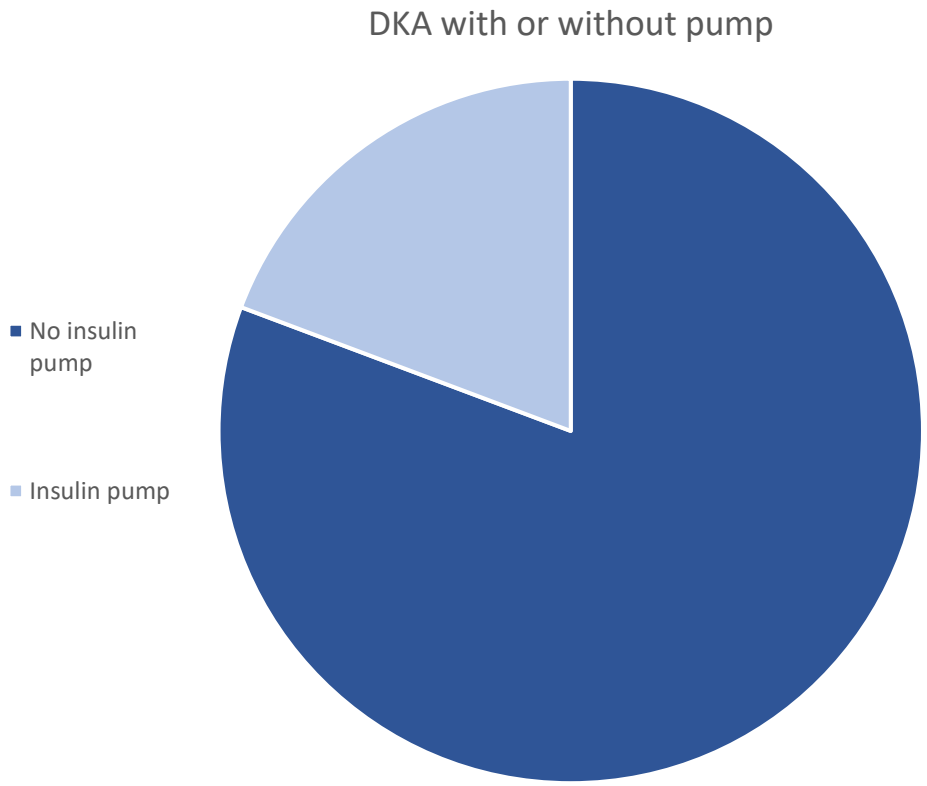
HCL and Sick Day Rules

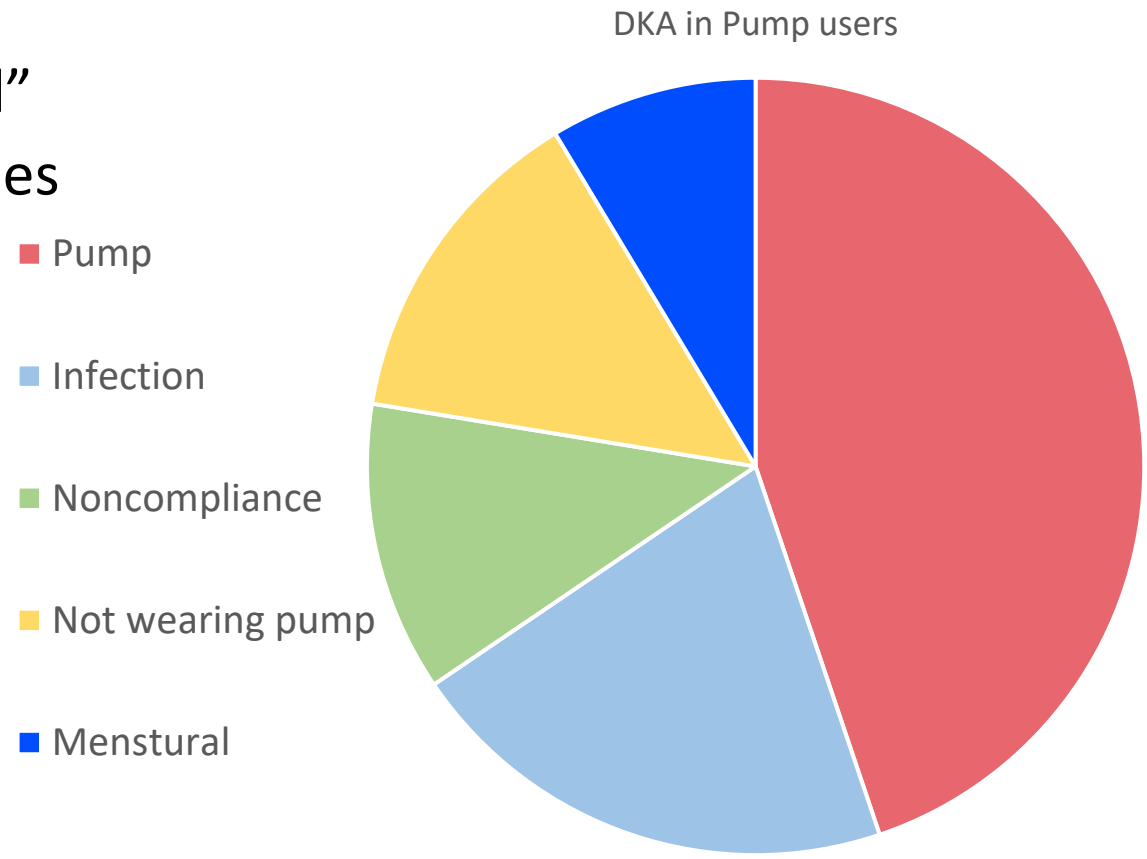
Grace Nelson, MD

The University of Tennessee Health Science Center and Le Bonheur Children's Hospital

- 306 DKAs
  - 82.4% did not have pump
  - 17.6 % with pump



- Reasons for DKA in insulin pump users (54 total)
  - 48% (26) Pump problem
  - 22% (12) Infection
  - 13% (7) Nonadherence “in general”
  - 7% (4) Not wearing/ Lack of supplies
  - 9% (5) “Menstrual”



Pump Ketone Treatment and/or Sick Days

Blood sugar is more than 250 or Feeling Sick
My Child Can Eat and Drink ON PUMP

Ketone Level	Blood Sugar Testing	Ketone Testing	Food and Drink	Treatment	Insulins
NEGATIVE Urine Ketones (Blood ketones less than 0.6)	**Test as usual** (At least every 4 Hours)	**CHECK** ketones with every trip to the bathroom or diaper change (every 8 hours if checking blood ketones)	Usual meal plan with extra water or sugar-free fluids (at least one ounce per year of age per hour)	**MONITOR** and treat blood sugar as usual. During illness, your child may have higher blood sugars than normal	**CONTINUE** your mealtime dosing as usual
