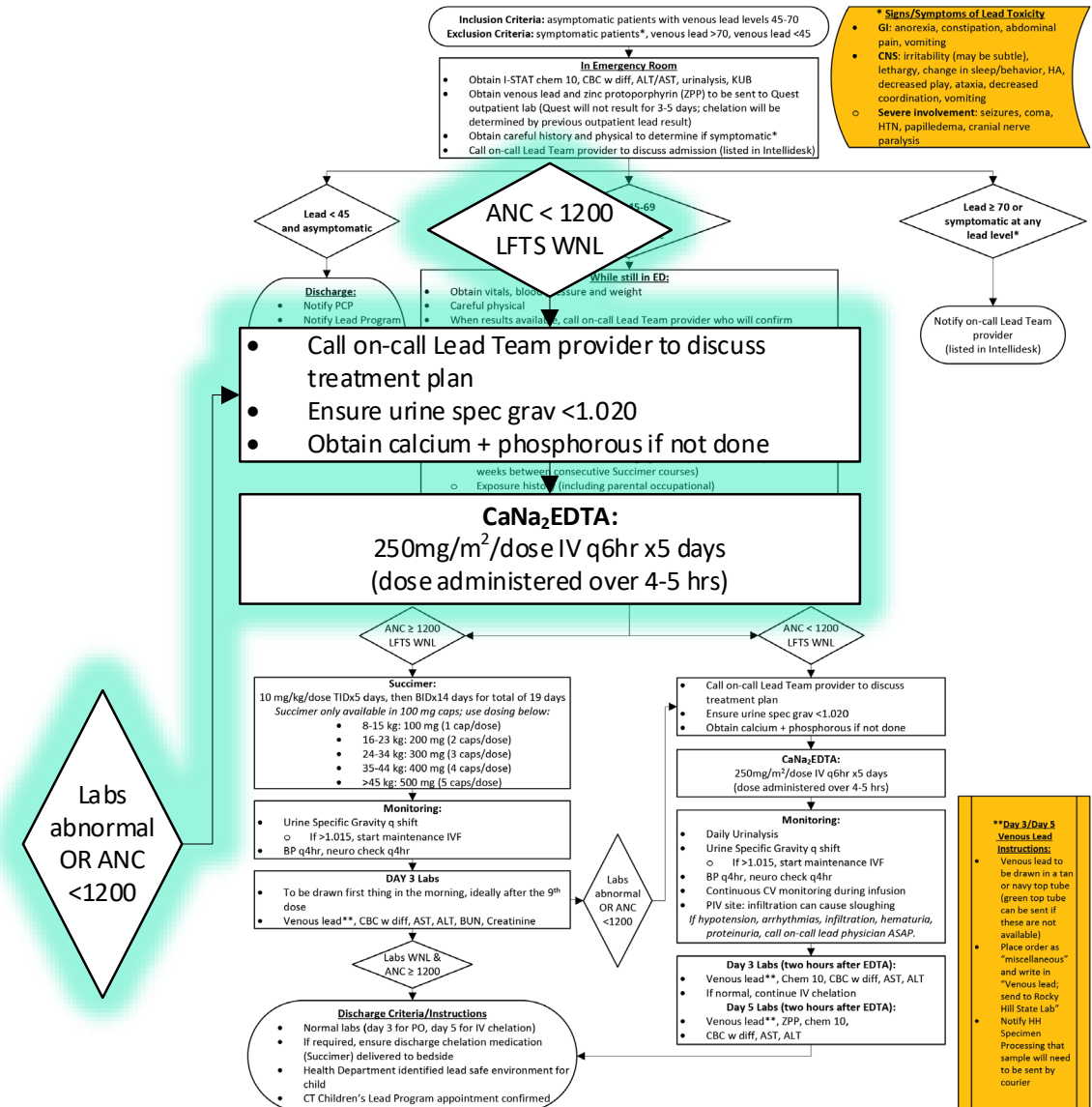
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If labs on admission or on Day 3 of Oral Chelation
therapy are abnormal
AND/ OR
ANC is <1200 at any point:
→ IV chelation therapy will be needed



