

You will complete the entire case study # 14 on Type 1 Diabetes and answer all 22 questions independently. AMA citation style is required for all references used (see Texts, Materials and Resources in syllabus).

1. What is currently understood regarding the etiology of type 1 diabetes mellitus

(T1DM)? no one else in Emma's family has diabetes- is this unusual? Are there any other findings in her family medical history that would be important to note?

The Immune-mediated T1DM is from a cell-mediated autoimmune response causing a gradual decline in beta cells within genetically susceptible individuals. The primary gene for T1DM is HLA region of chromosome 6 but there have been more than 50 different genes associated that may be linked to this disease.¹⁰ However, trying to determine the environmental causes that would initiate the autoimmune response has and still is very difficult but current research suggest that multiple interactions with environmental factors along with genetics could cause the onset of the autoimmune disease.¹⁰ Some of the environmental triggers could be viral infection, casein protein, gluten, vitamin D and the exposure of the microbiota.¹⁰ While her family does not have a history of T1DM, it is not unusual because 80-90% of cases may not be fully genetic and lean more towards environmental, but her family does have a history of disease.^{1,12} In her family history, it describes her mother as having hyperthyroidism and her sister having celiac disease, which is also an autoimmune disease, but through assessments, we would learn more about the family home environment but with the proper genetic testing, we could gain a better understanding.¹² However, genetic polymorphisms have been documented and very similar to the autoimmunity like T1DM and given all this information she may be at an increased genetic and environmental risk for autoimmune diseases.¹⁰

- 2. According to the American Diabetes Association Standards of Care, what are the standard diagnostic criteria for T1DM? Which criteria are found in Emma's medical record? Examine the labs that were drawn and describe how each is related to the diagnosis of T1DM.**

According to the ADA criteria for T1DM includes: a random plasma glucose >200 mg/dL along with the following symptoms (polyuria, polydipsia and weight loss), fasting plasma glucose >126 mg/dL, 2-hour oral glucose tolerance test (OGTT) or but an A1C $>6.5\%$. is only applicable for children with prediabetes and T2DM and not T1DM.¹ The other standards are two separate test samples but if the patient, like Emma, is showing signs and symptoms, measuring the plasma glucose alone is sufficient for a proper diagnosis.

¹Emma's current symptoms and labs help confirm her diagnosis because her glucose was 683 mg/dL, positive GADA and IA-2A autoantibodies test (which is autoimmunity), very low C-peptide (which is insulin deficiency), and her HbA1c was elevated (which would be chronic hyperglycemia).¹

- 3. Describe the metabolic events that led to Emma's symptoms and subsequent admission to the ED (polyuria, polydipsia, polyphagia, fatigue, and weight loss), integrating the pathophysiology of T1DM into your discussion.**

The metabolic events that took place up until her admission are described as the stages to T1DM and include the starting point (which you are 15x more at risk if you have relatives with this disease, then the immune activation happens (where the beta cells are attacked), then the immune response occurs (development of single autoantibody), then the 3-4 stages occur, but some sources only include stages 1-3 because they neglect to add the remainder of life with T1DM.^{1,2} The beginning stage is one: normal blood sugar

and >2 autoantibodies, but the characteristics would also include autoimmunity, normoglycemia and presymptomatic.^{1,2} Then stage 2 of abnormal blood sugar and still less than 2 autoantibodies, but the autoimmunity and presymptomatic remain but with dysglycemia.^{1,2} Moving into stage 3 of the clinical diagnosis with the same limit of autoantibodies but now they are symptomatic and have overt hyperglycemia and finally stage 4, which is long standing T1DM.^{1,2} However, the walkthrough of events that could have taken place up until her admission is as follows: her glucose couldn't effectively enter her cells, that led to plasma glucose to rise and cell starvation, which then signals the increase of gluconeogenesis in the liver that will further exacerbate hyperglycemic state and this would lead to those signs and symptoms.¹⁰

4. Describe the metabolic events that result in the signs and symptoms associated with DKA. Was Emma in DKA when she was admitted? What precipitating factors may lead to DKA?

