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*Illinois EMS for Children*  
**Pediatric DKA in the Emergency Department  
Summary Report  
July 2010**

## ABSTRACT

From January through June 2010, Illinois EMS for Children (EMSC) conducted a statewide Emergency Department quality improvement (QI) monitor regarding the assessment, management, disposition, and education of pediatric patients presenting with Diabetic Ketoacidosis (DKA). Participating hospitals completed the following:

- A survey of general practices
- 2 case scenarios
- Medical record reviews (inclusion criteria: 0-15 year old patients admitted to the ED for DKA).

For analysis purposes in this summary report, responses were aggregated by size of facility. Two categories were used to group facility size:

- Large facilities having more than 6,000 pediatric ED visits per year
- Small facilities having up to 6,000 pediatric ED visits per year

Separately, for additional analyses, responses were aggregated by location of facility using the 11 EMS regions in Illinois. Two categories were used to group facility location:

- Regions 7-11 – Chicago and the surrounding suburban counties
- Regions 1-6 – Outside of Chicago and the surrounding suburban counties

Regarding the survey component, 116 Illinois area hospitals responded (94% response rate).

Findings of note included the following:

- 28% of respondents (33 facilities) reported that, although pharmacists prepare insulin drips during the day shift, ED staff prepare insulin drips during the evening and overnight shift
  - 26 of these facilities were both located in Regions 1-6 *and* in the small size group.
    - There were only 41 such facilities (small and Region 1-6) in the total sample.
  - The other 7 facilities were either located in Regions 7-11 *or* in the large size group.
    - There were 75 such facilities (large or Region 7-11) in the total sample.
- 26% of respondents (30 facilities) reported using the “two-bag system” (a variable IV fluid and dextrose administration process)
  - Another 10% (12 facilities) reported *occasional use* of the “two-bag system.” However, of these 42 total facilities, only 73% required labeling of IV tubing lines when using the system.

Regarding case scenarios, 113 hospitals submitted data for Case Scenario #1 (a 3 year-old female with new-onset diabetes mellitus [DM]), and 110 hospitals submitted data for Case Scenario #2 (a 14 year-old male with known DM). Notable finding included the following:

- In the first hour of treatment, the majority of respondents would give an *IV fluid bolus of 10-20 mL/kg 0.9% NS over the first hour*. This was the response for 83% of hospitals for Case #1 and 79% for Case #2. However, other courses of treatment were also reported as follows:
  - *IV fluid bolus 15-20 mL/kg 0.45% NaCl over the first hour* (6% for Case #1 and 5% for Case #2)
  - *Administer insulin drip of 0.1 units/kg/hour* (7% for Case #1 and 11% for Case #2)

- *Wait for more laboratory results before giving any fluids or insulin* (3% for Case #1 and 4% for Case #2)
- In follow-up to analyzing lab results that confirmed the diagnosis of DKA, the majority of hospitals would *administer an insulin drip of 0.1 units/kg/hour* (75% for Case #1 and 81% for Case #2). However, a substantial percentage of hospitals would *administer an insulin bolus of 0.1 units/kg* (33% for Case #1 and 43% for Case #2). Note: This question allowed for more than one response.

Regarding the medical record review component, because DKA is an infrequent diagnosis for many EDs, hospitals were asked to submit up to 10 record reviews dating as far back as January 1, 2008. In total, 532 reviews were submitted by 88 hospitals. (Even using this extended time period, many hospitals reported seeing no pediatric DKA patients.) Notable findings included the following:

- Weight was recorded in kilograms in 79% of the records. A higher percentage of large facilities (86%) used kilograms than small facilities (58%).
- Over 90% of records documented a full set of vital signs, respiratory status, and neurological status.
- Patients received an initial IV bolus within the first hour in 87% of records.
- After initial IV fluid bolus, IV insulin infusion/drip (0.1 units/kg/hour) was given in 74% of records.
- Documentation of a cardiac monitor, fluid input and output status, hourly vital signs, and hourly POCT blood glucose testing were all recorded in approximately half of the records.
- 51% of patients were transferred to another facility, and 22% admitted to the PICU or ICU.
- When patients were transferred, 51% were transported by specialty/transport team and the rest by ALS/ILS service level (with or without a nurse). This value differed by region.
  - 64% of records from Region 7-11 facilities reported using specialty/transport teams compared with 30% for Region 1-6 facilities.