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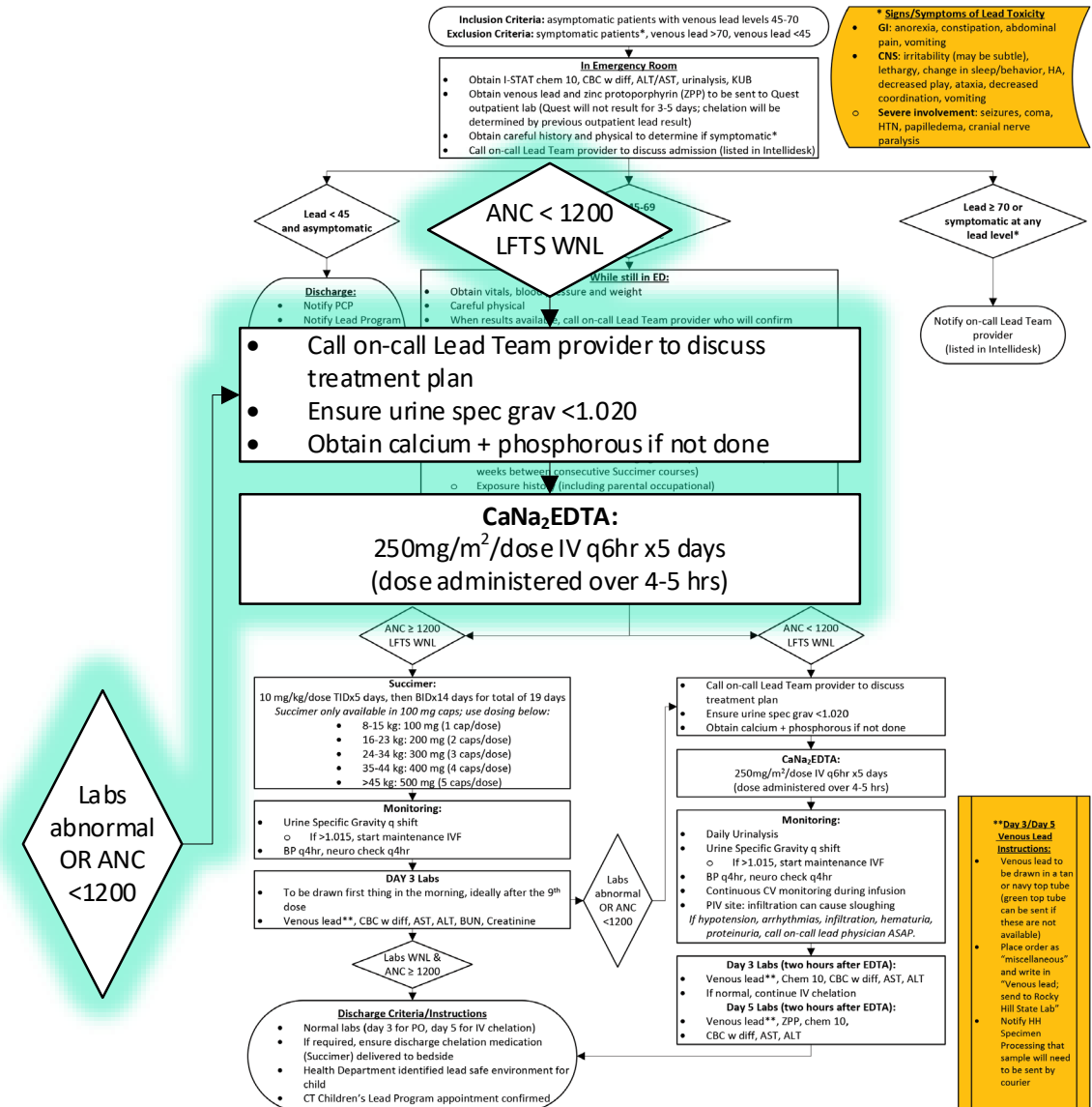
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IV Chelation:

- First, ensure that urine specific gravity is <1.020 as IV chelation can adversely affect the kidneys!
- Obtain a calcium and phosphorous level if not already done.