DKA can be extremely severe and includes insulin deficiency, lipolysis, ketogenesis, acidosis, dehydration and the warning signs the ADA recommends is to look for thirst, frequent urination, exhaustion, dry or flushed skin, nausea, vomiting or abdominal pain, difficulty breathing, fruity breath and confusion.^{2,3} I believe Emma was in early stages of DKA because of her lab values and wide array of symptoms but these could have been precipitating factors from undiagnosed T1DM (which DKA is very undiagnosed in children) and an infection (strep throat).³ However, DKA is a result from poor insulin management or an acute infection and while the body can no longer rely on glucose as its first source of fuel it turns to lipids, which increases the rate of lipolysis and in turn more ketones are produced.¹⁰

- 5. Emma will be started on a combination of Lispro prior to meals and snacks, with glargine given in the p.n. Describe the onset, peak, and duration for each of these types of insulin. Her discharge dosages are as follows: 8 u glargine with Lispro prior to each meal or snack-1:30 insulin: carbohydrate ratio. Emma's parents want to know why she cannot take oral medications for her diabetes like some of their friends do. What would you tell them?**

Lispro should have an onset ~10-15 minutes, a peak ~30-90 minutes and a duration of < 5 hours. Glargine should have an onset of ~2-4 hours, there is not a peak but the duration up to 24 hours.^{4,10} Emma cannot take oral agents because they require beta cell functions, which is no longer present in T1DM and therefore the insulin replacement is needed.^{4,12}

- 6. Emma's physician explains to Emma and her parents that Emma's insulin dose may change due to something called a honeymoon phase. Explain what this is and how it might affect her insulin requirements.**

The Honeymoon phase or partial remission is where ~60-70% of pediatric cases the transient beta cells recover, which in turn reducing the need for the initial insulin amount. This could last anywhere from 1-12 months after the diagnosis.⁵ But when I tell her family, I would describe it as this, sometimes Emma's glucose may not be within the typical range, and this could be caused by stress, acute illness or the honeymoon phase. All this means is that we need to ensure we monitor unpredictable insulin absorption and her exercise levels because every patient is different and the cells that produce what she injects may be able to create small amounts again and this is why glucose monitoring is so important.^{10,5,12} Lastly, I would tell them that this phase is very important because

although Emma has a set regiment and plan, it may need to be adjusted to ensure that Emma does not succumb from any adverse effects from her regression.

- 7. How does physical activity affect blood glucose levels? Describe the physiological process that occurs when physical activity impacts blood glucose. Emma is a softball player and usually plays daily. What recommendations will you make to Emma to assist with managing her glucose during exercise and athletic events?**

From the current research, the pre-during and post exercise insulin dosage should be highly individualized because of the variability from patient to patient.⁶ However, it is paramount to check blood glucose levels at these times because during certain activities it may lower dramatically but in others it could be polar opposite.⁶ For Emma, I would encourage after the entire family is properly educated on the topic to engage in regular physical activity that includes at least 60 minutes of moderate to vigorous aerobic activity every day and resistance training at least 3 days pr week.⁶ But I would also let the family know that I understand the current trend in technology and schools with screen time but highly emphasize the importance of limiting sedentary time, which would include screen time for less than 2 hours per day. ⁶ But with all of this being introduced to Emma and her family we would develop a plan that is not only manageable but also reasonable for Emma. Lasty, I would reiterate the concepts of actively managing her glucose via technology before, during and after excricse.⁶

- 8. At the follow up visit, Emma's blood glucose records indicate that her levels have been consistently high when she wakes in the morning before breakfast. What factors might influence high fasting blood glucose in the morning?**

This would be known as dawn phenomenon or a surge in hormones, insufficient basal insulin or Somogyi rebound.⁷ Although it is most likely due to nocturnal spike of growth hormone secretion given all the current research.¹³ However, counter to this and with the utilization of CGM's, which ensures no associated nocturnal episodes, lean towards either poor glycemic control or the Somogyi effect.¹³

9. What do the current ADA Standards of Care recommend for Emma to check her blood glucose levels?

They recommend frequent monitoring of the blood glucose levels (~6-10 times/day) or the use of a CGM but also always have a BGM.⁷ However the ADA recommends that no device used for diabetes management is effective without proper education, training and ongoing support but if all this is corrected for, if Emma was to use a CGM and trained based off alarms and alerts she could possibly mitigate any adverse effects. Lastly, the use of AID therapy currently has the best results for newly diagnosed children and as an overall guiding rule for Emma, I would recommend seeking a schedule that looks similar to this one: check insulin when fasting, prior to meals and snacks, after meals, at bedtime, middle of the night, prior to, during and after exercise, when symptoms are present and gain knowledge of her body over time.¹⁴

10. Emma's parents state that they now understand the symptoms she was experiencing are related to hyperglycemia. Discuss factors that may rise Emma's blood glucose in the future.