TRACE-SMALL Urine Ketones (Blood ketones 0.6-1.5)	**Every 2 Hours**	**CHECK** ketones with every trip to the bathroom or diaper change (every 4 hours if checking blood ketones)	Usual meal plan with extra water or sugar-free fluids (at least one ounce per year of age per hour)	**GIVE** a correction insulin dose **EVERY 2 HOURS** based on current blood sugar. *If blood sugar doesn't go down by at least 50 points in one hour, give a full correction dose by INJECTION and change site	**CONTINUE** your mealtime dosing as usual **INCREASE basal rate** by 20% while trace - small ketones continue
MODERATE-LARGE Urine Ketones (Blood ketones more than 1.5)	**Every 1 Hour**	**CHECK** ketones with every trip to the bathroom or diaper change (every 2 hours if checking blood ketones)	Usual meal plan with extra water or sugar-free fluids (at least one ounce per year of age per hour)	GIVE a correction insulin dose EVERY 1 HOUR based on current blood sugar *if blood sugar doesn't go down by at least 50 points in one hour, give a full correction dose by INJECTION and change site	**CONTINUE** your mealtime dosing as usual **INCREASE basal rate** by 50% while moderate - large ketones continue

Even if your blood sugar is below 250, keep checking ketones and using chart until ketones are NEGATIVE.
If ketones aren't improving after 3 injections, call 901-287-6659 for help

Pump Ketone Treatment and/or Sick Days

Blood sugar is more than 250 or Feeling Sick
My Child Can't Eat, but Can Drink ON PUMP

