

Clinical Standard Work and the AI Pathway Assistant



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CSW AI Pathway Assistant



Project Overview

- In collaboration with Google, we developed an AI based web application to serve as a “Pathway Assistant”.
- Uses Gemini’s Large Multimodal Modeling (LLM) capabilities to provide guidance based on our Clinical Standard Work (CSW) pathways.
- We have safeguarded against hallucinations by restricting ingested materials to CSW pathway content.
- Allows clinicians to ask targeted questions about management, ensures that recommendations are both contextually relevant and aligned with evidence-based practices.
- We look forward to continuing to refine the assistant with input from healthcare teams.

Panel B. An example of relationships in embeddings

This lower-dimensional representation of a higher-dimensional embedding shows how embeddings can encode conceptual relationships. See text for explanation of how embeddings are derived. Image adapted from [7]

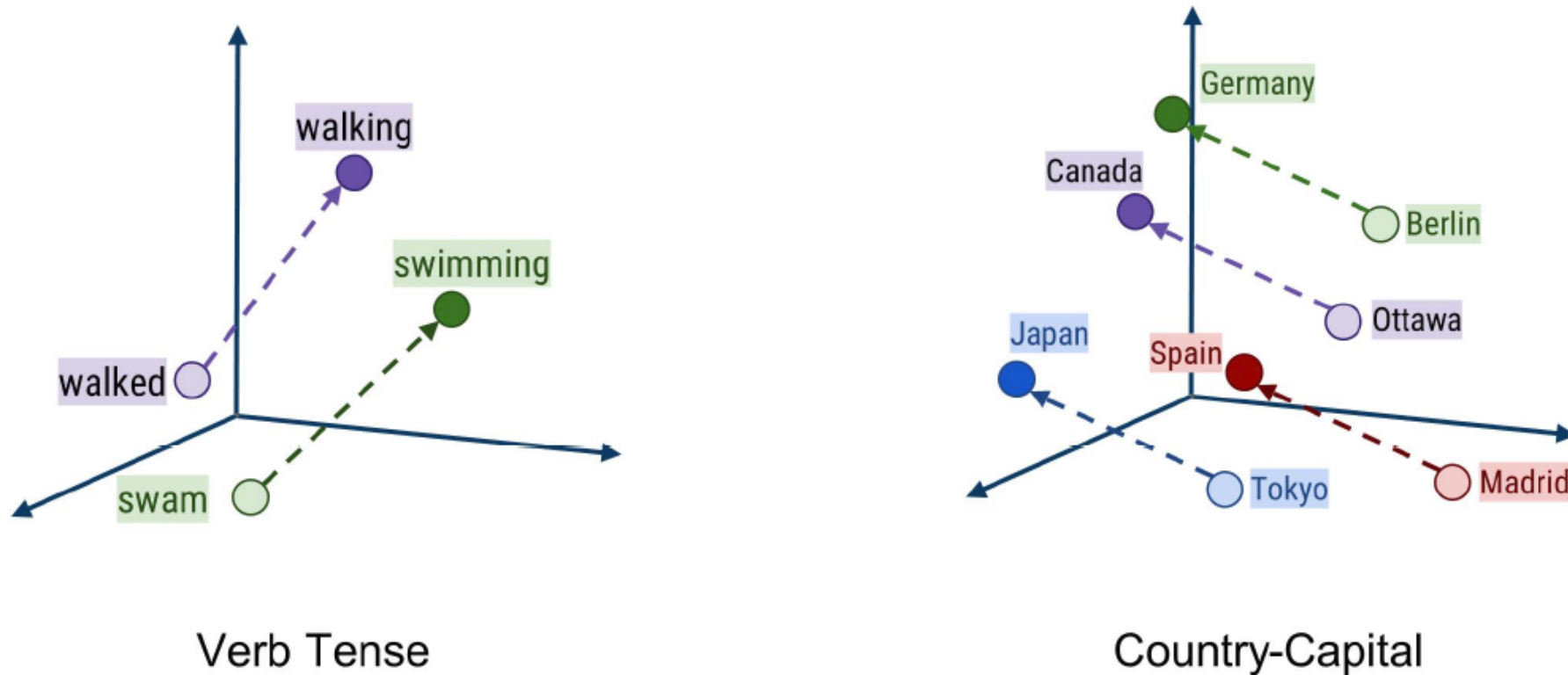
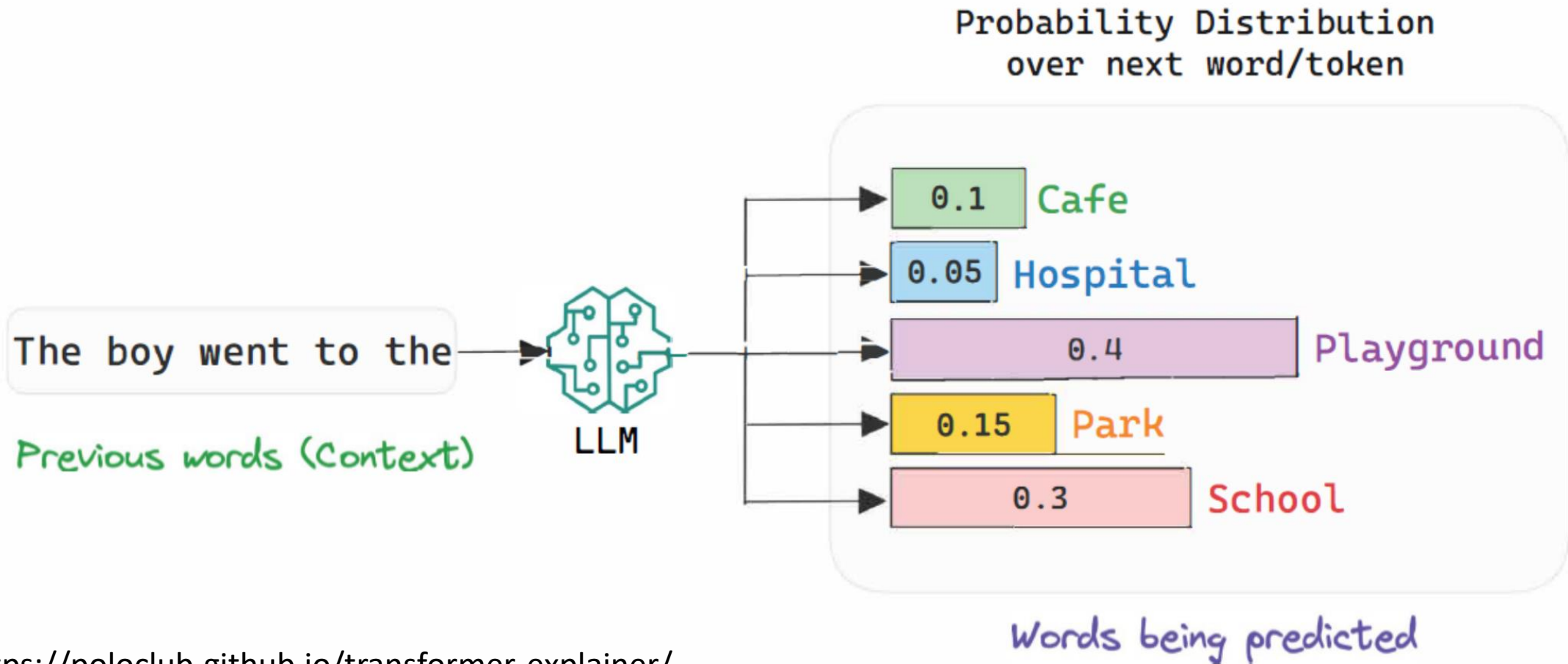


Figure 1 Core concepts in language models. (A) An example of next-word prediction in training a language model. Language-focused foundation models are trained on large amounts of text, but the text is not hand-annotated. Rather, the models mask certain words and try to predict them. For example, given this well-known statement from Crossing the Quality Chasm,⁶ how might a model train? Models can also train by masking attention from words in the middle of a sentence, and multimodal models can handle other types of input besides text (for example, images). (B) An example of relationships in embeddings. This lower-dimensional representation of a higher-dimensional embedding shows how embeddings can encode conceptual relationships. See text for explanation of how embeddings are derived. Image adapted from 8.

Token (Word) Prediction



Gemini Pathways Assistant: Version 1

Features

- User interface limited to a single prompt and response.
- Gemini references each page singly
- Limited number of pages ingested, algorithm pages only, supplementary material not ingested.
- Responses scored on a 0-5 scale: ≤ 2 incorrect; ≥ 3 correct
- Users designate if an answer was potentially risky to a patient.

Database Status

# Questions	# Correct An...	# Wrong Ans...	# Risky Ans...
1359	1115	164	80
↑ 0	↑ 0	↑ 0	↑ 0

Questions

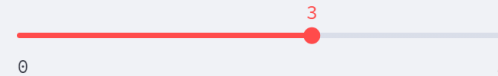
Previous Questions

What are the inclusion criteria? ▾

New Question

How do I assess dehydration clinically?

Question Difficulty (0 [easy] to 5 [very difficult])



Ask Gemini...

Answer

Generated answer

The diagram states that in children 1-36 months of age, the Clinical Dehydration Score (CDS) may be used to diagnose moderate to severe dehydration. However, given the wide confidence interval, the decision to treat should not solely rest on the CDS. The decision to treat should incorporate clinical judgment and assessment of the patient's vital signs (HR, RR), and ability to take oral intake. The CDS is not useful in assessing dehydration of <6%.