There are many factors that could raise Emma blood glucose and could put her at risk.

While some of these factors are black and white others are in the grey area. Some of these

include acute illness, acute or chronic stress, hormones/ puberty, inaccurate carb tracking and insufficient insulin management.⁷ However, others could include physical inactivity, medications, and variability in insulin absorption but as Emma progresses with this condition the family and Emma should begin to understand this risk better with the help of her entire care team.¹⁰

11. Emma's parents state they are unclear of the symptoms of hypoglycemia. What are the treatments for hypoglycemia and what emergency supplies should they have available to treat hypoglycemia?

There are many levels of hypoglycemia, which are 1,2 and 3. Level 1 is a glucose below 70, level 2 is below 54 and level 3 is characterized by an altered state of mental or physical state requiring assistance.⁷ Some symptoms to look for would be shakiness, irritability, confusion, tachycardia, sweating and hunger. If these symptoms or other are present, for most individuals, 15g of carbohydrates should be ingested or if she is using an automated insulin system, it should be 5-10g of carbohydrates.⁷ This condition can happen anywhere and anytime, so it is important to have a kit with both prepackaged and self-made items that could deliver oral glucose.⁷ While these are important for Ema and her family to understand, any care or school facilities should be aware of her condition and the steps and precautions to take if these symptoms were to arise during their care.

12. The MD ordered a carbohydrate-controlled diet for when Emma begins to eat.

Explain the rational for monitoring carbohydrate in diabetes nutrition therapy.

Carbohydrate intake can directly impact postprandial glucose, but it should be important to mention that these guidelines often fail because they don't tailor the education or counseling to the patient or their family to meet their needs. But counting helps to match

insulin dosing to minimize excursions. ⁶ The ADA suggest that to date there is not an ideal percentage for macronutrients but rather adjusting of the client's assessment and personal preferences. While this is the current research, carbohydrates are crucial for controlling hyperglycemia but while we still need to focus on the total amount, the type of carbohydrate is also important. ¹⁰ It must be mentioned that there is no long-term research, but the research is leaning heavily towards favoring increasing total fiber than lowering it. ¹⁰ Lastly, the important factor that is behind monitoring carbohydrate by spacing meals out, replacing certain items for more fiber or less or artificial sugars could help improve glycemic control and reduce the risk of hypoglycemia. ¹⁰

13. Outline the basic principles for Emma's nutrition therapy to assist in control of her T1DM.

There are 8 guidelines from ACEND which address several key areas. Dietary patterns help to explore the effects of specific dietary patterns i.e., mediterranean or the low glycemic index diets. ⁸Then you have carbohydrate management which could suggest that certain carbohydrate management strategies may off small improvements in quality for life scores and overall confidence compared to other methods.⁸ Diet quality is next, but there is limited evidence that indicate improvements in diet quality may be associated with better glycemic outcomes within this population.⁸ Next is food insecurity which is about acknowledging the challenges that food insecure families could face while trying to manage T1DM. ⁸ Cultural relevant nutrition is important to ensure that the patient is included in the goals and the plan to help with the nutrition intervention. ⁸ Vitamin D has been the new craze since covid but it could have a key key role in glycemic control

among children with T1DM.⁸ MNT is what we all know best but there is limited evidence that weekly MNT session for the first month after a T1DM diagnosis and monthly session thereafter lower A1C levels in this population.⁸ Lastly, we have macronutrient consumption, which also lacks research in examining the effects of differing amount or protocols of macronutrient but I would assume that controlling for overall energy would be better suited in long term studies along with carbohydrate control.⁸

14. Assess Emma's z-score for ht/ age; z-score for wt/age; z-score for ht/wt; and BMI for age. What is her desirable weight? What is the impact of T1DM on growth?

Evaluate Emma's weight loss using the pediatric malnutrition standards. What do you anticipate will happen when Emma begins insulin therapy?