Ketone Level	Blood Sugar Testing	Ketone Testing	Fluids	Treatment	Insulins
NEGATIVE-SMALL Urine Ketones (Blood Ketones 0.0-1.5)	**Every 2 hours**	**CHECK** ketones with every trip to the bathroom or diaper change (every 4 hours if checking blood ketones)	**DRINK** at least one ounce of fluid per year of age per hour **Blood sugar lower than 250,** up to 1 cup (8 ounces) of fluid per hour should HAVE SUGAR, and the rest should be SUGAR-FREE **Blood sugar higher than 250,** all fluids should be SUGAR-FREE	**GIVE** a correction insulin dose **EVERY 2 HOURS** based on current blood sugar *If blood sugar doesn't go down by at least 50 points in one hour, give a full correction dose by INJECTION and change site	**Increase basal rate** by 20% while trace - small ketones continue
MODERATE-LARGE Urine Ketones (Blood ketones larger than 1.5)	**Every 1 Hour**	**CHECK** ketones with every trip to the bathroom or diaper change (every 2 hours if checking blood ketones)	**DRINK** at least one ounce of fluid per year of age per hour **Blood sugar lower than 250,** up to 1 cup (8 ounces) of fluid per hour should HAVE SUGAR, and the rest should be SUGAR-FREE **Blood sugar higher than 250,** all fluids should be SUGAR-FREE	**GIVE** a correction insulin dose **EVERY 1 HOUR** based on current blood sugar *If blood sugar doesn't go down by at least 50 points in one hour, give a full correction dose by INJECTION and change site	**Increase basal rate** by 50% while moderate - large ketones continue

If you are VOMITING AND HAVE KETONES, OR CANNOT DRINK
Call Nurse or Doctor on call at 901-287-6659 or GO TO THE EMERGENCY ROOM

Even if your blood sugar is below 250, keep checking ketones and using chart until ketones are NEGATIVE.
If ketones aren't improving after 3 injections, call 901-287-6659 for help

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insulin pumps and dka

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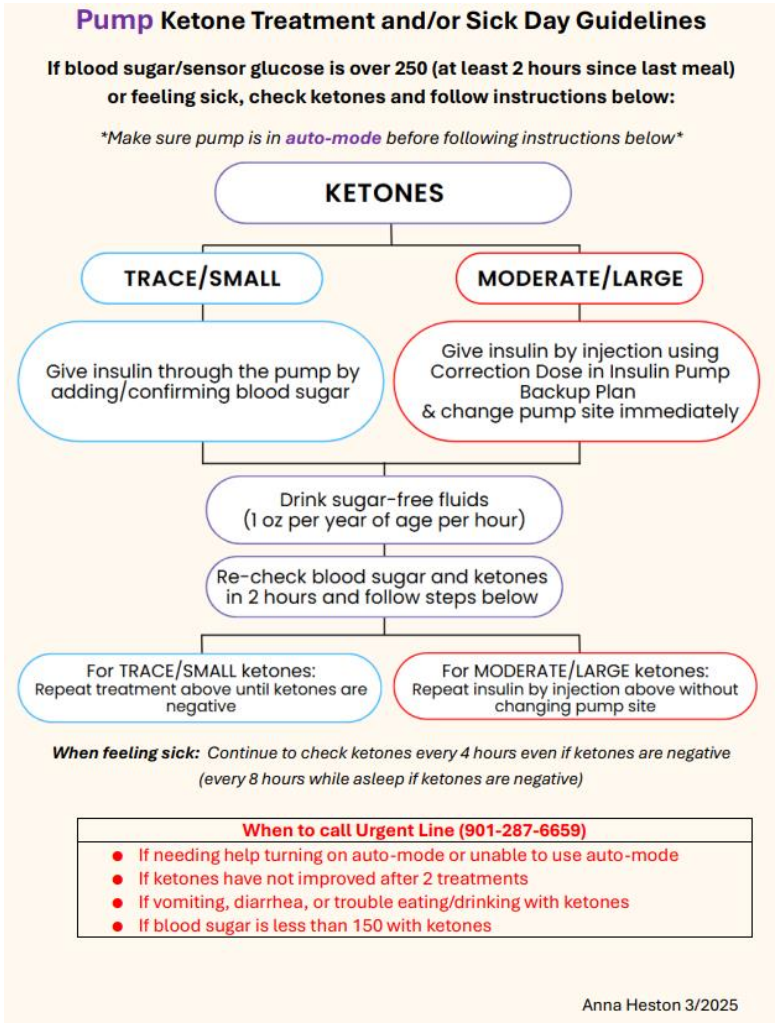
SDR HCL Nursing Triage guide:
1.Has the blood glucose been greater than 250 for more than 2 hours? Yes: Check ketones, move to next question
Recheck ketones at 2-hour mark and call back if needed.
2. Triage
Symptom triage:
· **Have they vomited? If yes, when and are they able to keep anything down since? ****
· **Any trouble breathing? ****
· **Is the patient sleepy or difficult to wake up? ****
· **Are they confused or not acting like themselves? ****
· **Any other illnesses or symptoms?**
· **Any new medications (steroid, antibiotics,etc.)**
· **Is patient on cycle? (if appropriate)**
****If the answer is yes to any of the stared questions, these critical concerns may warrant having the parent call 911 or come to ER. On call provider needs to be notified if the patient has any of these concerns.
Supply triage:
· **Are you in Automode?**
· **Is the Dexcom connected to HCL system? If no, follow old SDR**
· **Is insulin expired or compromised?**
· **Are ketones strips expired or compromised?**
Ketones:
Negative- follow pump recommendations
Trace/Small- Use CGM to give correction via pump and then call back in 2hrs if not improving.
Moderate/Large- Immediate site change, give correction factor with injection according to Insulin Pump back up plan, recheck in one hour and call back if not improving.