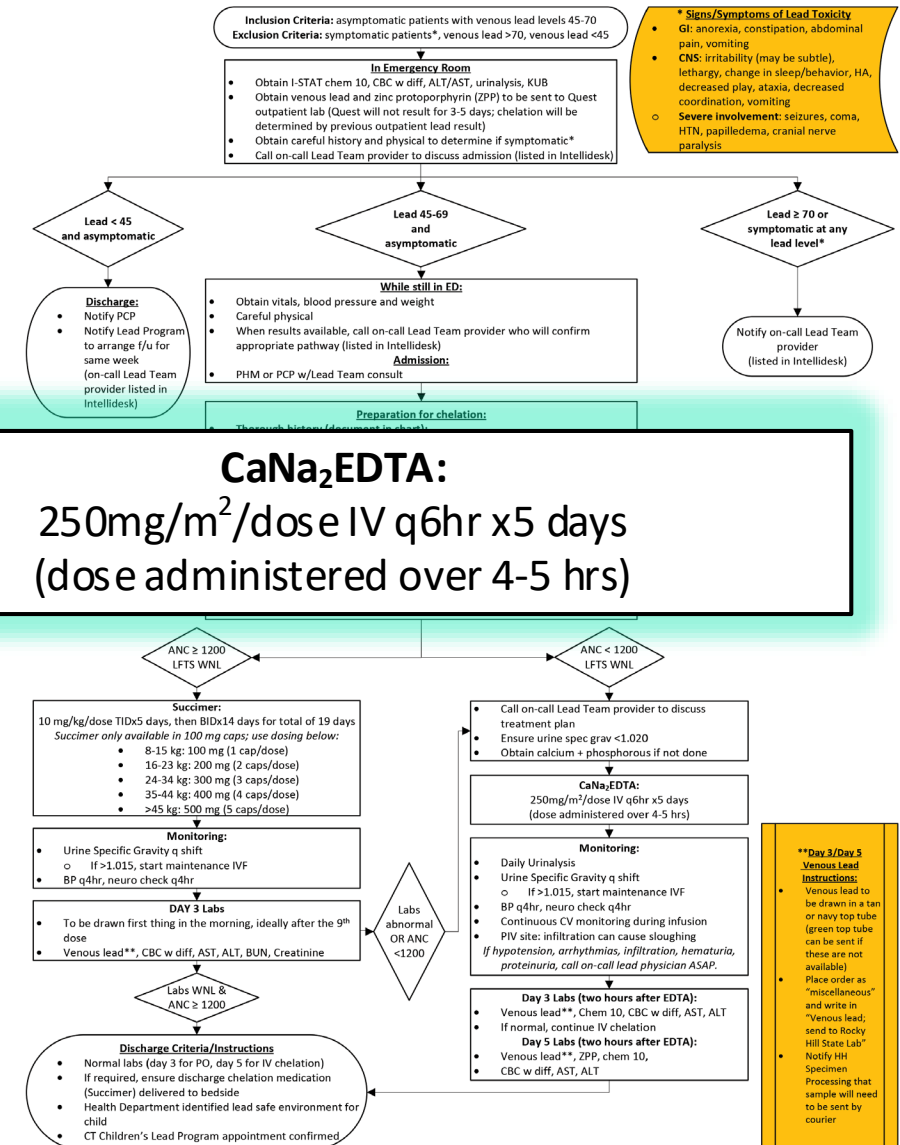
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IV chelation:

- Calcium Disodium EDTA (CaNa₂EDTA) is the agent utilized for IV chelation
- Each dose is given over 4-5 hours