When comparing data between the surveys, case scenarios, and record reviews, notable findings included the following:

- In survey questions regarding the ED monitoring of stable DKA patients (for *vital signs, blood glucose testing, and neurological status*), the survey responses of “continuously” or “every hour” were associated with higher actual monitoring documented in record reviews when compared with survey responses of “not defined in policy” or “per physician decision.”
- For both new-onset and known DM cases, similarities were found in the management of case scenarios and in the actual practice documented in record reviews in the *administration of initial IV fluid bolus over the first hour and subsequent IV insulin infusion/drip* (0.1 units/kg/hour).

# I. Introduction

In 2010, 124 emergency departments (EDs) actively participated in the Illinois EMSC regional QI program. Of these, 107 were recognized as PCCC, EDAP or SEDP facilities. The 124 EDs were asked to respond to a survey of practices regarding their management of pediatric Diabetic Ketoacidosis (DKA). They were also requested to complete two case scenarios and submit up to 10 medical record reviews of pediatric DKA patient visits to their ED between January 1, 2008 and June 30, 2010.

Of the 124 facilities, 116 submitted surveys (94%). Also, 113 provided data for Case Scenario #1, and 110 provided data for the Case Scenario #2. Finally, 88 facilities submitted a total of 532 record reviews. (Even with the extended time frame, many facilities reported no pediatric DKA patient visits to review.) After data submission, participants were provided with Web-based reports that allow comparison of their results to their region, to similar sized facilities, and to the rest of the state.

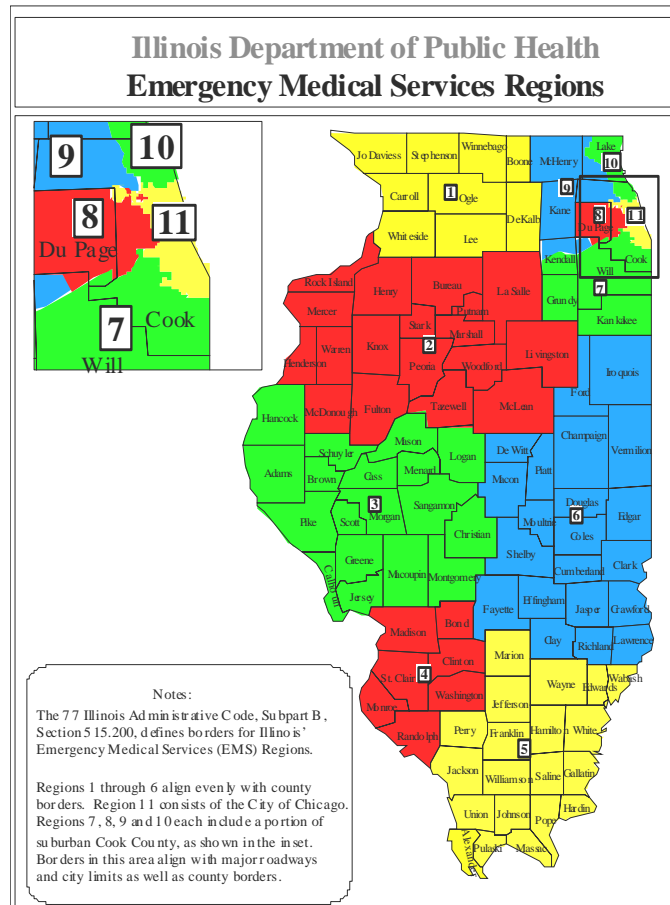
For analysis purposes in this summary report, responses were aggregated by size of facility. **Two categories were used to group facility size:**

- **Large** facilities having more than 6,000 pediatric ED visits per year
- **Small** facilities having up to 6,000 pediatric ED visits per year

Separately, for additional analyses, responses were aggregated by location of facility using the 11 EMS regions in Illinois as shown in the map below. **Two categories were used to group facility location:**

- **Regions 7-11** – Chicago and the surrounding suburban counties
- **Regions 1-6** – Outside of Chicago and the surrounding suburban counties

**Map of EMS Regions in Illinois**



## II. Record Review Results

### Notes Regarding Record Reviews

For this section of the report, percentages are used to describe results of the record reviews. For most of the record review questions, there were four possible responses: **Yes**, **No**, **ND (Not Documented)**, and **NA (Not Applicable)**.