New Sick Day Rules- Implemented (5/5/25)



Pump Ketone Treatment and/or Sick Day Guidelines

If blood sugar/sensor glucose is over 250 (at least 2 hours since last meal) or feeling sick, check ketones and follow instructions below:

Make sure pump is in **auto-mode before following instructions below**

KETONES

TRACE/SMALL

Give insulin through the pump by adding/confirming blood sugar

MODERATE/LARGE

Give insulin by injection using Correction Dose in Insulin Pump Backup Plan & change pump site immediately

Drink sugar-free fluids (1 oz per year of age per hour)

Re-check blood sugar and ketones in 2 hours and follow steps below

For TRACE/SMALL ketones: Repeat treatment above until ketones are negative

For MODERATE/LARGE ketones: Repeat insulin by injection above without changing pump site

When feeling sick: *Continue to check ketones every 4 hours even if ketones are negative (every 8 hours while asleep if ketones are negative)*

When to call Urgent Line (901-287-6659)

- If needing help turning on auto-mode or unable to use auto-mode
- If ketones have not improved after 2 treatments
- If vomiting, diarrhea, or trouble eating/drinking with ketones
- If blood sugar is less than 150 with ketones

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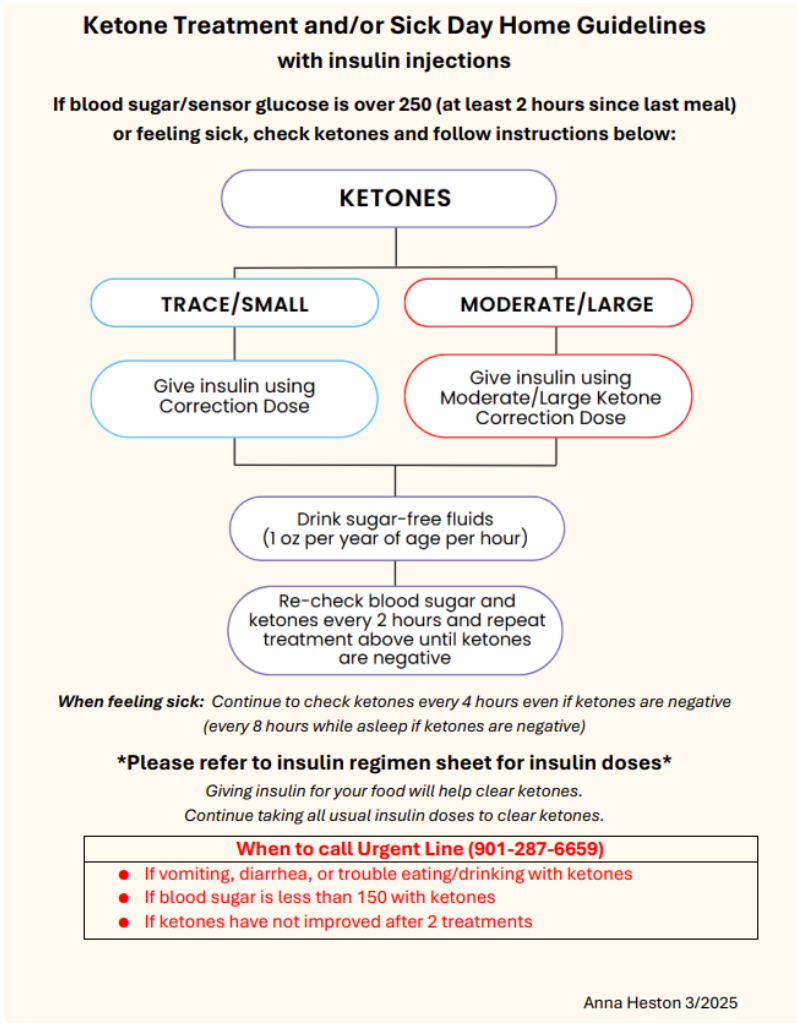