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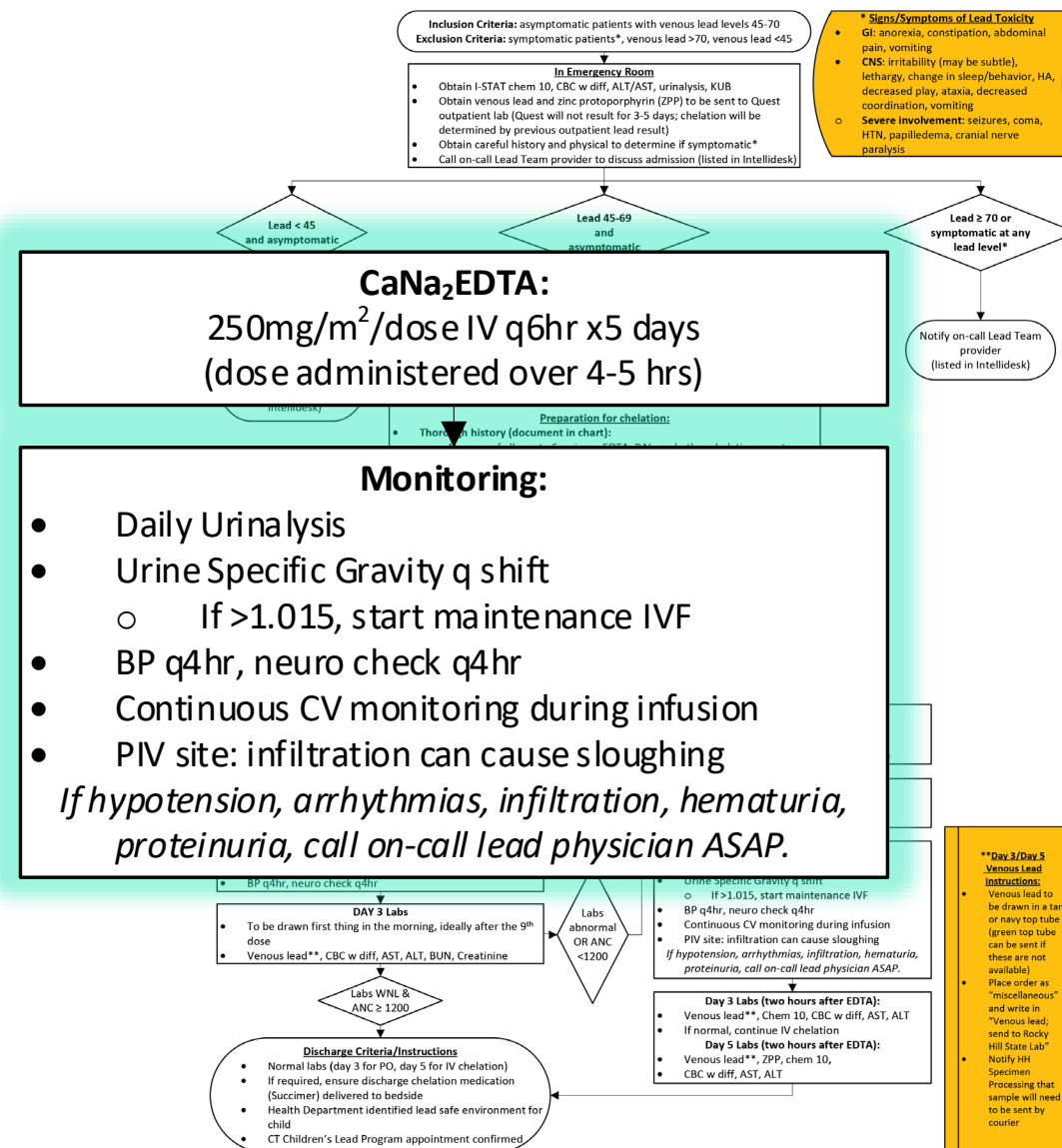
IV Chelation Monitoring:

- Adequate hydration is essential during therapy:
 - Monitor urine output
 - Daily UA and
 - Urine spec grav every shift.
- If the spec grav >1.015, you must start maintenance IVF.
- If there are any signs of infection or fever, consider withholding treatment for ANC <1200.
- Always monitor the PIV site: any infiltration can cause sloughing.

If any side effects occur, call the on-call lead physician ASAP.

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IV Chelation Monitoring:

Side effects of IV chelation therapy include:

Renal:

- Tubular necrosis (usually dose related and generally reversible)
- Hematuria, proteinuria

Cardiac:

- Hypotension
- Cardiac rhythm irregularities

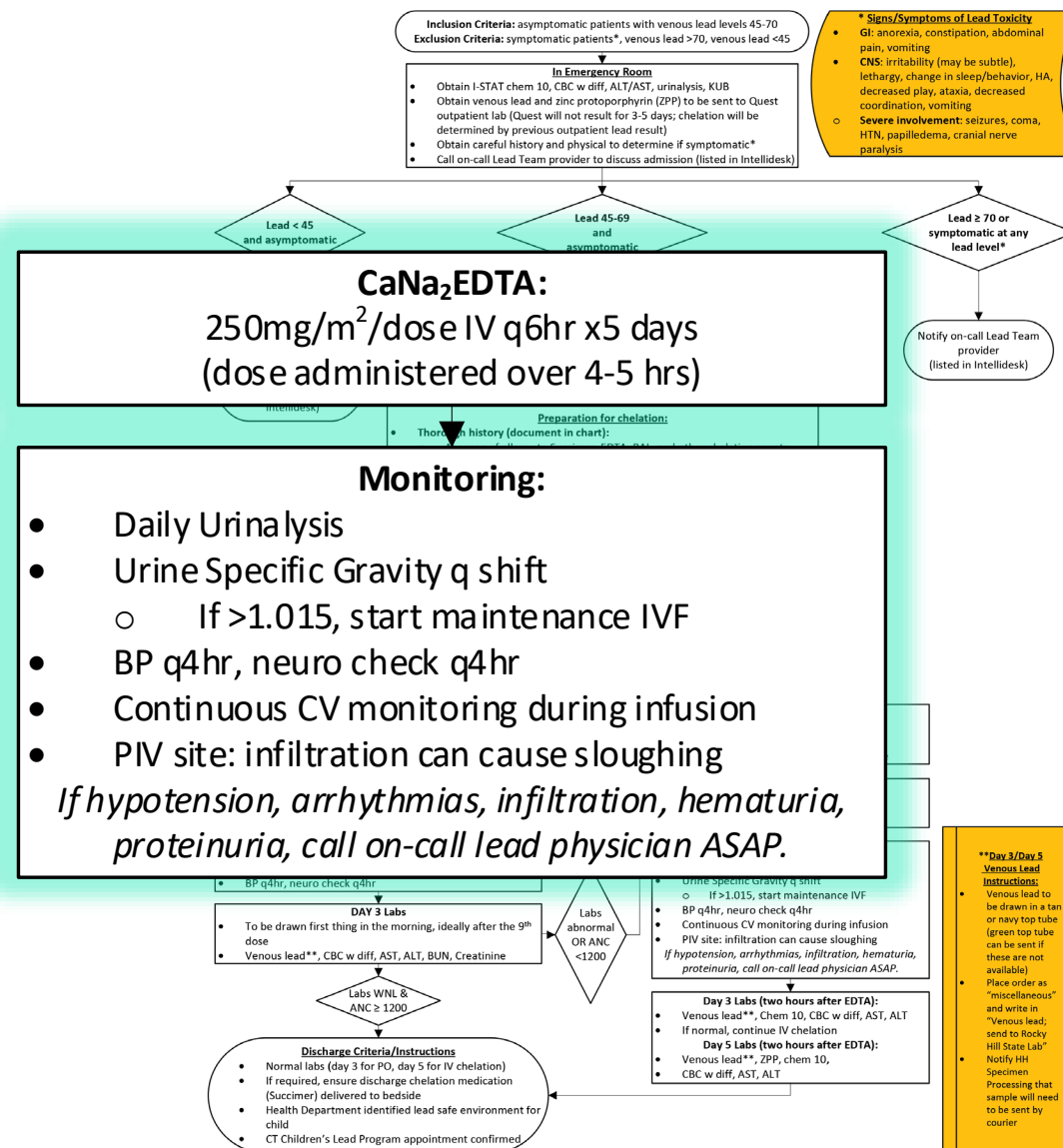
Thus, continuous CV monitoring during the infusion is required!

If any side effects occur, call the on-call lead physician ASAP.