Report percentages were calculated as the number of **Yes** responses divided by the total number of **Yes**, **No**, and **ND** responses. This **Yes/No/ND** total is shown in parentheses as the “n” value (e.g. “n=525” records). **NA** responses were excluded.

In addition, typically the number of **ND** responses was very small and so not very meaningful. For a few questions, this percentage was 5% or greater. When this is the case, then this “not documented” percentage is noted on the line directly below the question.

### Mode of Arrival and Prehospital Management

- By and large, the majority of pediatric DKA patients arrived as walk-ins (88%).
- For those 54 patients arriving by prehospital transport, 81% were treated at the ALS/ILS service level.
- Prehospital management included high percentages for blood glucose tests (86%) and neurological status (87%), and slightly lower values for ALS/ILS services of IV fluid bolus (76%) and cardiac monitor (68%).

<b><i>Patient's Mode of Arrival (n=525)</i></b>		
Prehospital	10%	
Transfer	2%	
Walk-in	88%	
<b><i>Level of Prehospital Service (n=54)</i></b>		
ALS/ILS	81%	
BLS	19%	
<b><i>For all prehospital levels</i></b>		
Blood glucose level checked by prehospital provider (n=49)	86%	
Neurologic status assessed by prehospital provider, e.g., AVPU, GCS (n=52)	87%	
<b><i>For ALS/ILS providers only</i></b>		
IV fluid bolus started or attempted by prehospital provider (n=38)	76%	
Cardiac monitor applied by prehospital provider (n=41)	68%	

## Initial Assessment

- Weight was recorded in kilograms in 79% of the records. A higher percentage of **large\*** facilities (86%) used kilograms relative to **small\*** facilities (58%).
- Over 90% of records documented a full set of vital signs, respiratory status, and neurological status.
- Point-of-care testing (POCT) blood glucose testing was recorded in 70% of records. A higher percentage of Region 7-11 facilities (76%) recorded testing than facilities in Regions 1-6 (59%).
- Slightly over half of the patients had a history of DM (56%).
  - Of these, 33% (26 facilities) reported stopping or disconnecting the patient's pump in the ED, while another 37% of records reported "not documented" for this item. Within this subgroup of 26 facilities, 62% reported that the patient was first switched to an alternate insulin source, although again a high percentage (23%) of records reported "not documented."
- Appropriate histories were documented for 81% of patients who had a history of DM and 93% of patients with new-onset DM. Large facilities reported higher percentages for both types of patients (85% for patients with DM history and 95% for new-onset) relative to small facilities (68% and 81%).

<b>Age Groups (n=512)</b>		
0-1 Year	4%	
2-5 Years	13%	
6-15 Years	83%	
<b>For all patients</b>		
Patient's weight documented in kilograms (n=525)	79%	
Full set of vital signs documented, must include: HR, RR, BP, Temp, Oxygen saturation (n=524)	93%	
POCT blood glucose level obtained within 15 minutes of patient assessment in triage (n=501)	70%	
Respiratory status assessed appropriately, e.g., Kussmaul's respiration (n=518)	91%	
Neurologic status assessed appropriately, e.g., AVPU, GCS (n=527)	93%	
Patient had a history of DM (n=528)	56%	
<b>For patients with a history of DM</b>		
Appropriate history taken (n=290)	81%	
If currently using an insulin pump, the patient's pump was stopped or disconnected in the ED (n=95)	33%	
<i>Note: For the above item, 37% of records were reported as "Not Documented"</i>		
If the pump was stopped or disconnected in the ED, this was after the patient was switched to an alternate insulin source (n=26)	62%	
<i>Note: For the above item, 23% of records were reported as "Not Documented"</i>		
<b>For new-onset DM patients</b>		
Appropriate history taken (n=218)	93%	

Note: \* **Large** and **small** facilities are defined on page 3.