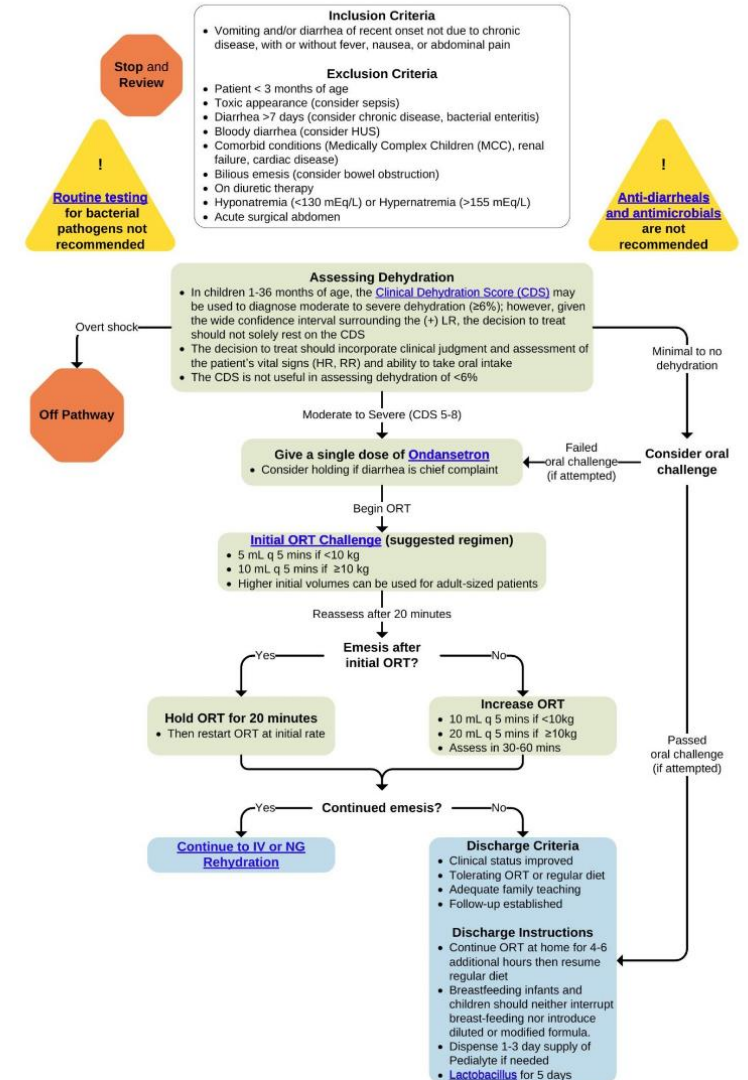
Pathways

Acute Gastroenteritis ▾

Chart

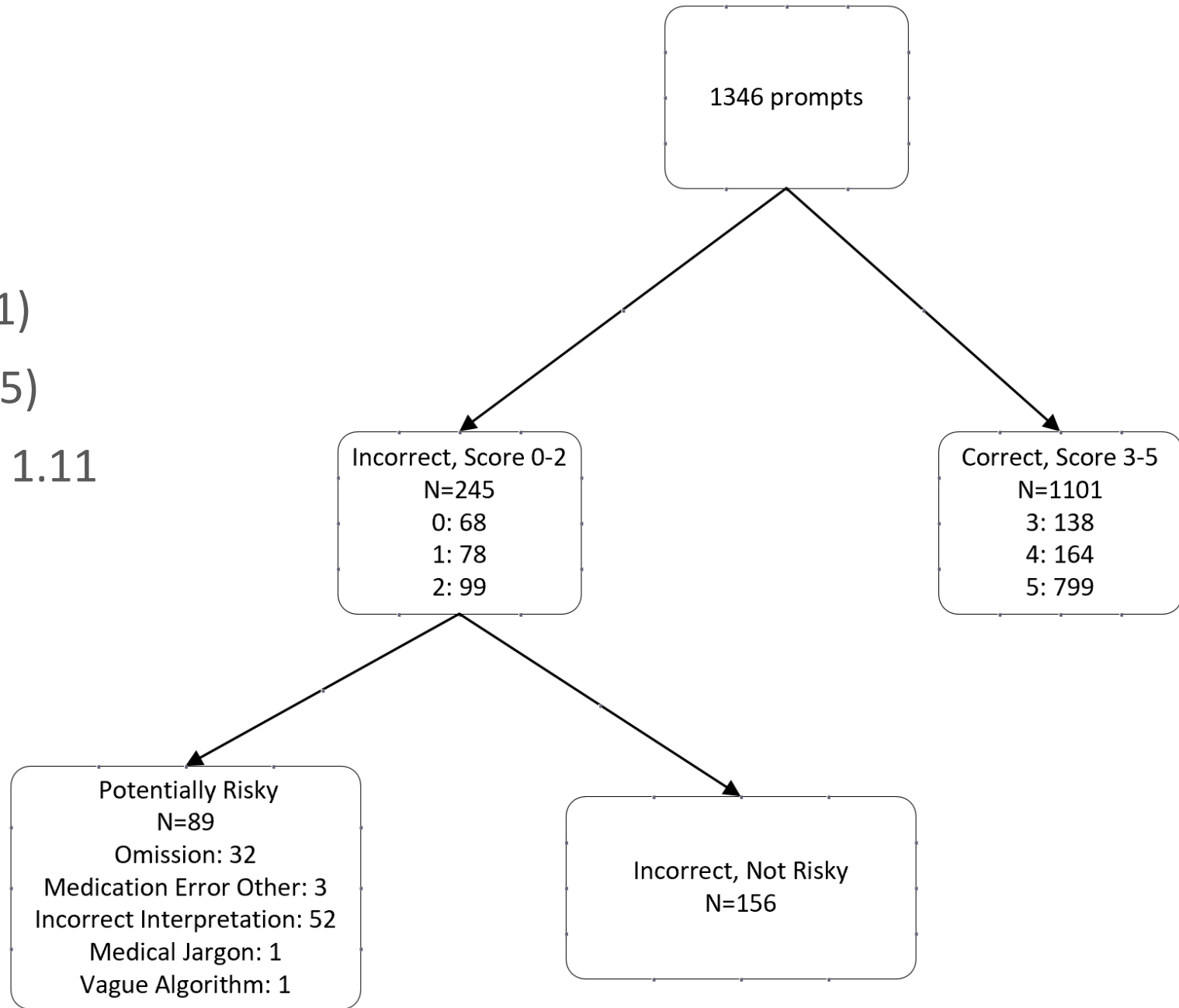
1 ▾

Acute Gastroenteritis Pathway v4.0: Emergency Department/ Urgent Care Oral Rehydration Therapy (ORT)



V1: Results

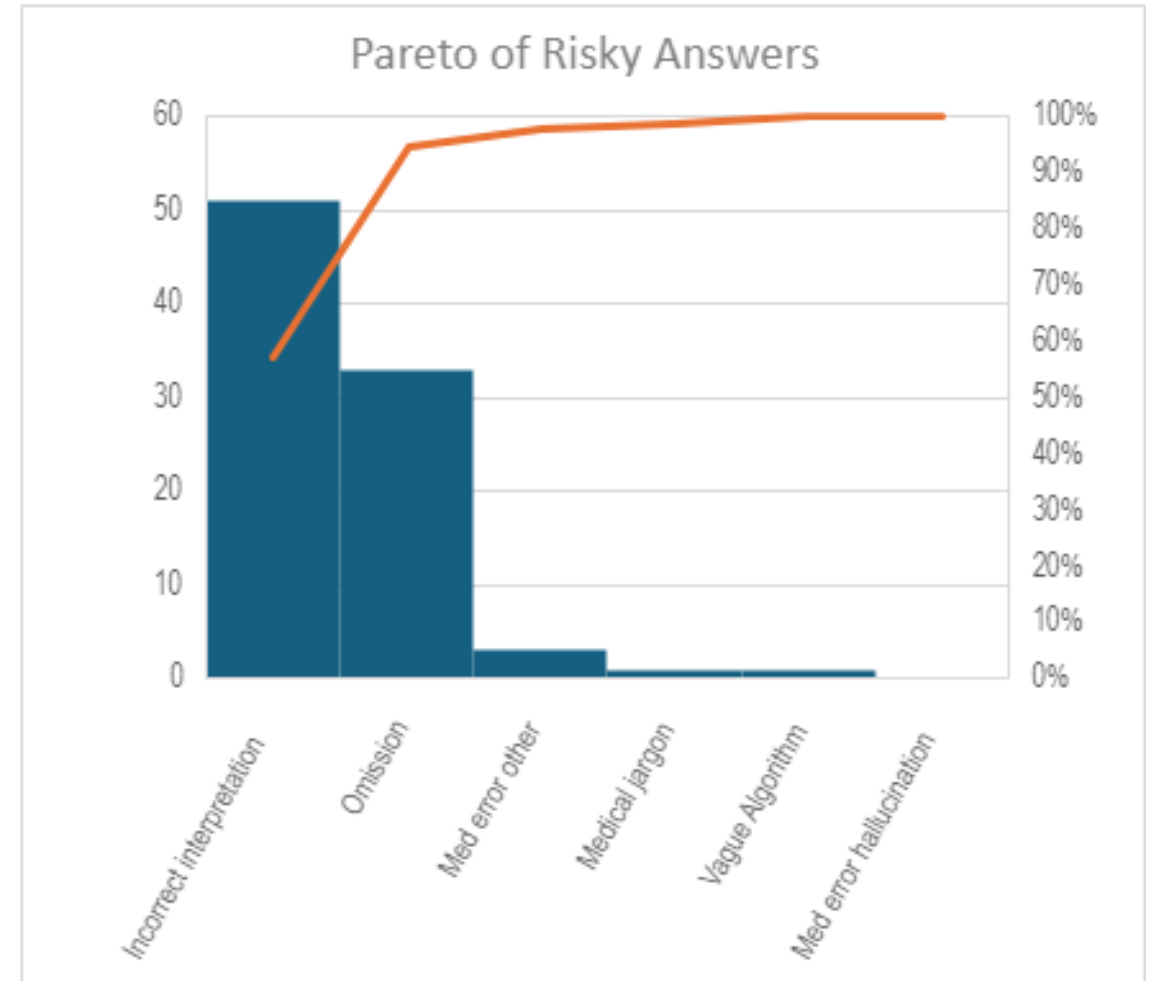
- Correct (Score ≥ 3): 77% (n=1101)
- Incorrect (Score ≤ 2): 23% (n=245)
- Average incorrect answer score: 1.11
- Risky answers: 89



Error Analysis of Incorrect “Risky” Answers

Incorrect response due to:

1. Limited ability to ground answers in the context of patient status, Gemini could not ask clarifying questions.
2. Limited content ingested.



Gemini Pathways Assistant: Version 2

Features

- All pathway pages ingested
- Chatbot feature mimics interactions between an MD and their assistant
- Chatbot allows for enhanced grounding, Gemini able to ask user clarifying questions before generating a response.
- Incorrect answers from V1 retested in V2

Pathways

Selected Pathway

Asthma

Hello, How can I help you today?

Can you help me calculate the respiratory score?

I sure can, but I need a little more information about your patient. Could you please tell me the following?

- Patient's age
- Respiratory rate
- Presence and type of retractions
- Level of dyspnea (according to the age-specific criteria on the chart)
- Auscultation findings

Once I have this information, I can help you calculate the score.

How do I assess dyspnea?

Dyspnea (difficulty breathing) is assessed differently depending on the age of the patient.

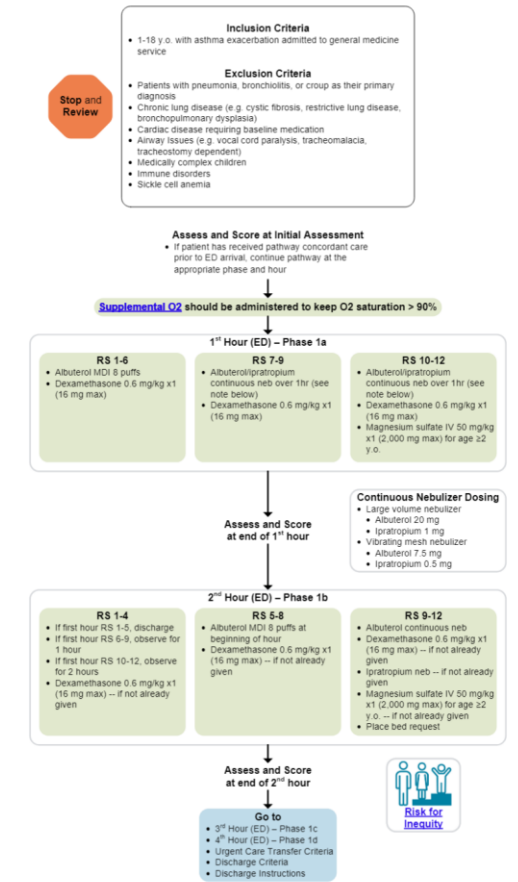
For children younger than 2 years old:

- Observe their feeding, vocalizations, and activity level.
- Refer to the "Dyspnea" section of the "Respiratory Score" table on page 2 of the protocol for specific examples and their corresponding scores.