By using the standard CDC growth charts and using her height (134.6 cm) and her weight (31.3 kg) her height z-score = ~0.6; weight z-score ~0.1: BMI ~50th percentile. Her desirable weight is ~70-75 lbs.^{11, 12} study Because T1DM may impair growth if not controlled, insulin is key to help restore anabolism and help increase her growth.¹² If she doesn't control her T1DM, it could lead to uncontrolled symptoms that can impair growth by nutrient loss, catabolism and IFG-1 suppression but if she controls her T1DM and she maintains her therapy it should support normal growth.² Emma weight loss, which was 82 lbs. to 69 lbs. is a total of 16% loss over 3 months but this is an acute loss, which only supports the reason she needs to properly manage her insulin therapy.^{2, 12}

15. Identify any additional abnormal laboratory values measured upon her admission.

Explain how they may be related to her newly diagnosed T1DM.

Her abnormal values were sodium which represents Hyponatremia, phosphate which represents hypophosphatemia, anion gap 4-10 which could be mild elevation ketones, her HbA1c which is very chronic hyperglycemia, and her C-peptide was low. Other measures were her positive autoantibodies, her urine represents dehydration, her pH was leaning towards an acidosis trend, plus her glucose which could be glucosuria, ketones which could be ketogenesis and finally her leukocyte esterase could be inflammation. ^{1,2,6, 10, 12}

16. Determine Emma's energy and protein requirements. Be sure to explain what standards you used to make this estimation.

BMR- $20.315 \times 31.3 + 485.9 = 1,121$ kcal/ day

PAL= 1.55 -1.65

Additional energy for her age group = 100-200 kcal/day

EER= $1,121 - 1,200 \times 1.55 - 1.65 + 100 - 200 = 1,800 - 2,100$ kcal/day (total 1800kcal/day)

Protein RDA for her age group is 0.95/g/kg/day (adjustment needed for needed weight gain and growth)

Minimum required= $0.95 \times 31.3 = \sim 30$ g/ day

Optimal range for weight and growth= $1.0 - 1.5 \times 31.3 = \sim 70$ g/day

17. Select two nutrition problems and complete the PES statement for each.

1. Inadequate energy intake related to her undiagnosed T1DM as evidenced by her 16% weight loss over previous 3 months and appearance and fatigue.

2. Altered nutrition-related lab values related to hyperglycemia and insulin deficiency as evidenced by her current values of: HbA1c at 14.6%, glucosuria and ketonuria. ^{6, 10, 12}

18. Determine Emma's initial nutrition prescription using her usual intake at home as a guideline, as well as your assessment of her energy requirements.

It would be ~1800 kcal/day with a focus on controlling carbohydrates (200-270 g/day), protein (~70-90 g/day) and fat (~50-70 g) per day. Given she tends to be a picky eater, the best option would be to use that as a foundation and introduce carb counting, balanced meals and a slow family adoption of this change.^{10, 12}

19. What is an insulin: CHO ratio (ICR)? Dr. Cho ordered ICR to start at 1:30. If her usual breakfast is one slice of WW toast with 1 T. peanut butter and 8 oz skim milk, how much Lispro should she take to cover the carbohydrate in this meal?

The ICR is the amount of carbohydrate in grams that is covered by 1 unit of bolus insulin.¹⁰ The typical recommendation is that 1 unit covers 30 grams of carbohydrate and therefore the required dose would be 1 unit.¹⁰

20. Dr. Cho set Emma's fasting glucose at 90-180mg/dL. Her total daily insulin dose is 17 u and her fasting a.m. blood glucose is 240mg/dL. Using the 1800 rule, what would her correction dose be?

By using the 1800 rule and her current blood glucose, if she was to take 1 unit it would bring her down to the set fasting glucose.⁴

21. Write an ADIME note for your initial nutritional assessment.

NUTRITION NOTE (Initial or follow-up) Initial

Date of Visit: 5/3/2026

Appointment Codes: 97804

Time with patient: 4 billable units (60 minutes)

In-person or virtual appointment: in-person

NUTRITION ASSESSMENT:**MEDICAL CHART REVIEW:**

Age: 10

Sex: female

Past Medical History: none-recent strep throat

Anthropometrics:

Height: 53"

Weight history (if appropriate): current weight 69 lbs. lost 2 lbs. in 7 days and weighed 82 lbs. 3 months ago.