## Management and Assessment

- Patients received an initial IV bolus within the first hour in 87% of records.
- After initial IV fluid bolus, IV insulin infusion/drip (0.1 units/kg/hour) was given in 74% of records.
- Documentation of a cardiac monitor, fluid input and output status, hourly vital signs, and hourly POCT blood glucose testing were all recorded in approximately half of the records.
- Hourly neurological status assessment and checking of electrolytes every 2-4 hours were documented in less than half of the records.
- Reassessment for vital signs was reported in 84% of records, for neurological status in 63%, and for POCT blood glucose testing in 75% of records.
- Sodium bicarbonate was given infrequently, in 4% of records.
  - In this subgroup, 74% of records documented that the patient was severely acidotic or symptomatic for hyperkalemia.

<b>First Hour</b>		
Patient received an initial IV fluid bolus within the first hour of treatment (n=509)	87%	
Standard/critical labs were ordered - blood glucose, urinalysis, venous blood gas, electrolytes/Chem-7 (n=518)	87%	
Additional labs ordered per policy, e.g., A1c, CBC, Osmolality, BOH, etc.(n=411)	82%	
Cardiac monitor applied (n=518)	50%	
<i>Note: For the above item, 14% of records were reported as "Not Documented"</i>		
Fluid input and output status documented per policy (n=494)	50%	
<i>Note: For the above item, 9% of records were reported as "Not Documented"</i>		
Vital signs checked every hour, minimally including: HR, RR, BP, Oxygen saturation (n=517)	58%	
POCT blood glucose level checked every one (1) hour (n=506)	52%	
Neurologic status assessed every one (1) hour, e.g., AVPU, GCS (n=507)	37%	
<i>Note: For the above item, 7% of records were reported as "Not Documented"</i>		
<b>Ongoing</b>		
Electrolyte levels checked every 2-4 hours (n=242)	45%	
After initial IV fluid bolus, IV insulin infusion/drip was given, 0.1 units/kg/hour (n=425)	74%	
Potassium replacement initiated (n=291)	40%	
IV dextrose given to prevent hypoglycemia (n=214)	39%	
Sodium bicarbonate given (n=529)	4%	
If sodium bicarbonate given, the patient was severely acidotic or symptomatic for hyperkalemia (n=19)	74%	
<b>Reassessment</b>		
Vital signs reassessed before disposition, minimally including: HR, RR, BP, Oxygen saturation (n=504)	84%	
Neurologic status reassessed before disposition, e.g., AVPU, GCS (n=525)	63%	
<i>Note: For the above item, 5% of records were reported as "Not Documented"</i>		
POCT blood glucose level reassessed before disposition (n=519)	75%	

## Disposition and Patient Education

- 51% of patients were transferred to another facility, and 22% admitted to their own PICU or ICU. These values differed between large and small facilities.
  - Large facilities reported 49% of their patients transferred and 26% admitted to their own PICU/ICU.
  - Small facilities reported 59% of their patients transferred and 8% admitted to their own PICU/ICU.
- When patients were transferred, 51% were transported by specialty/transport team and the rest by ALS/ILS service level (with or without a nurse). This value differed by region.
  - 64% of records from Region 7-11 facilities reported use of specialty/transport teams compared with 30% for facilities in Regions 1-6.
- Pediatric Diabetes/DKA patient education was initiated in the ED (when appropriate) in only 44% of records, with 24% of records reported as "not documented".
- Appropriate follow up referral with a Diabetes Educator and/or Physician was documented (when appropriate) in 75% of records, with 15% reporting "not documented".

<b>Disposition from the ED (n=531)</b>		
Transferred	51%	
PICU/ICU Admission	22%	
Intermediate Care Admission	4%	
General Admission	11%	
Observed	0%	
Home	11%	
Expired	0%	
<b>If transferred, level/type of patient transport service used (n=257)</b>		
Specialty/Transport Team	51%	
ALS/ILS	37%	
ALS/ILS (with nurse)	11%	
BLS	0%	
BLS (with nurse)	0%	
Private vehicle	0%	
<b>Patient Education</b>		
Pediatric Diabetes/DKA patient education initiated in the ED, when appropriate (n=135)	44%	
<i>Note: For the above item, 24% of records were reported as "Not Documented"</i>		
Appropriate follow up referral with Diabetes Educator and/or Physician documented, when appropriate (n=120)	75%	
<i>Note: For the above item, 15% of records were reported as "Not Documented"</i>		

### III. Survey and Case Scenario Results

#### Notes Regarding Survey and Case Scenarios

This section presents highlighted findings from the survey and case scenarios. Statewide totals for all questions for the survey, Case #1, and Case #2 respectively are available online in the documents <http://ilemsc.org/DKArpt/SurveyResults.pdf>, <http://ilemsc.org/DKArpt/Case1Results.pdf>, and <http://ilemsc.org/DKArpt/Case2Results.pdf>.