For children between 2 and 4 years old:

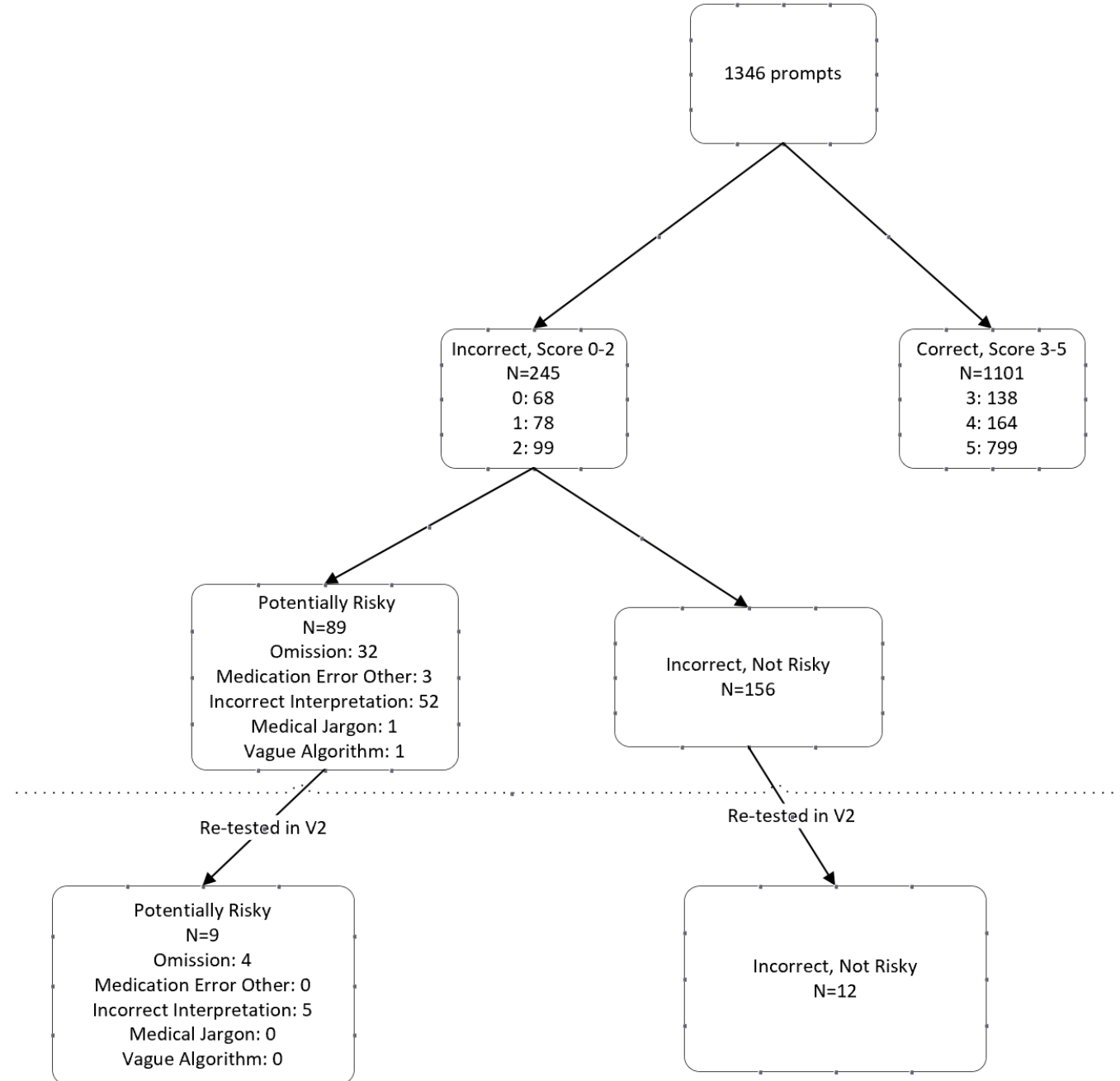
- Observe their feeding, vocalizations, and play.

Asthma Pathway v12.0: ED Management



V2 Results

- V2 answered 224/245 of previously incorrect answers correctly
- Average score of previously incorrect answers increased from 1.11 to 3.88
- # Risky answers decreased from 89 to 9



Guardrails: Hard Stops

Pathways

Selected Pathway

Bronchiolitis

Hello, How can I help you today?



Infant with bronchiolitis has congenital heart disease and digoxin and has normal room air saturation of 90%, should oxygen be administered?



This pathway excludes patients with cardiac disease requiring baseline medication, so I cannot provide guidance for this patient.

Gemini will not answer questions if it detects exclusion criteria are present or if information cannot be found within the pathway documents

Bronchiolitis Pathway v16.1: Table of Contents



Inpatient & ED Inclusion Criteria

- Age <2 years
- Prematurity and/or age <12 weeks may be included, but expect a more severe course of illness
- Viral upper respiratory symptoms & lower respiratory symptoms that may include: increased work of breathing, cough, feeding difficulty, tachypnea, wheeze, fever

Inpatient & ED Exclusion Criteria

- Cardiac disease requiring baseline medication
- Anatomic airway defects
- Neuromuscular disease
- Immunodeficiency
- Chronic lung disease

What causes “hallucinations”?

- When an LLM is asked about question it has not been trained on or if the training material is contradictory; it will still construct an answer based on its predictive language function.
- So, if you ask about an event in the news that happened yesterday, and the training data was last updated a month ago, there is potential for hallucination.
- The Pathway Assistant can ONLY access CSW content, this is known as an “enterprise data” restriction, (aka Retrieval Augmented Design (RAG)) therefore, hallucinations should not occur.
- The PA’s known “universe” of information is the pathway document.

Retrieval Augmented Generation (RAG)



- RAG is the ability to connect model output to verifiable sources of information
- Instead of relying solely on its pre-trained knowledge, RAG anchors the model responses to our pathways
- Drastically reduces model hallucinations from the improved context

Guardrails: System Instructions

System instructions apply to ALL queries and is how we safeguard against irrelevant responses and hallucinations

“You are a specialist reading and understanding clinical protocols described in the provided document and the metadata. These protocols are described by flowcharts and text contents. You are very good at inferring knowledge from flowcharts and answering questions using them and the text contents. You interact with the physician or nurse about the clinical pathways described in the provided documents. If your answer depends on whether the patient is in the Emergency Department (ED), Urgent Care or Inpatient setting, please ask for clarification. You try to answer the questions on the first shot. Keep your answers short. You ask questions when you think that you might be missing information to answer a question correctly. You never make up anything and stay focused on the flowchart’s content. You do not know anything about medicine beyond the information provided by the document and the interaction with the physician. When you make a recommendation include the page numbers you used to make that recommendation. Use a serious tone at all times”.

Guardrails: Temperature

USER

Algorithm_EatingDisorderAc

Eating Disorders

Ask me all the questions to

AI

Thoughts

Expand to show model

To determine if a patient

Is this evaluation occ

Once the setting is

General Eligibility C

1. "What is the patient's rate of recent weight loss? Is it: * ≥ 1 kg/week for ≥ 2 consecutive weeks? (Red) * 0.5-0.99 kg/week for ≥ 2 consecutive weeks? (Yellow)
2. "Is there a diagnosis of, or concern for, an eating disorder (e.g., Anorexia Nervosa, OSFED (Other Specified Feeding or Eating Disorder), Bulimia Nervosa, or Binge Eating Disorder)?" (This is required).
3. "Is the patient's condition primarily due to another diagnosis that results in severe malnutrition but is NOT an eating disorder (e.g., cystic fibrosis, IBD)?" (This would be an exclusion).
4. "Is the patient's diagnosis Avoidant Restrictive Food Intake Disorder (ARFID)?" (If yes, this pathway may not apply as ARFID patients require individualized care plans off pathway, as noted on pages 2 and 3).

If the evaluation is in an OUTPATIENT / PRE-ADMISSION setting (based on page 2 and the MEED criteria on page 9):

To determine if the patient meets Eating Disorder Medical Admission Criteria:

A. Weight Status (from MEED criteria, page 9, Step 1):

i. "What is the patient's rate of recent weight loss? Is it:

* ≥ 1 kg/week for ≥ 2 consecutive weeks? (Red)

* 0.5-0.99 kg/week for ≥ 2 consecutive weeks? (Yellow)

Temperature
This is the most critical setting. It forces the model to be deterministic and choose the most logical and syntactically correct tokens, eliminating creative or unpredictable outputs

Model ?

Preview

gemini-2.5-pro-preview-05-06

Our most advanced reasoning model, capable of solving complex problems

Switch model

Outputs

Structured output ?

Tools

Grounding: Google

Grounding with Google Search or Google Maps.

Grounding: Your data

Advanced

Region *

us-central1 (Iowa)

Safety Filter Settings

Temperature ?

0 2 0

Output token limit ?

1 65535 10880

Seed ?

0 Randomize

Max responses ?

1 1 N/A

Top-P ?

0 1 0.2

Stream model responses

The most important
thing is the prompt

Prompt Engineering

A concise question will elicit clarifying questions.



Help me pick 2nd line seizure meds

Seattle Children's Hospital



This tool provides information for internal testing purposes only. Medical knowledge is constantly evolving, and while we strive for accuracy, the information provided should not be used as a substitute for professional medical judgment. Readers should confirm the information contained herein with other sources and accepted best practice before making any clinical decisions.

Pathways

Selected Pathway

Seizure

Hello, How can I help you today?



Help me pick 2nd line medications for seizure



To recommend 2nd line medications, I need to know the patient's characteristics (age, if this is the 1st seizure, blood pressure, and history of seizures) and the location of the patient (Emergency Department, Urgent Care or Inpatient). (Page 2)

Prompt Engineering

A less specific question elicits an anticipatory framework and additional clarifying questions.



I have a patient who is seizing, advise

Seattle Children's Hospital



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Pathways

Selected Pathway

Seizure

Hello, How can I help you today?



I have a patient who is seizing, advise



I can provide guidance based on the 'Seizure Pathway v7.0'.

First, at 0 minutes (seizure begins):

- Prepare 1st Line medication
- Secure IV access
- Support airway, oxygenation, circulation
- Check glucose and sodium (page 2)

If seizure continues for 5 minutes:

- Administer 1st Line - Benzodiazepines: Lorazepam IV if IV access is available, else Midazolam IN.
- Request both 2nd Line drug doses.
- Diagnostic tests and assess for risk of infection.
- Consult neurology (page 2)

If seizure continues for 15 minutes:

- Administer 2nd Line Medications (page 2)

If seizure continues for 40 minutes:

- Administer 3rd Line - Midazolam (page 2)

To provide more specific guidance, can you please confirm the patient's location (Emergency Department, Urgent Care, or Inpatient)? This will help in determining the appropriate 2nd line medications.