Ketone Treatment and/or Sick Day Home Guidelines with insulin injections

If blood sugar/sensor glucose is over 250 (at least 2 hours since last meal) or feeling sick, check ketones and follow instructions below:

KETONES

TRACE/SMALL

Give insulin using Correction Dose

MODERATE/LARGE

Give insulin using Moderate/Large Ketone Correction Dose

Drink sugar-free fluids (1 oz per year of age per hour)

Re-check blood sugar and ketones every 2 hours and repeat treatment above until ketones are negative

When feeling sick: *Continue to check ketones every 4 hours even if ketones are negative (every 8 hours while asleep if ketones are negative)*

Please refer to insulin regimen sheet for insulin doses

Giving insulin for your food will help clear ketones.
Continue taking all usual insulin doses to clear ketones.

When to call Urgent Line (901-287-6659)

- If vomiting, diarrhea, or trouble eating/drinking with ketones
- If blood sugar is less than 150 with ketones
- If ketones have not improved after 2 treatments

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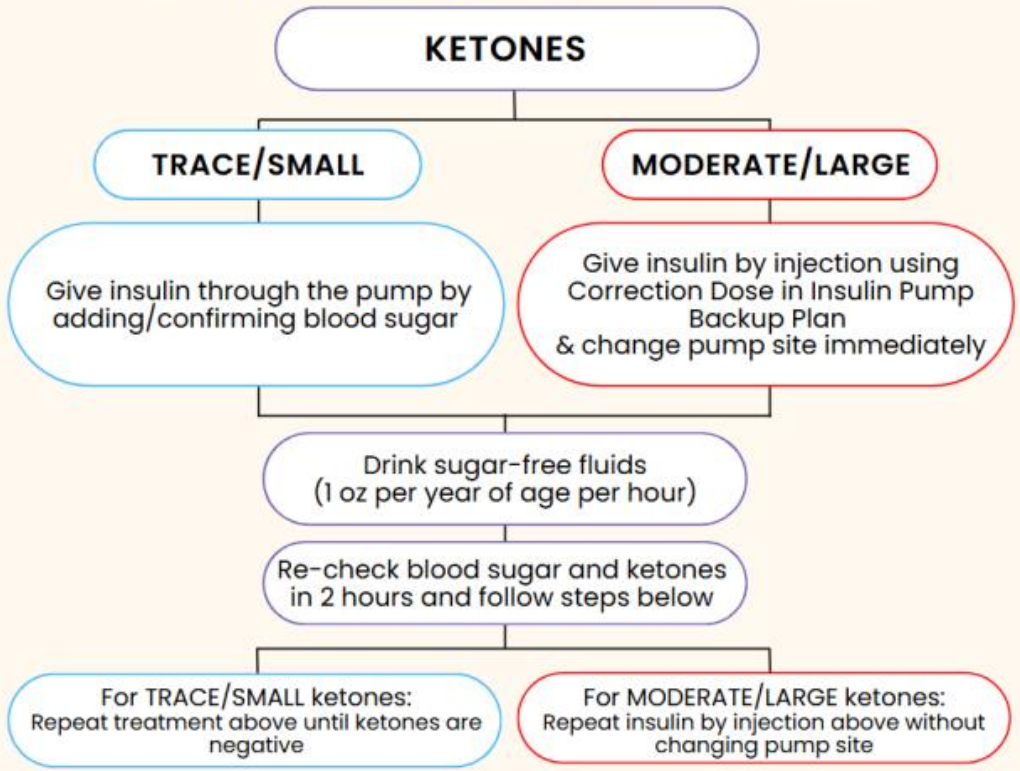
Pump Ketone Treatment and/or Sick Day Guidelines