#### A. Survey Results (116 Responses)

##### DKA Policies

- 34% of respondents (39 facilities) reported that they have a documented protocol/policy/guideline/clinical pathway for DKA.
- Of these 39 facilities with policies, 28 (74%) specifically addressed pediatrics. However, only 21 (55%) of the 39 addressed the monitoring and treatment of cerebral edema.

##### Monitoring of DKA Patients

- Respondents reported monitoring of stable DKA patients per policy as follows:
  - 49% reported *hourly* or *continuous* monitoring of vital signs, with 43% reporting either *not defined in policy* or *per physician decision*
  - 48% reported *hourly* or *continuous* cardiac monitoring, with 51% reporting either *not defined in policy* or *per physician decision*
  - 39% reported *hourly* or *continuous* monitoring of neurological status, with 55% reporting either *not defined in policy* or *per physician decision*
  - 41% reported *hourly* or *continuous* monitoring of blood glucose levels, with 55% reporting either *not defined in policy* or *per physician decision*
  - 25% reported monitoring of electrolytes at least every 2-4 hours, with 75% reporting either *not defined in policy* or *per physician decision*

##### Preparation of Insulin Drips for the ED

- 63% of respondents reported that pharmacists are available 24/7 to prepare insulin drips for the ED
- 28% of respondents (33 facilities) reported that, although pharmacists prepare insulin drips during the day shift, ED staff prepare insulin drips during the evening and overnight shift
  - 26 of these facilities were both located in Regions 1-6 *and* in the small size group.
    - There were only 41 such facilities (small and Region 1-6) in the total sample.
  - The other 7 facilities were either located in Regions 7-11 *or* in the large size group.
    - There were 75 such facilities (large or Region 7-11) in the total sample.

##### Safety Checks Routinely Used When Administering Insulin

- 94% of respondents conduct an independent double check with another caregiver prior to insulin administration
- 82% designate insulin as a “High-Alert” medication

##### Use of the “Two-Bag System”

- 26% of respondents (30 facilities) reported using the “two-bag system” (a variable IV fluid and dextrose administration process)
  - Another 10% (12 facilities) reported *occasional use* of the “two-bag system.” However, of these 42 total facilities, only 73% required labeling of IV tubing lines when using the

system. NOTE: labeling multiple IV tubing lines is a standard patient safety risk-reduction strategy.

- The “two-bag system” was used more by facilities in Regions 7-11 (31% responded “Yes” and 17% responded “Occasionally”) than in facilities in Regions 1-6 (21% responded “Yes” and 5% “Occasionally”).

### **Endocrinology Services**

- Availability of endocrinology services differed greatly by region, as shown in the following table:

<b>Endocrinology Services Provided by the Hospital</b>	<b>Regions 7-11</b>	<b>Regions 1-6</b>	<b>All Facilities</b>
Pediatric Endocrinologist – at all times (24/7)	27%	7%	17%
Pediatric Endocrinologist – limited coverage	15%	0%	7%
Adult Endocrinologist with pediatric privileges – at all times (24/7)	9%	5%	7%
Adult Endocrinologist with pediatric privileges – limited coverage	4%	7%	5%
Adult Endocrinologist (provides no/minimal pediatric consultation services) – at all times (24/7)	<b>35%</b>	7%	20%
Adult Endocrinologist (provides no/minimal pediatric consultation services) – limited coverage	18%	12%	15%
None	9%	<b>62%</b>	<b>37%</b>
Other	2%	10%	6%

### **Patient Transfers**

- 60% of respondents (69 facilities) reported transferring pediatric DKA patients within the past 12 months. These 69 facilities reported the following:
  - 52% typically used Specialty/Transport Teams (either ground or air)
  - 70% required that their preferred EMS service personnel be PALS or PEPP educated

### **Diabetes Education**

- 55% of respondents have a Diabetes Educator available to provide PATIENT education for both *adult and pediatric patients*, 27% for *adults only*, and 2% for *pediatrics only*.
- 74% of respondents have a Diabetes Educator available to provide STAFF education.