Prompt Engineering - Meta-Prompting

- Asking Gemini to prompt Gemini.
- The model will produce high quality prompts, generally better than a human
- Useful when multiple factors contribute to a final clinical decision - a feature of many pathways
- Gemini will find decision points based on the metadata and produce a prompt accordingly.

Prompt Engineering - Meta-Prompting

- Critical information is most efficiently retrieved by meta-prompting;
- Examples:

“My goal is to.....write a prompt for this”

“Ask me all the questions I need to

“Write a prompt that”

Complex Prompting - Examples

- I am in the preadmit phase, ask me all the questions to determine if a patient needs to be admitted, include details from the MEED criteria
- Write a prompt that determines when abxs should be given to a pt with confirmed appendicitis
- Write a prompt that determines if an infant with a fever needs a lumbar puncture?
- Write a prompt that helps me pick the correct abxs for a patient with PNA
- In ED, XX year old, XX.X kg, pH X.XX, Bicarb XX, GCS XX, Glucose XXX, BOHB X.X, Na XXX, K X.X, lactic acid X.X, calcium X.X, received a total of XXXXcc of resus fluids, advise, calculate insulin rates and fluid rates
- Write a prompt that determines which patients with UTI need imaging
- Ask me for all the clinical information needed to determine if a patient should be treated for KD

V3 Performance

- V3 is powered by Gemini 3.1 PRO
- Incorporated calculators in JSON
- All known errors eliminated
- Enhanced Reasoning

A Complex Prompt...



In ED, 10-year-old, 30 kg, pH 7.11, Bicarb 12, GCS 14, Glucose 292, BOHB 4.2, Na 132, K 2.8, lactic acid 2.1, calcium 7.7, Hb and Hct are normal, received a total of 980cc of resus fluids at an outside hospital, advise, calculate insulin rates, fluid rates and give me the electrolyte composition of IVFs for the two-bag system, also give me the lab schedule.

Diabetes DKA Pathway v8.0: Criteria and Overview

Stop and Review

Inclusion Criteria

- Diabetic Ketoacidosis (DKA) is defined as (**need all 3 criteria**):
 - Hyperglycemia > 200 mg/dL **AND**
 - Ketonemia (BOHB > 1 mmol/L) **AND**
 - Venous pH < 7.3 or HCO₃ < 15mEq/L

Exclusion Criteria

- Age < 12 months

If Hyperglycemic Hyperosmolar Syndrome (HHS) is suspected, consult Endocrinology to formulate an individualized management plan for your patient

Where Child is Managed

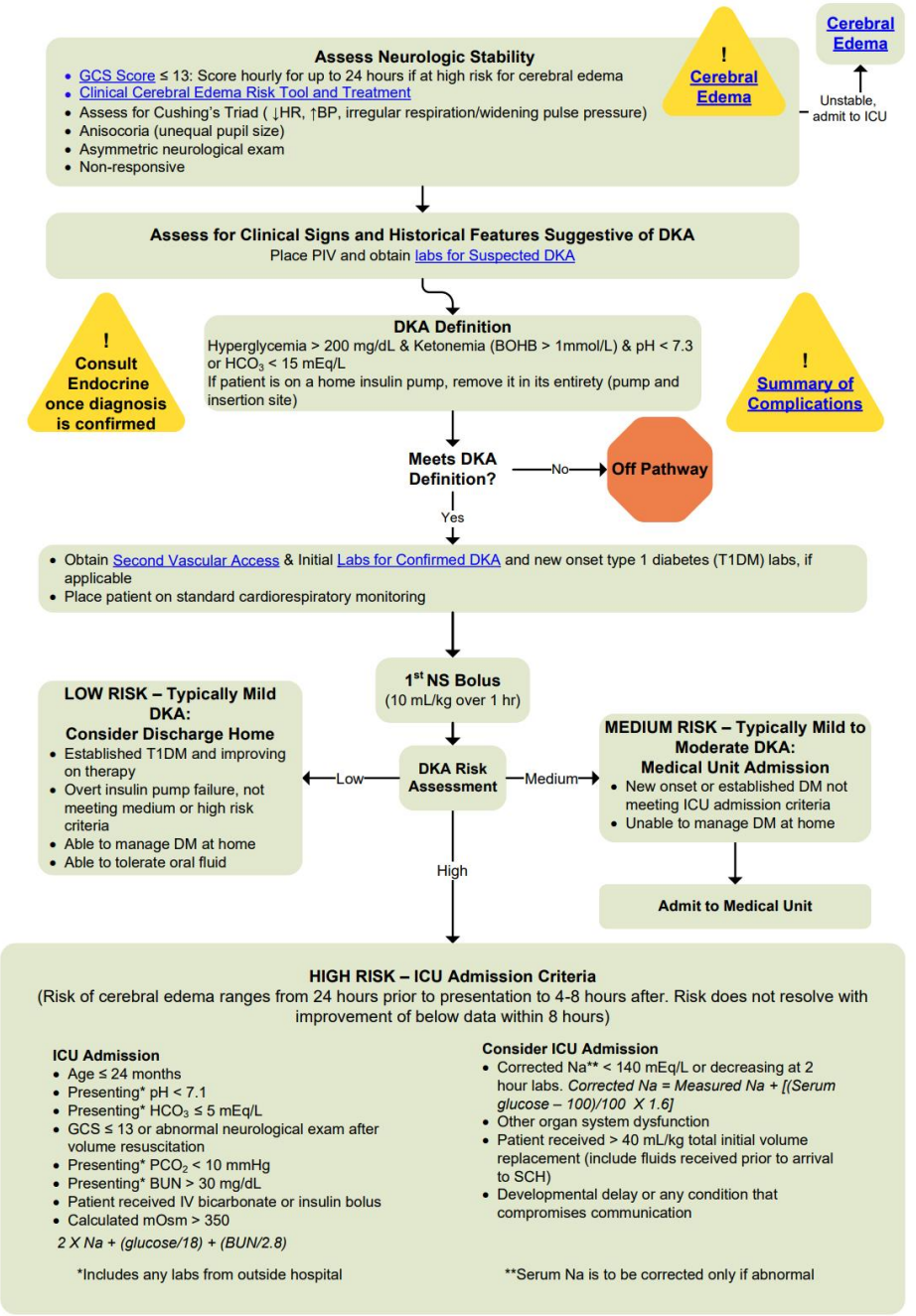
DKA Severity Definitions

Severity	Venous pH	Sodium bicarbonate (mEq/L)
Mild	7.2 to < 7.3	10 to < 15
Moderate	7.1 to < 7.2	5 to < 10
Severe	< 7.1	< 5

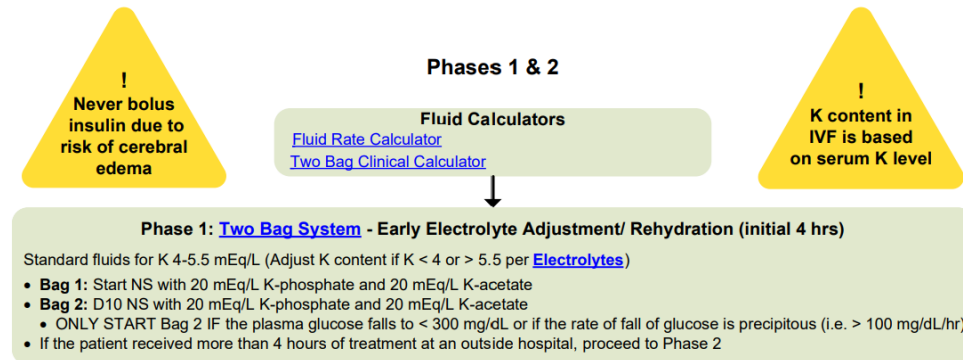
Diabetes DKA Pathway Overview								
Time	PHASE 1	PHASE 2	Transition					
First 1 hour (time may vary for patients who first presented to outside facility)	Hour 1 to 4	Hour 4 until DKA resolves	When BOHB < 1					
Assessment	<ul style="list-style-type: none"> ABCds and weight Confirm dx and consult Endocrinology Confirmed DKA labs → activate pathway Place 2 IVs Monitor GCS 	<p>Neuro checks based on presenting pH*</p> <ul style="list-style-type: none"> pH < 7.1: q1 hr pH 7.1 to < 7.2: q1 hr x 8 hrs, then q2 hrs pH ≥ 7.2: q2 hrs See Lab Monitoring 	See Lab Monitoring					
Fluids & Electrolytes	2 bag IVF fluid rate based on fluid calculator	<ul style="list-style-type: none"> Continue same IVF rate Consider NS if high risk for CE 						
	NS Bolus 10mL/kg over 1 hour	<table border="1"> <tr> <th>Bag</th> <th>Contents</th> </tr> <tr> <td>Bag 1</td> <td>NS + K-phos + K-acetate</td> </tr> <tr> <td>Bag 2</td> <td>When glucose < 300 or falls precipitously start D10 NS + K-phos + K-acetate</td> </tr> </table>	Bag	Contents	Bag 1	NS + K-phos + K-acetate	Bag 2	When glucose < 300 or falls precipitously start D10 NS + K-phos + K-acetate
Bag	Contents							
Bag 1	NS + K-phos + K-acetate							
Bag 2	When glucose < 300 or falls precipitously start D10 NS + K-phos + K-acetate							
Insulin	DO NOT START Insulin until after first 10mL/kg fluid bolus	<p>Start continuous insulin infusion</p> <p>If patient ≥ 10 years: discuss Early Basal Insulin with Endo</p>	Continue continuous insulin infusion					

*Neuro checks: [GCS assessment](#). If concerns on assessment, patient symptomatic or GCS ≤ 13, [assess neurologic stability](#)

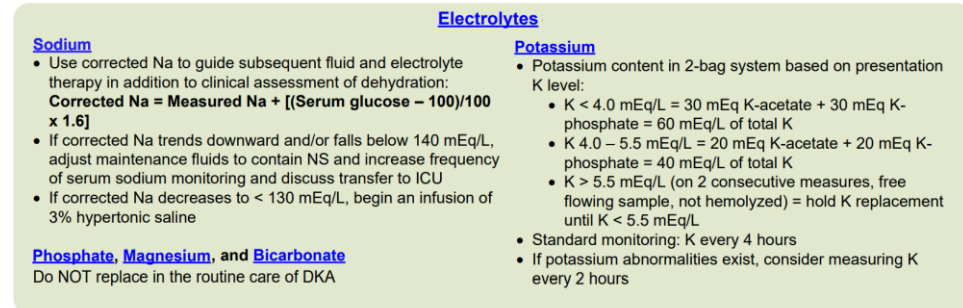
Diabetes DKA Pathway v8.0: Assessment and Disposition



Diabetes DKA Pathway v8.0: Insulin and Fluids



Diabetes DKA Pathway v8.0: Electrolytes



Begin planning for transition to subcutaneous insulin **when BOHB is < 3 mmol/L**

[To Transition Phase](#)