If blood sugar/sensor glucose is over 250 (at least 2 hours since last meal) or feeling sick, check ketones and follow instructions below:

Make sure pump is in **auto-mode before following instructions below**



When feeling sick: *Continue to check ketones every 4 hours even if ketones are negative (every 8 hours while asleep if ketones are negative)*

When to call Urgent Line (901-287-6659)
• If needing help turning on auto-mode or unable to use auto-mode
• If ketones have not improved after 2 treatments
• If vomiting, diarrhea, or trouble eating/drinking with ketones
• If blood sugar is less than 150 with ketones

Anna Heston 3/2025

Ketone Management in Pediatric Diabetes Centers in the USA: Current Practices and a Call for Improved Standardization

Brynn E Marks [1,2], Seema Meighan [1], Emily E Fivekiller [3], Estella Escobar [3], Cari Berget [3]

- ## Abstract
- **Introduction:** Diabetic ketoacidosis (DKA) is the leading cause of mortality among youth with type 1 diabetes (T1D). Guidelines for DKA prevention exist; however, specific guidance about when to check ketones and how to manage youth using insulin pumps and automated insulin delivery (AID) systems is lacking.
- **Methods:** A 35-item online survey exploring clinical ketone management practices for youth with T1D in the USA was distributed to diabetes healthcare professionals (HCPs). Survey responses, including multiple-choice and Likert scale questions, were summarized and rates of agreement and disagreement (Likert scale 4, 5 vs. 1, 2, 3) are reported.
- **Results:** In total, 123 HCPs (51% physicians, 26% diabetes educators, 19% nurse practitioners) from 47 institutions completed the survey. Seventy percent worked at academic specialty centers. Ninety-seven percent reported >50% continuous glucose monitoring use in their clinic and 72% reported > 50% insulin pump use. Although 79% reported having ketone management protocols, the level and duration of hyperglycemia at which ketone monitoring was advised ranged from >200 to 350 mg/dL and from 0 min to >6 h of duration. While 72% had distinct ketone management protocols for pump users, only 29% had specific protocols for AID. Sixty-two percent agreed that DKA due to infusion site failure was a significant problem in their practice, and 70% agreed there was a need to standardize ketone management guidelines.
- **Conclusions:** The preventable nature and high incidence of DKA highlight the need to build consensus for clinical ketone management and to develop tools to facilitate management, especially as the use of diabetes technologies continues to increase.

- **Keywords:** Automated insulin delivery; Diabetes self-management; Diabetic ketoacidosis; Insulin pumps; Ketosis; Type 1 diabetes.

Insulin Pump Use and Diabetic Ketoacidosis Risk in Type 1 Diabetes: Secular Trends over Four Decades

Dalton R Budhram [1 2], Priya Bapat [1 3], Abdulmohsen Bakhsh [1 3 4], Mohammad I Abuabat [1 3 5], Natasha J Verhoeff [1 6], Doug Mumford [1], Wajeeha Cheema [1], Andrej Orszag [1 3], Akshay Jain [7 8], David Z I Cherney [6 9], Michael Fralick [1 2], Bader N Alamri [10], Alanna Weisman [1 3 11], Leif Erik Lovblom [12], Bruce A Perkins [1 3 11]

Affiliations + expand

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Abstract

Introduction: Continuous subcutaneous insulin infusion (CSII) in type 1 diabetes has been regarded as a major diabetic ketoacidosis (DKA) risk factor. We aimed to determine secular trends in risk since CSII implementation in the 1980s. ***Research Design and Methods:*** We assessed the relationship between time-varying CSII use and DKA events from 1983 to 2017 and by each decade in the 1441 Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study participants using crude and adjusted Cox proportional hazards models. ***Results:*** Time-varying CSII exposure was associated with significantly higher DKA risk in the 1980s (adjusted hazard ratio [HR] 5.81; 95% confidence interval [CI] 3.28-10.29; $P < 0.001$), but in the 2010s, this risk was not significantly elevated (adjusted HR 1.24; 95% CI 0.73-2.12; $P = 0.43$). ***Conclusions:*** DKA risk associated with CSII in type 1 diabetes has declined substantially since the 1980s such that the remaining risk in the past decade appears to be of low magnitude.

Keywords: diabetes technology; diabetic ketoacidosis; insulin pumps; type 1 diabetes.