## **B. Case Scenario Results**

### **Case Descriptions**

- Case Scenario #1 was described as follows:  
A lethargic child is rushed into the emergency department by her frantic mother who states that she was unable to arouse the three-year-old from bed this morning. She reports that her child had appeared “totally fine” until last evening when her daughter complained of some “belly pain” and experienced several episodes of vomiting. The mother denies a history of trauma and states that her child has no medical problems. The child is not taking any medications, has no medication allergies, and has had no recent contact with any communicable diseases.
- Case Scenario #2 was described as follows:  
A 14-year-old male is brought to the Emergency Department via ambulance with a report of the patient being found unresponsive. Paramedics report that the patient’s mother came home to find her son lying on the sofa unresponsive. They also report that the child is a diabetic and gives himself his own insulin. His mother told the paramedics she was unsure when her son last took his medication. The patient himself offers no history whatsoever.

### **Number of Responses**

- 113 facilities submitted responses for Case #1
- 110 facilities submitted data for Case #2

### **Potential Diagnosis**

- For Case #1 (new onset DM), the most frequent potential diagnoses reported by respondents consisted of the following:
  - DKA (89%)
  - Poisoning (87%)
  - Dehydration (84%)
  - Infection (79%)
  - Overdose/opiates (73%)
  - Abuse (73%)

### **First Hour of Treatment**

- For treatment of both cases, respondents typically would give an *IV fluid bolus of 10-20 mL/kg 0.9% NS over the first hour*. This was the response for 83% of hospitals for Case #1 and 79% for Case #2.
- However, other courses of treatment were also reported as follows:
  - *IV fluid bolus 15-20 mL/kg 0.45% NaCl over the first hour* (6% for Case #1 and 5% for Case #2) NOTE: this is the recommended fluid course for adults, not pediatrics
  - *Administer insulin drip of 0.1 units/kg/hour* (7% for Case #1 and 11% for Case #2) NOTE: current guidelines recommend administering insulin after the initial fluid resuscitation, not concurrently.
  - *Wait for more laboratory results before giving any fluids or insulin* (3% for Case #1 and 4% for Case #2) NOTE: current guidelines recommend Initial intravenous fluid administration and, if needed, volume expansion, should begin immediately.

### **Diagnostic Studies**

- The following were the most common diagnostic studies ordered by respondents:
  - Electrolytes (Na, K, Cl, HCO<sub>3</sub>) – 100% Case #1, 100% Case #2
  - CBC with differential – 99%, 100%
  - Blood glucose – 96%, 100%
  - Urinalysis – 96%, 95%
  - BUN and Creatinine – 92%, 94%
  - Venous blood gas – 85%, 95%
  - Serum ketones [beta-hydroxybutyrate (BOH)] – 80%, 83%
  - Ca, Mg, Phos – 68%, 76%
  - Chest radiograph – 58%, 56%

### **Follow-up to Lab Results That Confirmed DKA**

(Note: This question allowed users to enter more than one response.)

- In follow-up to analyzing lab results that confirmed the diagnosis of DKA, the majority of respondents would *administer an insulin drip of 0.1 units/kg/hour*. This response was reported by 75% of respondents for Case #1 and 81% for Case #2.
- However, a substantial percentage of hospitals would *administer an insulin bolus of 0.1 units/kg*. This response was reported by 33% of respondents for Case #1 and 43% for Case #2. NOTE: current guidelines suggest IV insulin bolus may increase the risk of cerebral edema, and should not be used at the start of therapy.

### **Admission or Transfer**

- For both of these cases, admission or transfer would be made principally to a PICU (91% for Case #1 and 87% for Case #2) or a PICU step-down unit (7% for Case #1 and 10% for Case #2).

## IV. Comparisons of Survey and Case Scenario Results with Record Reviews

Several questions in the survey and case scenarios allowed for comparison with record review findings. The following two results were particularly noted.