ICU Discharge Criteria

- BOHB ≤ 3 mmol/L (if overnight, consider early morning transfer) **and**
- GCS = 15 **or** at prebolic baseline **and**
- K requirement can be maintained with ≤ 60 mEq/L supplementation **and**
- No ICU care needed for any other reason
- Exception: hyperosmolar dehydration

Lab Monitoring

Labs for Confirmed DKA

- Electrolyte panel, Ca, Mg, Phos q4h
- HbA1c, BUN, Cr, osmolality (one time)
- BOHB q2h
- POC glucose q1h

	A	B	C
1	*** TO PRINT THIS WORKSHEET, HIT CTRL+P ***		
2			
3	IV fluid rate for patients with Diabetic Ketoacidosis (DKA)		
4	Fill in the yellow boxes and everything else will be calculated.		
5	Weight of patient	30 kg	
6			
7	Severity of Dehydration - assume:	7 percent	
8	Fluid deficit = weight (max: 80 kg) * percentage dehydrated	2100 ml	
9			
10	DKA Suspected - include all fluids administered at SCH and at other facilities		
11	TOTAL fluids administered during resuscitation	980 ml = 32.67 ml/kg	
12			
13	Maintenance fluids for one day:	1700 ml	
14			
15	Total fluids to administer over 48 hours (maintenance * 2 + deficit - resuscitation)	4520 ml	
16	NOTE: Formula is such that we never provide less than 1 x maintenance fluids.		
17			
18	TOTAL IV FLUID RATE:	94 ml / hr	

	A	B	C
1	*** TO PRINT THIS WORKSHEET, HIT CTRL+P ***		
2			
3	DKA Fluid Calculator: Use to determine two-bag system rates based on blood glucose and rehydration fluid rate.		
4			
5	ENTER TOTAL IV FLUID RATE:	94 ml / hr	
6			
7	IF HOURLY BLOOD GLUCOSE FALLS > 100 mg/dL/hr, call medical staff to guide management.		
8			
9	IF hourly blood glucose falls 100 mg/dL/hr or less, use the following table:		
10	TWO BAG SYSTEM TABLE		
	For blood glucose values of	SALINE bag (ml/hr)	DEXTROSE-SALINE bag (ml/hr)
11	≥ 300	94	OFF
12			
13	250-299	71	23
14			
15	200-249	47	47
16			
17	150-199	24	70
18			
19	100-149 (if < 125, order D12.5-containing bag as below, but do not hang)	OFF	94
20			
21	< 100: Discontinue the two-bag system and instead use D12.5% concentration with identical saline and electrolyte content. Discuss with Attending. Check BOHB results and consider readiness to transition off insulin infusion.	run at 94 ml / hr	

Pathways

Selected Pathway

Diabetes DKA

Hello, How can I help you today?



In ED, 10-year-old, 30 kg, pH 7.11, Bicarb 12, GCS 14, Glucose 292, BOHB 4.2, Na 132, K 2.8, lactic acid 2.1, calcium 7.7, Hb and Hct are normal, received a total of 980cc of resus fluids at an outside hospital, advise, calculate insulin rates, fluid rates and give me the electrolyte composition of IVFs for the two-bag system, also give me the lab schedule.



The patient's clinical presentation indicates Diabetic Ketoacidosis (DKA). Based on the provided information and the Diabetes DKA Pathway document, the following recommendations are made:

Reasoning:

1. DKA Definition and Severity Assessment (Page 2):

- **Inclusion Criteria:** The patient's glucose is 292 mg/dL (> 200 mg/dL), BOHB is 4.2 mmol/L (> 1 mmol/L), and venous pH is 7.11 (< 7.3) with HCO₃ of 12 mEq/L (< 15 mEq/L). All three criteria for DKA are met.
- **Exclusion Criteria:** The patient's age of 10 years does not meet the exclusion criterion of age < 12 months.
- **Severity:** A venous pH of 7.11 classifies the DKA as **Moderate** (pH 7.1 to < 7.2).

2. Risk Assessment and Disposition (Page 3):

- **DKA Risk Assessment:**
 - The corrected Sodium (Na) is calculated as: Measured Na + [(Serum glucose – 100)/100 X 1.6].
 - Corrected Na = $132 + [(292 - 100)/100 \times 1.6] = 132 + [1.92 \times 1.6] = 132 + 3.072 = 135.072$ mEq/L.

- A corrected Na of 135.072 mEq/L is less than 140 mEq/L, which is a criterion for "Consider ICU Admission" under "HIGH RISK – ICU Admission Criteria".
- The total fluids administered at the outside hospital (980 mL) for a 30 kg patient is 32.67 mL/kg (980 mL / 30 kg), which is not greater than 40 mL/kg.
- **Disposition:** Given the Moderate DKA and the corrected Sodium level, the patient should be **Admitted to a Medical Unit**. It is imperative to discuss this patient with Endocrinology and potentially ICU attendings due to the corrected Sodium level, which suggests considering ICU admission.

3. Fluid Management (Page 4, and Calculator Metadata):

- **Total IV Fluid Rate Calculation:**
 - Patient Weight: 30 kg.
 - Assumed Dehydration: 7% (default value from the calculator).
 - Total Resuscitation Fluids Administered: 980 mL.
 - Fluid Deficit: $30 \text{ kg} \times 7\% \times 10 = 2100$ mL.
 - Maintenance Fluids for one day: $(100 \text{ mL/kg} \times 10 \text{ kg}) + (50 \text{ mL/kg} \times 10 \text{ kg}) + (20 \text{ mL/kg} \times 10 \text{ kg}) = 1000 \text{ mL} + 500 \text{ mL} + 200 \text{ mL} = 1700$ mL.
 - Total Fluids to Administer over 48 hours: $(1700 \text{ mL} \times 2) + \text{MAX}(2100 \text{ mL} - 980 \text{ mL}, 0) = 3400 \text{ mL} + 1120 \text{ mL} = 4520$ mL.
 - **TOTAL IV FLUID RATE:** $4520 \text{ mL} / 48 \text{ hours} = 94 \text{ mL/hr}$.
- **IVF Composition for Two-Bag System (Phase 1 & 2):**
 - The patient's corrected Sodium is < 140 mEq/L, indicating a "High risk for cerebral edema". Therefore, the pathway recommends continuing with the NS two-bag system.
 - The patient's serum Potassium is 2.8 mEq/L, which is less than 4.0 mEq/L. According to the guidelines, this requires 60 mEq/L of total Potassium.
 - **Bag 1:** Continue NS with **30 mEq/L K-phosphate and 30 mEq/L K-acetate** (total 60 mEq/L K).

- **Bag 2:** Continue D10 NS with **30 mEq/L K-phosphate and 30 mEq/L K-acetate** (total 60 mEq/L K). This bag should be initiated because the plasma glucose (292 mg/dL) is below 300 mg/dL.
- This NS two-bag system should be continued for up to 12 hours, followed by reassessment to determine if a switch to ½ NS two-bag system is appropriate (Page 4).
- **Two-Bag System Rates:**
 - Given the total IV fluid rate of 94 mL/hr and the current blood glucose of 292 mg/dL (which falls into the 250-299 mg/dL range in the Two Bag System Table):
 - **Saline bag (Bag 1) rate:** $\text{ROUND}(0.75 * 94 \text{ mL/hr}, 0) = 71 \text{ mL/hr}$.
 - **Dextrose-Saline bag (Bag 2) rate:** $94 \text{ mL/hr} - 71 \text{ mL/hr} = 23 \text{ mL/hr}$.

4. Insulin Management (Page 4):

- **Initiation:** Insulin infusion should be started immediately, as the initial 10 mL/kg fluid bolus (300 mL) has been completed (the patient received 980 mL of resuscitation fluids).
- **Infusion Rate:** For a 10-year-old patient, the standard IV insulin infusion rate is 0.05 units/kg/hour. For this 30 kg patient, this translates to **1.5 units/hour** ($0.05 \text{ units/kg/hour} * 30 \text{ kg}$).
- **Early Basal Insulin:** As the patient is 10 years old, discussion regarding Early Basal Insulin with Endocrinology is recommended (Page 2, 4).

5. Electrolyte Management (Page 5):

- **Sodium:** The corrected Sodium of 135.072 mEq/L is below 140 mEq/L. This necessitates adjusting maintenance fluids to contain Normal Saline (NS), increasing the frequency of serum sodium monitoring, and discussing transfer to the ICU. If corrected Na decreases to < 130 mEq/L, an infusion of 3% hypertonic saline should be initiated.
- **Potassium:** The patient's serum Potassium is 2.8 mEq/L, which is less than 4.0

mEq/L. Therefore, the intravenous fluids should contain **60 mEq/L of total Potassium** (30 mEq K-acetate + 30 mEq K-phosphate). Given the potassium abnormality, consider measuring K every 2 hours instead of the standard every 4 hours.

- **Phosphate, Magnesium, and Bicarbonate:** These electrolytes should **NOT** be replaced in the routine care of DKA.

6. Lab Schedule (Page 8):

- For confirmed DKA, the following lab monitoring is required:
 - Electrolyte panel, Calcium, Magnesium, Phosphate: Every 4 hours.
 - HbA1c, BUN, Creatinine, Osmolality: One time.
 - BOHB: Every 2 hours.
 - POC glucose: Every 1 hour.

Diabetes DKA Pathway v8.0: Criteria and Overview

Stop and Review

- Inclusion Criteria**
- Diabetic Ketoacidosis (DKA) is defined as (need all 3 criteria):
 - Hyperglycemia > 200 mg/dL AND
 - Ketonemia (BOHB > 1 mmol/L) AND
 - Venous pH < 7.3 or HCO₃ < 15mEq/L
- Exclusion Criteria**
- Age < 12 months
- If Hyperglycemic Hyperosmolar Syndrome (HHS) is suspected, consult Endocrinology to formulate an individualized management plan for your patient