BMI (if appropriate):

Usual Body Weight (UBW): 82 lbs.

Ideal Body Weight (IBW): 70-75 lbs.

Labs: BMP Stat, Phos Stat, Calcium Stat, UA with culture if indicated Stat Clean catch, bedside glucose stat, bedside I-Stat: EG7 Stat, GAD 65, IA-2, Thyroid peroxidase antibodies, TSH, CMP, Thyroglobulin antibodies, C-peptide, Hemoglobin A1c, and TTG-IgA.

Medical tests (if appropriate): N/A

Significant Nutrition Medications:

Regular insulin 1 unit/mL NS 40 mEq KC/liter @108 mL/hr. Begin infusion at 0.1 unit/kg/hr.= 3.7 units/hr. Begin dextrose when glucose is <300 mg/dL or decrease in POC glucose >100 mg/dL per hour.

SOCIAL AND DIET HISTORY**Subjective reports provided by the patient:**

Appetite: the mother states her appetite is normal but says if anything it has increased due to increased activity.

Chew/Swallow: none

Nausea or Vomiting: none
Constipation or Diarrhea: none
Other GI: none
Known Food Allergies: none

Diet Followed at Home: Diet is reported by mother, and she states that Emma is a picky eater and tries to only eat “healthy” food. However, diet includes chicken, fish, salad, broccoli, tomatoes, and asparagus. Her breakfast includes cereal with milk or whole wheat bagel with milk. Lunch is usually a prepacked sandwich of either PB & J or turkey and cheese, carrots, apple and grapes. Before practice she has a granola bar and for dinner she has a salad, meat with pasta, potato or rice. They tend to eat out around 1 to 2 times a week, and their choices are pizza, Mexican or Asian food. Her late-night snack is cereal, ice cream, yogurt or fruit. She tends to just hydrate with water throughout the day.

Food Preferences: self-perceived “health” food

DIETARY INTAKE: meals/day and snacks/day.

B(AM): 7:30 am Breakfast: 2 slices of WW toast 1 banana 16 oz skim milk, 2 tsp Ovaltine

L(PM): 12 noon lunch: 2 slices of pepperoni pizza, 2 chocolate chip cookies, water

D(PM): 1 c fried rice, 2 oz chicken, ½ c broccoli, 1 egg roll, 2 c skim milk

SNACKS: 2 p.m. snack: Granola bar

4:30 p.m. snack: apple, 6 saltines, 2tbsp peanut butter

5-6:30 p.m. 16 oz Gatorade

8:30 p.m. snack: 2 c ice cream, 2tbsp peanuts

FLUIDS: none reported

ETOH: none

Physical activity history and limitations:

Very active because of sporting activity (soccer) and PE class but is limited due to fatigue and fainting

NUTRITION FOCUSED PHYSICAL EXAM (NFPE): None

ESTIMATED NUTRITION REQUIREMENTS:

Calories: ~1800 kcal/day

Protein: ~70-90 g/day

Carbohydrates: 200-270 g/day

Fluid: 1730 ml/day

NUTRITION DIAGNOSIS:

Problem: Inadequate energy intake

Etiology: undiagnosed T1DM

Signs/Symptoms: 16% weight loss over previous 3 months and appearance and fatigue

NUTRITION INTERVENTION (COUNSELING/EDUCATION):

Educational Materials Provided: Print out of Type 1 Diabetes self-care manual for the family but limit the material to only patient centered information.

NUTRITION MONITORING AND EVALUATION:

GOALS (as verbalized by the patient): Emma and her family will incorporate more foods as a whole but emphasize more accurate carbohydrate counting to match with the prescribed lispo.

Increase total energy intake to 1,800 kcal/day with food preferences and carbohydrate counting to start.

Resume sporting activities once Emma and her family is confident about pre, during and post glucose monitoring and appropriate CHO intake during activities.

Follow-up appointment date: one month from today's date.

COORDINATION OF CARE:

Collaboration/referral to: diabetes educator for Emma and her family

Recommend the following labs: A1c but if annual also include lipid profile, liver function test, spot urinary test, serum creatinine and GFR, TSH, CBC, Calcium, vitamin D, and phosphorus.

Recommend the following supplementation: Not recommended at this time, wait until follow up appointment to discuss.