### Hourly Monitoring Reported in Surveys Relative to Record Reviews

- In the **survey**, questions were asked regarding how frequently *Vital Signs, Blood Glucose, and Neurological Assessment* for stable DKA patients are monitored in the ED per policy. Potential responses consisted of the following:
  - Continuously (i.e., more than once an hour)
  - Every Hour
  - Every 2 – 4 hours
  - Not defined in DKA policy
  - Per physician decision
- In the **record reviews**, the following questions were asked:
  - Were vital signs checked every hour (minimally include: HR, RR, BP, Oxygen saturation)?
  - Was POCT blood glucose level checked every one (1) hour?
  - Was neurological status assessed every one (1) hour (e.g., AVPU, GCS)?
- When combining data from both of these sources, the survey responses of requiring “continuous” or “hourly” monitoring were associated with higher hourly monitoring in practice when compared with “not defined in policy” or “physician decision”. Details are shown in the following table.

Record Review Question	Total % Yes	% Yes when Survey Response was <i>Continuously</i> or <i>Every Hour</i>	% Yes when Survey Response was <i>Not Defined in Policy</i> or <i>Physician Decision</i>
Vital Signs Hourly	58%	68%	48%
Blood Glucose Hourly	52%	65%	39%
Neuro Assessment Hourly	37%	59%	23%

### ED Management Reported in Case Scenarios Compared with Record Reviews

- Information about initial management was obtained in both the case scenarios and record reviews. Similarities percentages were found for both new-onset and known DM cases.
  - In the **case scenarios**, ED staff would give an *IV fluid bolus of 10-20 mL/kg 0.9% NS over the first hour* as follows:
    - 83% of responses for Case #1 (new-onset)
    - 79% of responses for Case #2 (known DM)
  - In the **record reviews**, it was asked if the patient received an *initial IV fluid bolus within the first hour* of treatment. Record review responses of *Yes* were as follows:
    - 82% of new-onset cases
    - 91% of known DM cases
- Information about subsequent management was also obtained in both the case scenarios and record reviews. Similarities were also found for this set of responses.
  - In the **case scenarios**, after lab confirmation of DKA, ED staff would give an *insulin drip of 0.1 units/kg/hour* as follows:
    - 75% of responses for Case #1 (new-onset)
    - 81% of responses for Case #2 (known DM)
  - In the **record reviews**, it was asked if, after initial IV fluid bolus, *was IV insulin infusion/drip given (0.1 units/kg/hour)*. Record review responses of *Yes* were as follows:
    - 77% of new-onset cases
    - 71% of known DM cases

## V. Conclusions

Results of the DKA survey, case scenario, and record reviews show areas of strength for participating facilities, as well as opportunities to improve. In ED management, *initial IV fluid bolus over the first hour* and *subsequent IV insulin infusion/drip (0.1unit/Kg/hour)* were found at high percentages in both record reviews and case scenarios, consistent with current guideline recommendations. On the other hand, case scenario responses also showed substantial percentages of facilities that would use alternative initial fluid management and subsequent treatment, such as the following:

- IV fluid bolus 15-20 mL/kg 0.45% NaCl over the first hour. NOTE: this is the recommended fluid course for adults, not pediatrics
- Administer insulin drip of 0.1 units/kg/hour over the first hour. NOTE: current guidelines recommend administering insulin after the initial fluid resuscitation, not concurrently.
- Wait for more laboratory results before giving any fluids or insulin. NOTE: current guidelines recommend Initial intravenous fluid administration and, if needed, volume expansion, should begin immediately.
- Following lab results that confirm DKA, administer an insulin bolus of 0.1 units/kg. NOTE: current guidelines suggest IV insulin bolus may increase the risk of cerebral edema, and should not be used at the start of therapy.

For initial ED assessment, the majority of record reviews documented *vital signs, respiratory status, and neurological status*. However, hourly monitoring assessments of *vital signs, blood glucose, and neurological status* were only documented in approximately half of the records. The percentage of documentation was even lower for facilities who, on survey, reported that such monitoring was “not defined in policy” or was performed “per physician decision.”

Regarding ED practices, survey results showed that a substantial number of facilities use *ED staff to prepare insulin drips during the evening and overnight shifts*, particularly in small facilities located in Regions 1-6. Also a substantial number of facilities use the “two-bag system,” but not all of these facilities require labeling of IV tubing lines when doing so. Both of these practices suggest opportunities for policy and educational enhancements to assure patient safety.