Where Child is Managed

DKA Severity Definitions

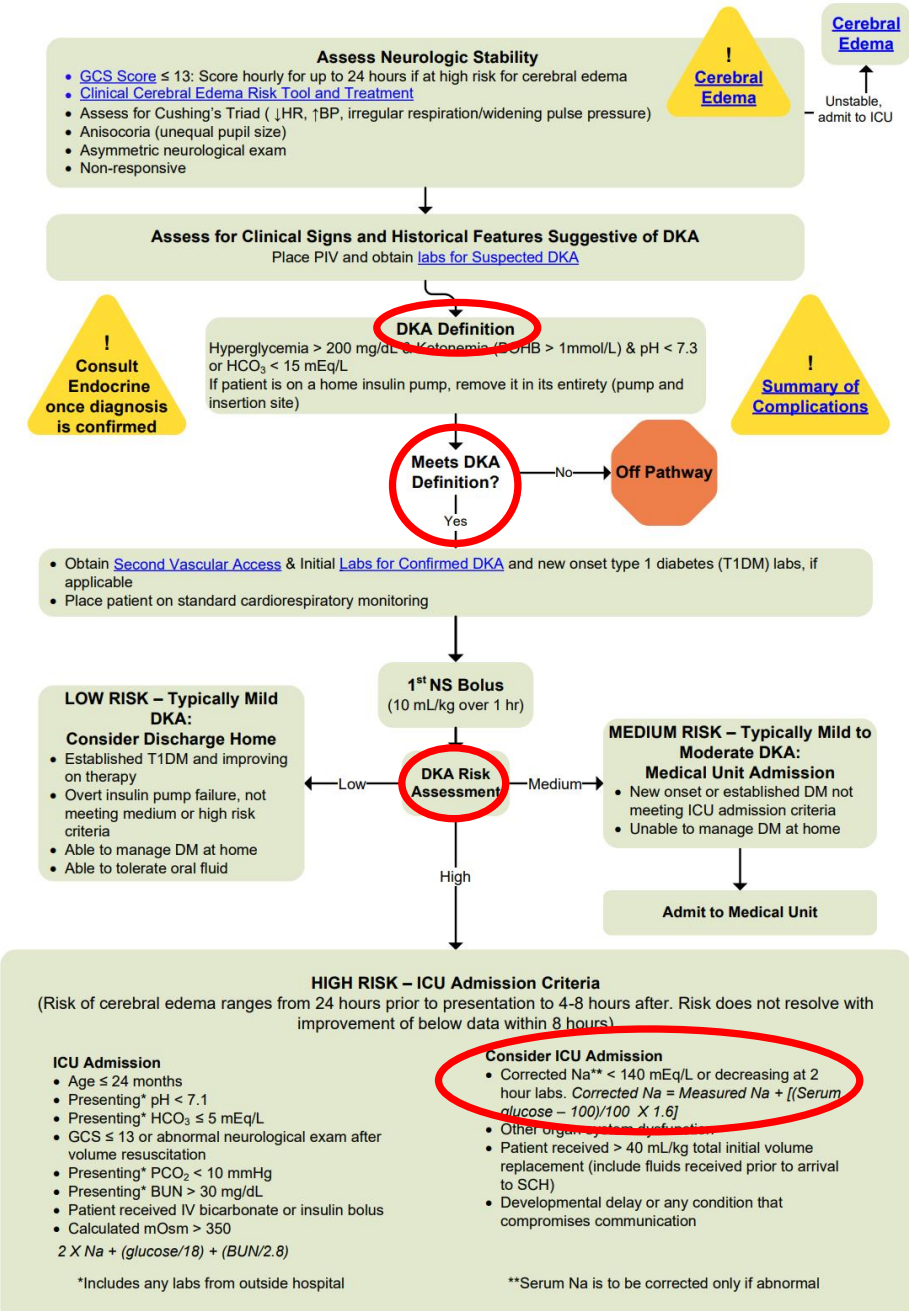
Severity	Venous pH	Sodium bicarbonate (mEq/L)
Mild	7.2 to < 7.3	10 to < 15
Moderate	7.1 to < 7.2	5 to < 10
Severe	< 7.1	< 5

Diabetes DKA Pathway Overview

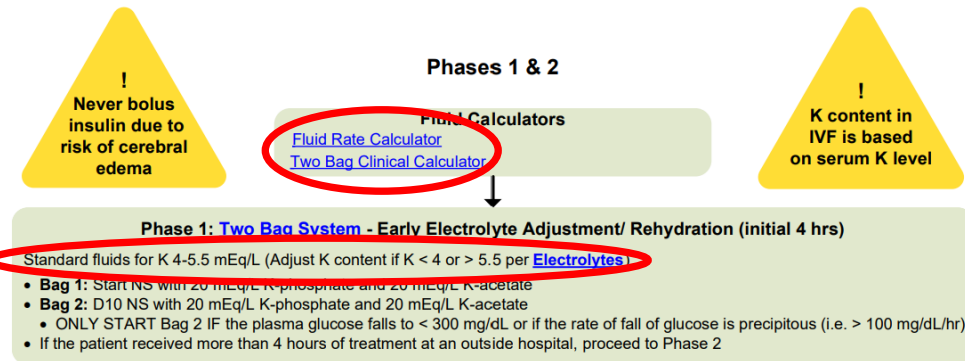
	DKA Confirmed	PHASE 1	PHASE 2	Transition
Time	First 1 hour (time may vary for patients who first presented to outside facility)	Hour 1 to 4	Hour 4 until DKA resolves	When BOHB < 1
Assessment	<ul style="list-style-type: none"> ABCDs and weight Confirm dx and consult Endocrinology Confirmed DKA labs → activate pathway Place 2 IVs Monitor GCS 	<p>Neuro checks based on presenting pH*</p> <ul style="list-style-type: none"> pH < 7.1: q1 hr pH 7.1 to < 7.2: q1 hr x 8 hrs, then q2 hrs pH ≥ 7.2: q2 hrs <p>See Lab Monitoring</p>	See Lab Monitoring	See Lab Monitoring
Fluids & Electrolytes	NS Bolus 10mL/kg over 1 hour	2 bag IVF fluid rate based on fluid calculator	<ul style="list-style-type: none"> Continue same IVF rate Consider NS if high risk for CE 	Discuss Transition with Endocrinologist <ul style="list-style-type: none"> DC 2-bag IVF May need to continue maintenance IVF
Insulin	DO NOT START Insulin until after first 10mL/kg fluid bolus	<p>NS + K-phos + K-acetate</p> <p>Bag 1</p> <p>When glucose < 300 or falls precipitously start D10 NS + K-phos + K-acetate</p> <p>Bag 2</p> <p>Start continuous insulin infusion</p> <p>If patient ≥ 10 years: discuss Early Basal Insulin with Endo</p>	D10 ½ NS + K-phos + K-acetate	Subcutaneous insulin

*Neuro checks: [GCS assessment](#). If concerns on assessment, patient symptomatic or GCS ≤ 13, [assess neurologic stability](#)

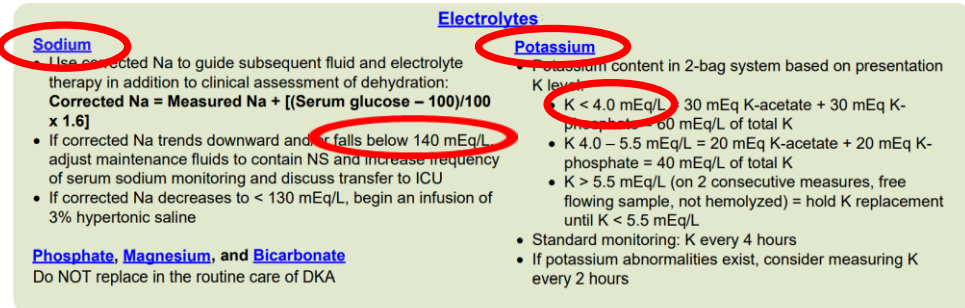
Diabetes DKA Pathway v8.0: Assessment and Disposition



Diabetes DKA Pathway v8.0: Insulin and Fluids



Diabetes DKA Pathway v8.0: Electrolytes



Begin planning for transition to subcutaneous insulin when BOHB is < 3 mmol/L

To Transition Phase

ICU Discharge Criteria

- BOHB ≤ 3 mmol/L (if overnight, consider early morning transfer) and
- GCS = 15 or at prebolic baseline and
- K requirement can be maintained with ≤ 60 mEq/L supplementation and
- No ICU care needed for any other reason
- Exception: hyperosmolar dehydration

Lab Monitoring

- Labs for Confirmed DKA**
- Electrolyte panel, Ca, mg, Phos q4h
 - HbA1c, BUN, Cr, osmolality (one time)
 - BOHB q2h
 - POC glucose q1h

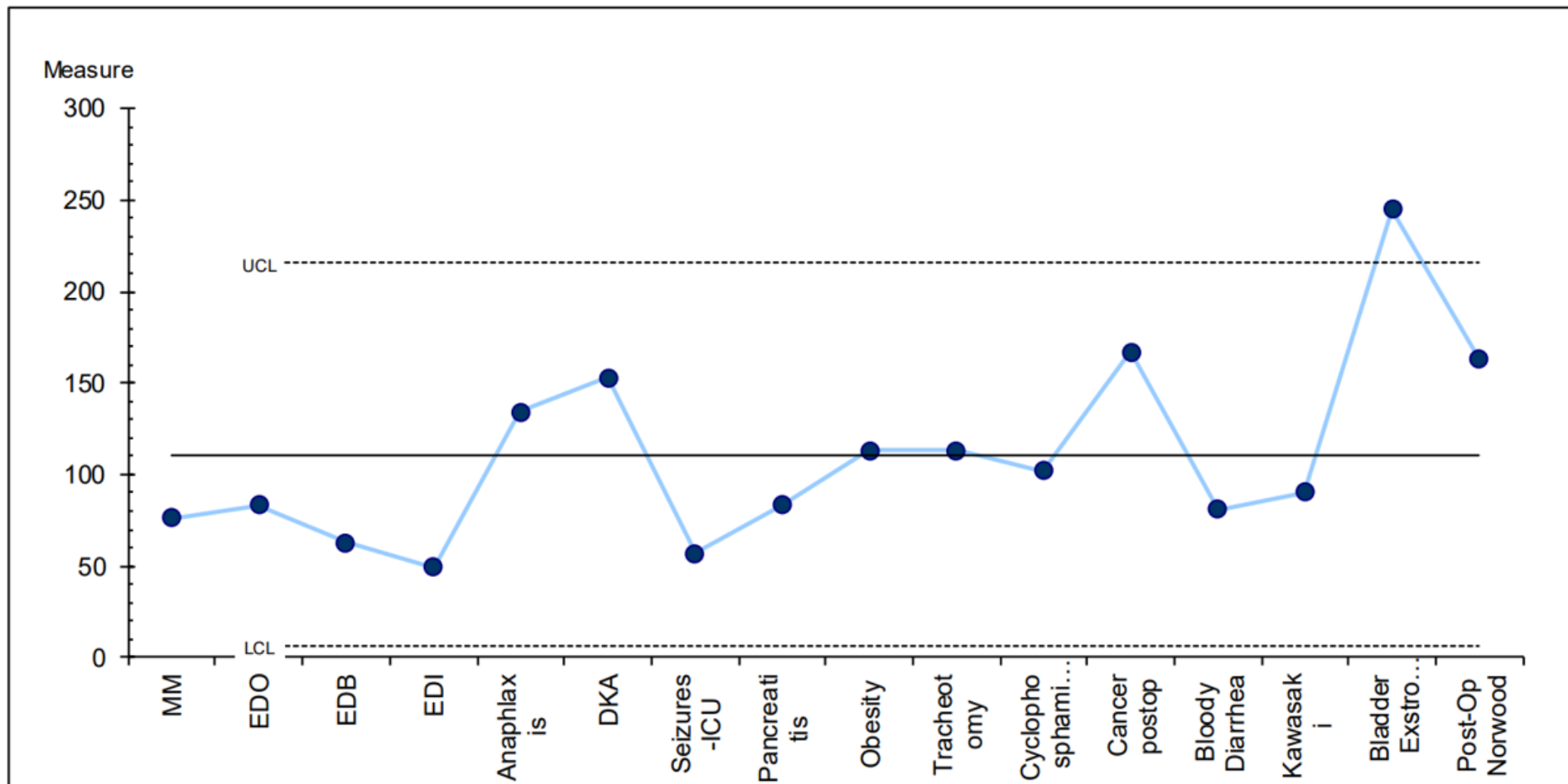
	A	B	C
1	*** TO PRINT THIS WORKSHEET, HIT CTRL+P ***		
2			
3	IV fluid rate for patients with Diabetic Ketoacidosis (DKA)		
4	Fill in the yellow boxes and everything else will be calculated.		
5	Weight of patient	30 kg	
6			
7	Severity of Dehydration - assume:	7 percent	
8	Fluid deficit = weight (max: 80 kg) * percentage dehydrated	2100 ml	
9			
10	DKA Suspected - include all fluids administered at SCH and at other facilities		
11	TOTAL fluids administered during resuscitation	980 ml = 32.67 ml/kg	
12			
13	Maintenance fluids for one day:	1700 ml	
14			
15	Total fluids to administer over 48 hours (maintenance * 2 + deficit - resuscitation)	4520 ml	
16	NOTE: Formula is such that we never provide less than 1 x maintenance fluids.		
17			
18	TOTAL IV FLUID RATE:	94 ml / hr	