Monitor per team meeting

22. When Emma comes back to the clinic 3 weeks later, she brings the following food and blood glucose record with her.

a. Determine amount of carbohydrate she is consuming at each meal.

I tried to approximate the CHO values using Chronometer and found the following:

7:30 am Breakfast: 2 slices of WW toast (~30g), 1 banana (~27g), 16 oz skim milk (~24g), 2 tsp Ovaltine (~9g) = total ~90 g CHO.

10:30: no intake recorded= total 0 g CHO

12 noon lunch: 2 slices of pepperoni pizza (~57g), 2 chocolate chip cookies (~20), water (0g) = ~77g CHO

2 p.m. snack: Granola bar (~16g) =total ~16g CHO and 30 minutes of gym exercise (broad)

4:30 p.m. snack: apple (~31g), 6 saltines (~35g), 2tbsp peanut butter (~6g) =total 72g CHO

5-6:30 p.m. 16 oz Gatorade (~29g) =total 29g CHO and soccer practice 1.5 hours

6:30 p.m. Dinner: 1 c fried rice (~30g), 2 oz chicken (~0g), ½ c broccoli (~3g), 1 egg roll (~18g), 2 c skim milk (~24g) =total 75g CHO

8:30 p.m. snack: 2 c ice cream (~62g), 2tbsp peanuts (~6g) =total ~68 g CHO

Her daily total of CHO is around 430g which is high for the recommended 200-270g, but the majority came from pizza and fried rice.

b. Determine whether she is taking adequate amounts of Lispro for each meal according to her record.

For her amounts she took and the amount that are needed for her current diet trends it should be more similar to this: breakfast (3.5U), Lunch (3U), snack (may or not need

1U), snack 2 (1.4 U), dinner (she took correct amount) and snack 3 (she took the correct amount).

c. Is she taking in adequate energy and protein?

As directed before, Emma's estimated energy intakes are between 1800-2000 kcal/day because of her age, activity level and energy needs to gain weight to pre unintentional weight loss amount. Her protein was concluded to be between 0.85 and 1 g/kg which is about 26-31 g/day.

Her total energy: ~3300 kcal and broken down it looks like this: breakfast (~480, lunch ~750, first snack ~140, second snack ~513, pre workout drink ~110, dinner ~680 and last snack ~734.) While she does have to be at an energy surplus, this may become unintentional weight gain or hyperglycemia because her current energy intake exceeds her needs by ~1300 -1500kcal/ day. Which simplistically without adding outside factors, is about 2+ lbs. a week.

Her total protein: ~133 g and broken down like energy it is: (breakfast ~28g, lunch ~22g, snack 1 ~2g, snack 2 10g, pre workout 0 g dinner ~45 g, last snack ~17g.)

While her goal was ~26-31g she has met but exceeded her goal, which is not necessarily bad for protein consumption, but given her large excess of calories, we would like to be more moderate and cut this amount in half from ~532 kcal to 266kcal or in grams from 133 g to 66 g/day. Overall, her total energy and protein intake is excessive and needs to be addressed during the next session to limit unintentional weight gain and adverse side effects of her T1DM.

d. What might be the next topics you discuss with Emma and her family in regard to her nutrition plan? She really wants to start playing softball again soon.

The next topic I would want to discuss with Emma and her family is what is working, what are some current or future concerns, and how are we feeling towards the current plan. I ask this to ensure that Emma and her family are continually included in her care and are not left out during her journey. The next topic would be her medications and if they have noticed any changes or side effects that are pleased with or concerned about. This would be assessed via lab work but also how they feel because the biomarkers could be great, but Emma may not be feeling great. The next topic is her weight and how they are currently feeling and about moving forward. Then I before I get to the end of the sessions, I would ask if they needed help with anything related to her health or the plan she is following. After all of this is addressed, I would make sure I we discuss the plan moving forward with her passion for softball. Before we talk about if she can start participating again, we would need to ensure that everyone understands the methods and precautions they need to follow to not allow let Emma continue her health journey but also play softball without any concerns. Depending on where this brings us towards the end of the session, I would provide the family with all necessary information via handouts, websites and checklist so they not only have the information in office, but Emma and her family always have the information they need in their hands. Finally, I know we addresses everything already, I would ask the beginning question again to allow them to readdress all concerns or positive thoughts before the session ends.

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