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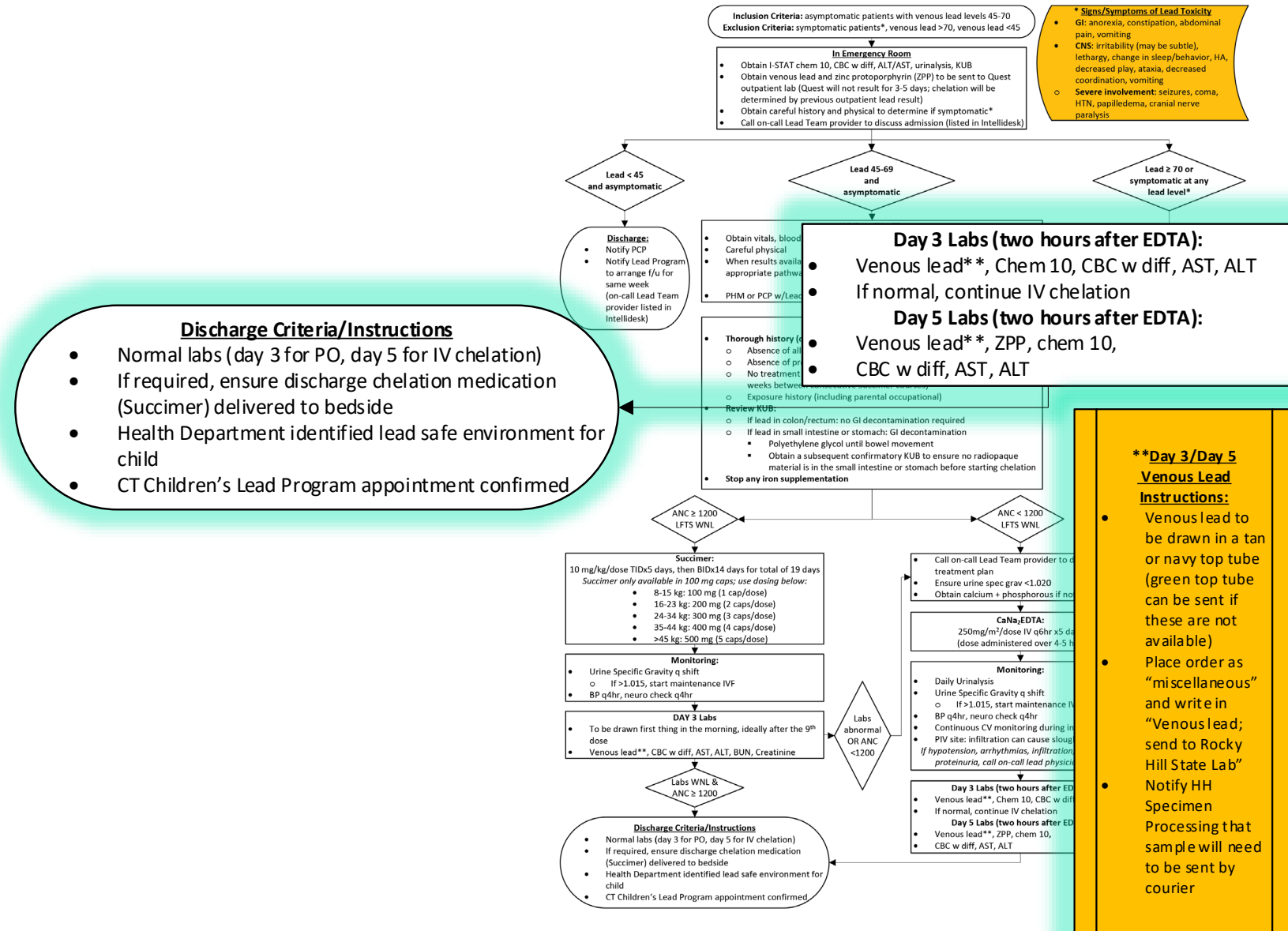
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IV Chelation:

- Labs are repeated on Day 3 and Day 5
- If labs are normal on Day 3 then continue day 4 and 5 of IV chelation.
- If day 5 labs are normal, proceed to discharge criteria.

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IV Chelation Discharge:

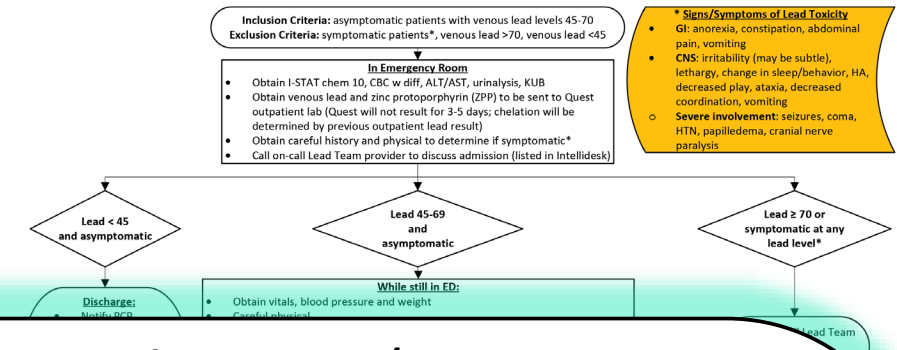
If labs are improved after day 5 of IV chelation, patient is nearing discharge