	A	B	C
1	*** TO PRINT THIS WORKSHEET, HIT CTRL+P ***		
2			
3	DKA Fluid Calculator: Use to determine two-bag system rates based on blood glucose and rehydration fluid rate.		
4			
5	ENTER TOTAL IV FLUID RATE:	94 ml / hr	
6			
7	IF HOURLY BLOOD GLUCOSE FALLS > 100 mg/dL/hr, call medical staff to guide management.		
8			
9	IF hourly blood glucose falls 100 mg/dL/hr or less, use the following table:		
10	TWO BAG SYSTEM TABLE		
	For blood glucose values of	SALINE bag (ml/hr)	DEXTROSE-SALINE bag (ml/hr)
11	≥ 300	94	OFF
12			
13	250-299	71	23
14			
15	200-249	47	47
16			
17	150-199	24	70
18			
19	100-149 (if < 125, order D12.5-containing bag as below, but do not hang)	OFF	94
20			
21	< 100: Discontinue the two-bag system and instead use D12.5% concentration with identical saline and electrolyte content. Discuss with Attending. Check BOHB results and consider readiness to transition off insulin infusion.	run at 94 ml / hr	

CSW AI Literature Review



Prior state: Time from initial meeting to new recommendations



Category	Root Cause	Details
Methods	Complex Standard Work (SW) (100+ pages)	<ol style="list-style-type: none"> The SW lacks critical steps, such as searching for full text or requesting articles from the library. Despite detailed instructions, complex tasks such as the PRISMA flow diagram are still error prone.
Personnel & Training		<p>work</p> <p>Reviewers</p> <p>rs, librarians,</p> <p>er response</p>
Quality Control & Tools	Checklists/Tools	<p>otentially</p> <ol style="list-style-type: none"> There is a lack of level 1 & 2 error proofing mechanisms. Templates for complex new work, such as GRADEing diagnosis questions, are difficult to construct
Overall Impact: Backlog of Periodic Reviews	Delays and Rework	<ol style="list-style-type: none"> The issues combined result in work effort exceeding estimates and persistent backlog.

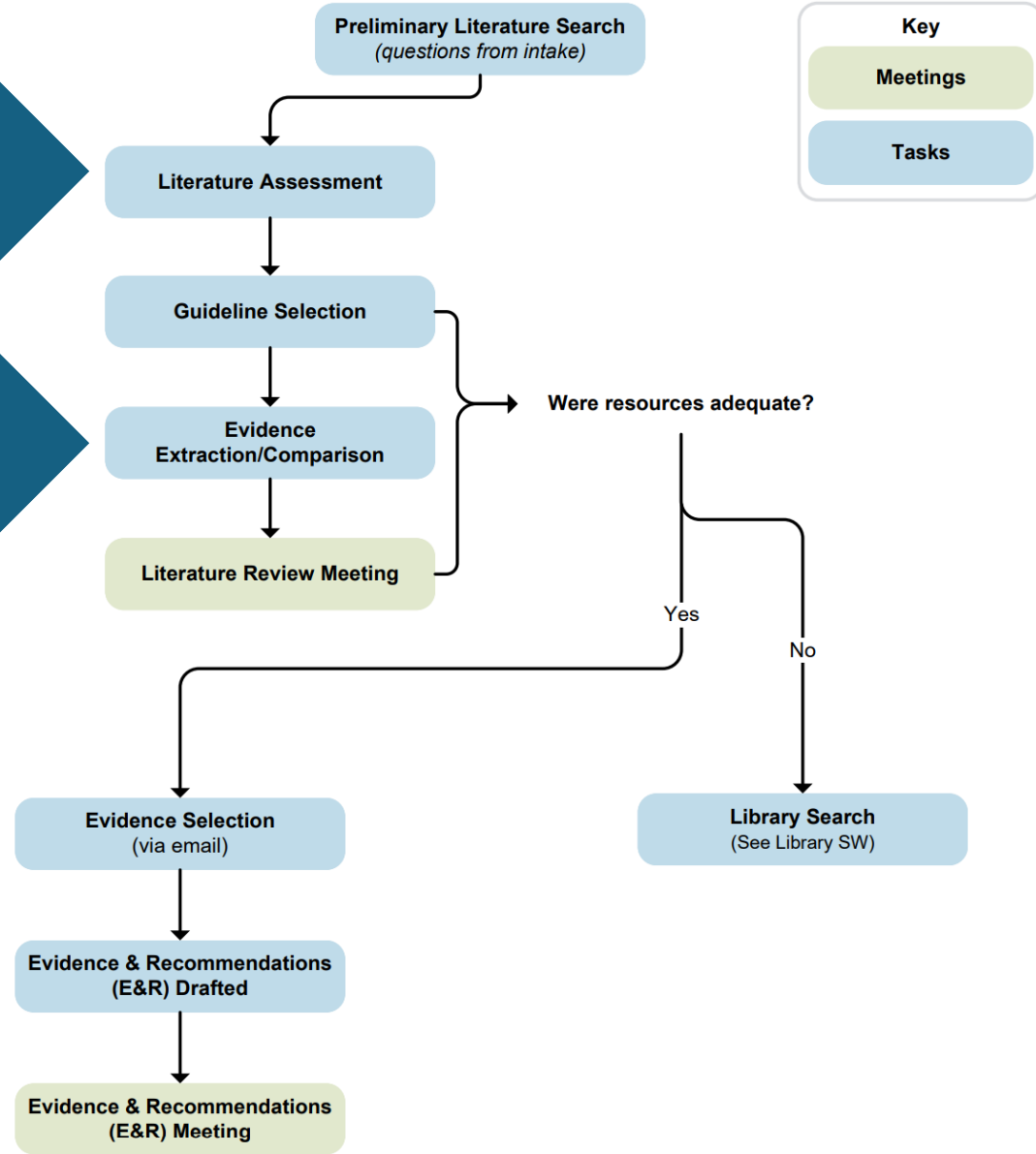
Delays mean that state of the art care reaches patients later.

Clinical Standard Work Literature Review

OVERVIEW

AI Solution #1

AI Solution #2



CE AI Literature Review Prompts – 1st AI prompt written June 2025 (1 month development time)

Literature Review Prompt 1

- Identifies type of article excludes all non-guidelines (previously required 10 - 20 hours of human processing time)
- All guidelines proceed to AGREE (rigor of development) appraisal (previously required 20 - 40 hours if training needed)

Literature Review Prompt 2

- Extracts recommendation from guidelines (30 - 60 hours)
- Coverts new evidence to GRADE (5 - 10 hours)
- Compares and summarizes differences between current materials and new recommendations (30 - 60 hours)

Gemini performs tasks that previously took
95-190 hours in 30 mins:

99.4 – 99.7% decrease

Real world results (initial meeting to new
recommendations): Thyroidectomy and Eating
Disorder were each completed in 15 days.

Appraisal for NASPGHAN_Refractory_Constipation_2025.pdf

Study Characteristics Summary

- **Population Age Range:** Pediatrics (infants, children)
- **Article Developer:** NASPGHAN (North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition) neurogastroenterology and motility committee
- **Development Method:** Formal voting by the author group with a pre-defined agreement threshold.
- **Development Date:** The literature search was completed on January 31, 2023.
- **Evidence Level Scale:** Not specified; the document explicitly states that the GRADE approach could not be utilized.
- **Literature Search Strategy:** The search included the databases PubMed and Cochrane databases, covering literature through January 31, 2023.

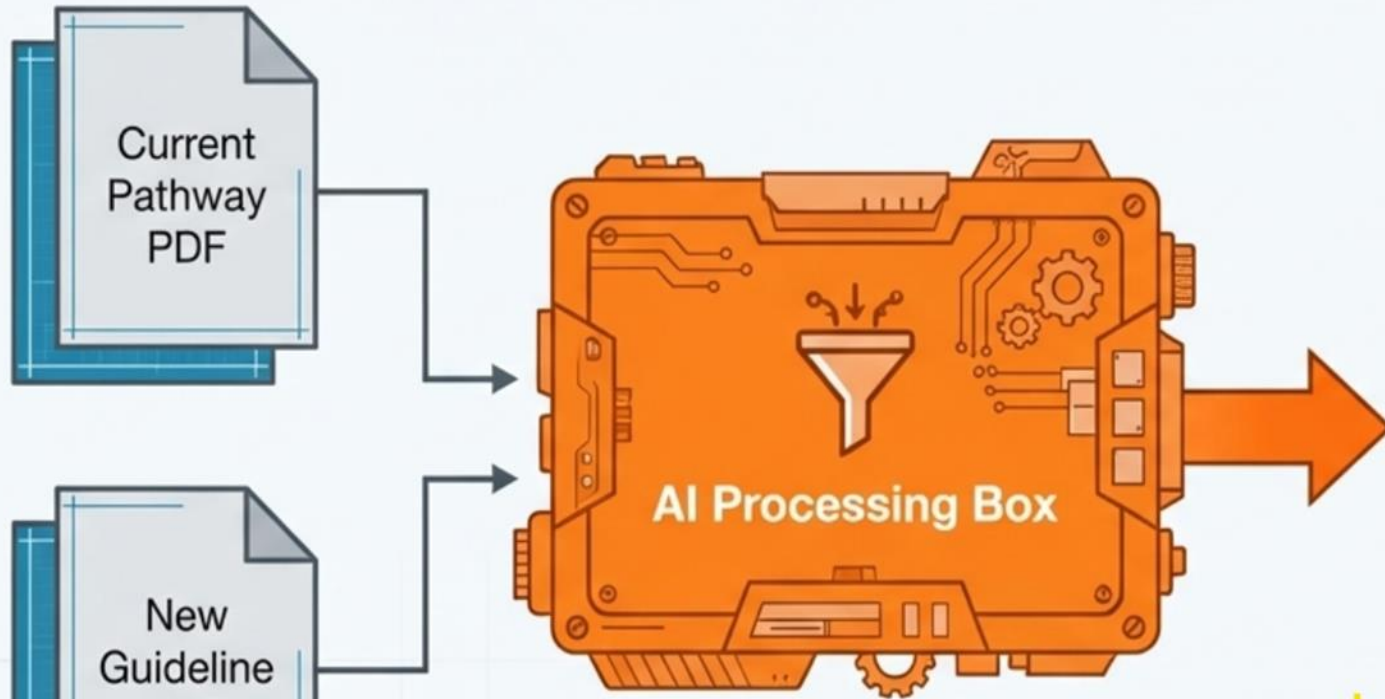
Domain 3 Appraisal Summary

Domain 3: Rigor of Development — Score: 75.0%

AGREE II Item	Score (1-7)	Rationale
7. Systematic methods were used to search for evidence.	6	The guideline names the databases searched (PubMed, Cochrane), the end date for the search (January 31, 2023), and the key search terms used, but a full, replicable search strategy was not included.
8. The criteria for selecting the evidence were clearly described.	3	The document describes inclusion criteria for language (English) and population (pediatric, with adult data used if limited), but fails to describe criteria for selecting evidence based on study design or quality.
9. The strengths and limitations of the body of evidence are clearly described.	6	The document includes a "LIMITATIONS" section that explicitly discusses weaknesses in the body of evidence, such as the retrospective nature of many studies and the lack of a clear definition for the condition.
10. The methods for formulating the recommendations are clearly described.	7	The document clearly describes the methods for formulating recommendations, which involved a formal voting process by the author group with a predefined threshold for agreement (7 of 8 authors).
11. The health benefits, side effects, and risks have been considered in formulating the recommendations.	7	The guideline consistently considers health benefits, side effects, and risks, for example by noting the risk of electrolyte derangements with phosphate enemas and the risk of permanent incontinence with IAS myectomy.
12. There is an explicit link between the recommendations and the supporting evidence.	6	There is a clear link between recommendations and evidence through in-text citations and discussion, although a summary evidence table is not provided.
13. The guideline has been externally reviewed by experts prior to its publication.	2	The document only reports internal review by NASPGHAN committees and council; there is no mention of external review by experts or a formal peer-review process prior to publication.
14. A procedure for updating the guideline is provided.	7	The document explicitly states that the authors agreed the recommendations should be considered for revision in 5 years.

Retrieved From	Recommendation	Summary of Evidence	Level of Evidence
Yachha, 2018	Functional constipation should be diagnosed only in the absence of red flags on history and examination. (p. 885) [Context: Indian children]	The diagnosis of functional constipation is clinical and does not require routine investigations in most cases. The presence of 'red flag' symptoms or signs (e.g., onset <6 months of age, failure to thrive, bilious vomiting) suggests an underlying organic etiology that requires further evaluation. This approach is based on the consensus opinion of the expert group.	Expert Consensus
NICE, 2010	Establish during history-taking whether the child or young person has constipation. Two or more findings from table 1 indicate constipation. (p. 7)	The diagnosis is based on clinical features. Key findings include stool patterns (e.g., fewer than three complete stools per week, 'rabbit droppings', overflow soiling) and associated symptoms (e.g., distress on stooling, retentive posturing, anal pain). This is based on the consensus of the Guideline Development Group (GDG) after reviewing descriptive literature.	[Inferred] Guideline Development Group Consensus
Tabbers, 2014	Based on expert opinion, we recommend the Rome III criteria for the definition of functional constipation for all age groups. (p. 262)	The Rome III criteria are the most widely accepted and validated definitions for childhood functional constipation. Studies comparing them to the older Rome II criteria found that the Rome III criteria demonstrated greater applicability and identified significantly more children with functional constipation (Boccia et al., 2007; Devanarayana et al., 2011).	Expert Opinion
Yachha, 2018	A plain erect Xray abdomen or barium enema is not required as a routine investigation in all cases. (p. 888) [Context: Indian children]	Routine investigations are not needed for most children, as 95% of cases are functional. Investigations are reserved for children with 'red flag' signs suggestive of an organic cause or for those who do not respond to therapy. This is based on a review of the literature [12-14].	Expert Consensus
NICE, 2010	Do not use a plain abdominal radiograph to make a diagnosis of idiopathic constipation. (p. 15)	No evidence was found to support the use of abdominal radiographs for diagnosing idiopathic constipation. The GDG noted that while some clinicians use it, there is no standardized method for interpretation, and it exposes the child to radiation without clear benefit.	[Inferred] Based on lack of evidence and GDG consensus
Tabbers, 2014	The routine use of an abdominal radiograph to diagnose functional constipation is not indicated. (p. 265)	A systematic review of five diagnostic studies assessing various scoring systems for fecal loading on abdominal radiographs found them to have poor to moderate discriminative value for diagnosing constipation. For example, one study reported an Area Under the Curve (AUC) of only 0.68, indicating poor discrimination (de Looze et al., 2006).	[Inferred] Based on a systematic review of diagnostic accuracy studies

Evidence Extraction & Comparison



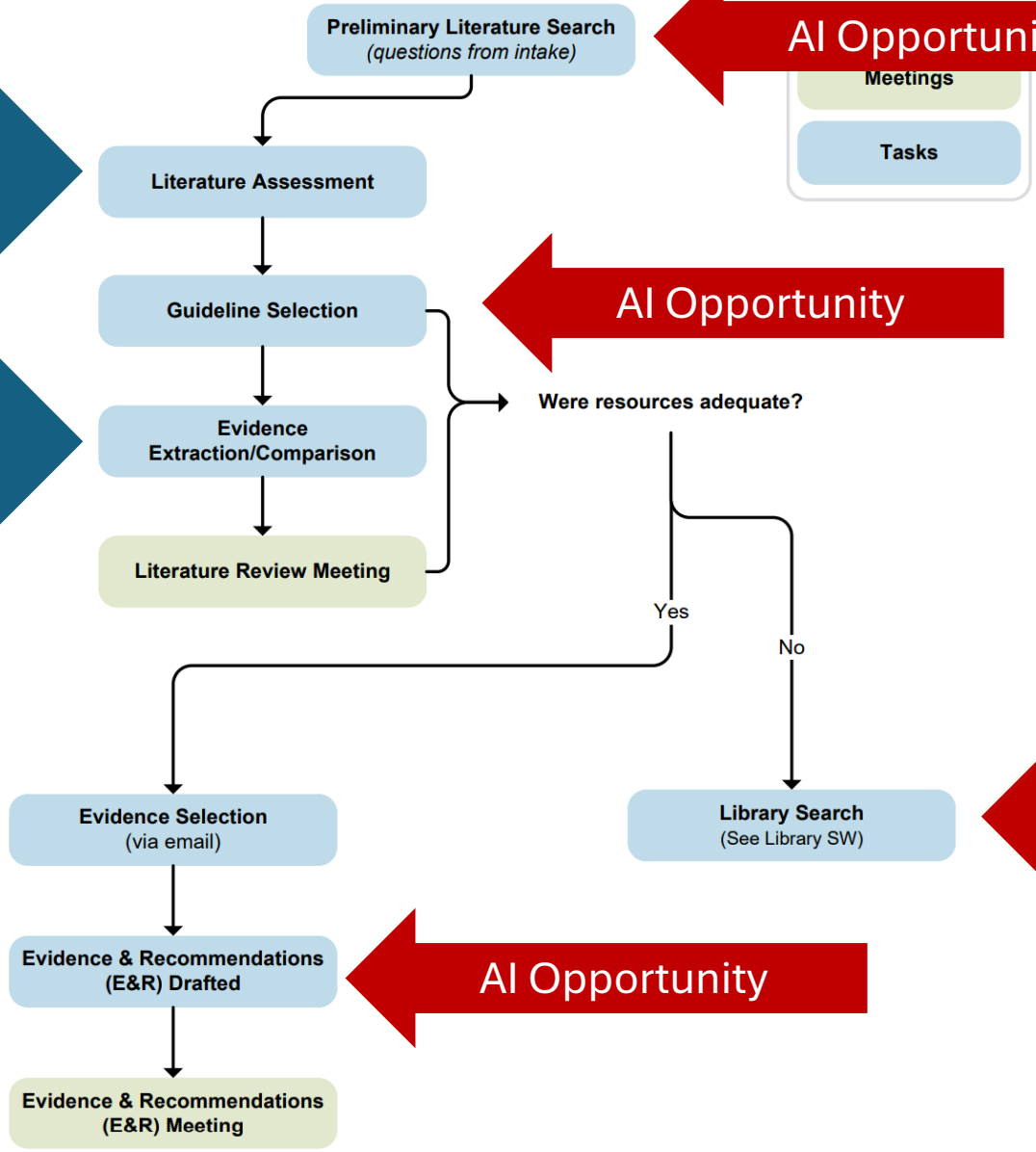
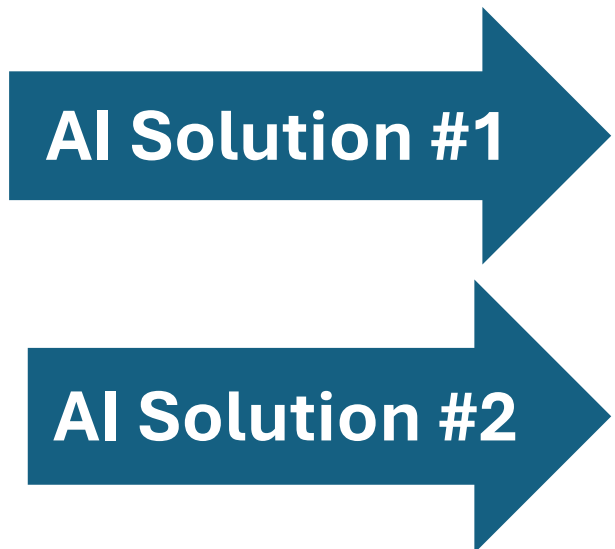
Delta analysis between current pathways and new guidelines.

Clinical Recommendation	Source Evidence (Guideline)	Current Pathway Status	Delta (Difference)	Evidence Strength
Recommendation A	Guideline X, p. 45	Not Included	ADD: New Step	Strong (Grade A)
Recommendation B	Guideline Y, p. 12	Partially Included	UPDATE: Modify Dosage	Moderate (Grade B)
Recommendation C	Guideline Y, p. 12	Not Included	ADD: New Step	Moderate (Grade B)
Recommendation D	Guideline Y, p. 45	Not Included	ADD: New Step	Strong (Grade A)
...

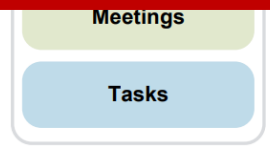
Perfectly maps new clinical recommendations directly back to their primary source evidence.

Clinical Standard Work Literature Review

OVERVIEW



AI Opportunity



AI Opportunity

AI Opportunity

AI Opportunity

Take-home Messages

- **Adoption of AI in clinical decision making starts with knowing how LLMs generate their responses.**
- **RAG is an important tool that increases contextual precision and decreases erroneous responses.**
- **Teach your users how to prompt effectively**
- **Providers remain accountable for the source material which must be curated to ensure alignment with best practice.**
- **For AI to be used responsibly, we must have providence over it and be able to observe its behavior.**