Discharge criteria and instructions are same as for Oral Chelation:

- Normal labs
- Bedside medication delivery
- DPH lead safe environment
- Lead program follow up confirmed

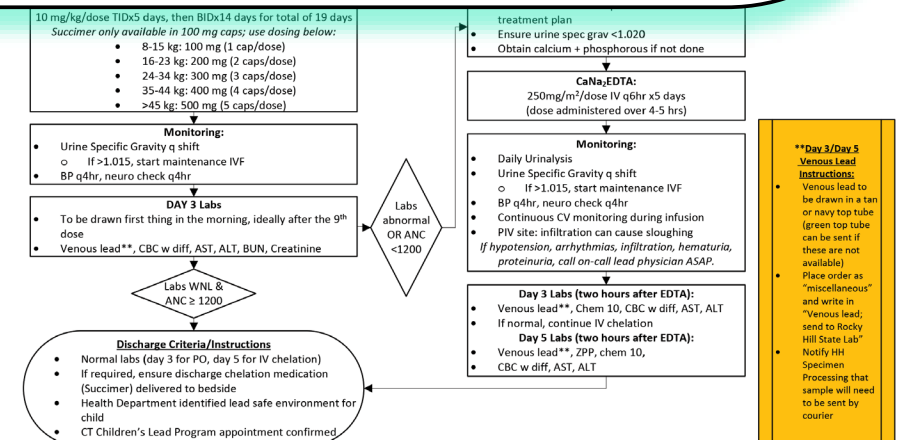
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Discharge Criteria/Instructions

- Normal labs (day 3 for PO, day 5 for IV chelation)
- If required, ensure discharge chelation medication (Succimer) delivered to bedside
- Health Department identified lead safe environment for child
- CT Children's Lead Program appointment confirmed



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Review of Key Points

- Obtaining a careful history and physical is important prior to starting any chelation.
- Ensure adequate hydration through chelation therapy.
- Succimer is difficult to obtain – call bedside delivery pharmacy when the patient is nearing discharge criteria (if they require PO chelation for home)
- Always call the on-call lead attending to notify them of lead patients, if any side effects are seen during therapy, or with any questions.

Quality Metrics

- % Patients with pathway order set
- % Patients with Lead Consult Note
- % Patients with discharge Chelation medication delivered to bedside
- Pathway Bundle: % Patients with Lead Consult & % Patients with discharge medication delivered to bedside

Pathway Contacts

- Jennifer Haile, MD
 - CT Pediatrics at CHC
 - Director of the Connecticut Children's Lead Treatment Center

Key References

- Connecticut Department of Public Health. (2023). *Requirements and Guidance for Childhood Lead Screening for Healthcare Providers in Connecticut*. [Requirements and Guidance for Childhood Lead Screening for Healthcare Providers in Connecticut](#).
- Connecticut Department of Public Health. (2020). *2020 Executive Summary: Childhood Lead Poisoning Surveillance*. [Executive-Summary-of-CT--2020-Childhood-Lead-Poisoning-Surveillance-Report-and-prev-data-tables.pdf](#).
- Newman, N., Binns, H.J., Karwowski, M., Lowry, J., PEHSU Lead Working Group. (2013). *Recommendations on Medical Management of Childhood Lead Exposure and Poisoning*. American Academy of Pediatrics & Pediatric Environmental Health Specialty Units. <https://www.pehsu.net/Library/facts/medical-mgmt-childhood-lead-exposure-June-2013.pdf>.
- Advisory Committee on Childhood Lead Poisoning Prevention. (2002). *Managing Elevated Blood Lead Levels Among Young Children: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention*. Centers for Disease Control and Prevention. <https://www.cdc.gov/nceh/lead/casemanagement/managingEBLLs.pdf>.

Thank You!



About Connecticut Children's Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children's, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings. These pathways serve as a guide for providers and do not replace clinical judgment.