Adverse events in the Pediatric Emergency Department: a prospective cohort study

**Supplementary material 1: Patient characteristics and systems factors to be examined for association with the occurrence of adverse events**

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Further Description/Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Age, in years</td>
</tr>
<tr>
<td>Sex</td>
<td>male/female</td>
</tr>
<tr>
<td>Language</td>
<td>Both parents fluent in English and/or French</td>
</tr>
<tr>
<td>Immigration</td>
<td>Both parents immigrated to Canada in last five years</td>
</tr>
<tr>
<td>Pediatric Canadian Triage Acuity Scale (PedsCTAS)</td>
<td>Five categories: 1=resuscitation; 2=emergent; 3=urgent; 4 semi-urgent; 5=nonurgent. Variable be grouped into 3 categories for analysis: (1) resuscitation and emergent; (2) urgent; and (3) semi-urgent and nonurgent</td>
</tr>
<tr>
<td>Time of day of patient presentation to the ED</td>
<td>‘regular hours’ (8 am to 5 pm) / ‘after hours’ (5 pm to 8 am)</td>
</tr>
<tr>
<td>Weekday/weekend presentation of patient to the ED</td>
<td>‘weekday’ (Monday to Friday) / ‘weekend’ (Saturday and Sunday)</td>
</tr>
<tr>
<td>Discharge disposition</td>
<td>Admitted / discharged / left without being seen / left against medical advice/died. Variable will be grouped in 3 categories for analysis: (1) admitted, (2) discharged, (3) left without being seen and left against medical advice. If any patients die, then a fourth category will be added.</td>
</tr>
<tr>
<td>Indwelling line, or indwelling urinary catheter, or dialysis catheter or respiratory support needed</td>
<td>Variable grouped as ‘yes’ vs ‘no’</td>
</tr>
<tr>
<td>Mental health presentation</td>
<td>For example, depression, anxiety, substance abuse</td>
</tr>
<tr>
<td>Chronic condition</td>
<td>Defined as a condition needing on-going, regular follow-up or regular medication use (e.g. asthma, cancer, kidney disease, congenital heart disease, diabetes)</td>
</tr>
</tbody>
</table>

**System factors**

<table>
<thead>
<tr>
<th>Further Description/Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of time to see physician</td>
</tr>
<tr>
<td>Number of ED physicians involved in that patient’s care</td>
</tr>
<tr>
<td>Location within the ED</td>
</tr>
<tr>
<td>Need for a consultation</td>
</tr>
<tr>
<td>Level of physician initially managing patient (ED staff versus medical trainee)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall ED census (i.e. the overall number of patients present in the ED)*</td>
<td>This reflects all the patients currently present in the ED - those in the waiting room, those in ED examination rooms, and those in ED examination rooms awaiting inpatient beds.</td>
</tr>
<tr>
<td>The number of patients waiting to be seen*</td>
<td>The number of patients in the ED who have not yet been seen by a physician.</td>
</tr>
<tr>
<td>Number of patients awaiting in-patient beds*</td>
<td>The number of patients for whom inpatient beds have been requested (for admission) but who remain in the ED.</td>
</tr>
</tbody>
</table>

*These are system variables that reflect volume and operational processes. Given the volume of patients that can present over a short period to the triage desk it was not feasible to collect these variables at the exact moment each patient is triaged. We operationalized the data collection of these variables by capturing these variables at the midpoint of each hour during each shift. We then used this data for patients who arrived within 30 minutes before or after this time point. For example, if a patient presents to the ED at 13:10, we used for this patient the data collected at 13:30 for these specific variables.
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Supplementary material 2: Types of adverse events and system response required

Types of adverse events

Diagnostic issue: documented signs, symptoms, laboratory tests or imaging not acted on or an indicated diagnostic test not ordered

Management issue: suboptimal management plans despite accurate diagnosis or based on an inaccurate diagnosis.

Unsafe disposition decision: patient placed at unnecessary risk of experiencing death or major disability by being discharged from the ED or hospital.

Suboptimal follow-up: problems with follow-up arrangements lead to the development of new symptoms, unnecessary prolongation of symptoms, an unscheduled return visit to the ED or a subsequent unscheduled hospital admission (this could be due to inadequate availability of follow-up or due to inappropriate follow-up arrangements.

Medication adverse effect: patient experiences a symptom related to a medication regardless of whether the medication was appropriately prescribed or taken.

Procedural complication: patient experiences adverse consequences of a procedure.

Nosocomial infection: infection acquired in ED or in hospital.

System response for adverse events

• No treatment (symptoms only)
• Medical intervention
• Visit to lab facility or other healthcare facility
• Surgical intervention
• Visit to MD
• Admission to hospital
• Visit to ED
• Transfer to critical care
• Death

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Supplementary material 3: Telephone survey

ED Visits
Since your child’s Emergency Department visit on _________(date), have your child returned to an Emergency Department?  
☐ Yes  ☐ No
OR Since our last phone call on      (date , have you/your child returned to an Emergency Department?)  
☐ NA

Why NA?
How many visits to an emergency department have they had?  
☐ 1  ☐ 2  ☐ 3

Visit 1: Which Emergency Department did you visit?
Visit 1: Please describe the reason for your visit:
Visit 1: Do you remember the date of this visit?  
☐ Yes  ☐ No
Visit 1: What was the date of the visit?

Visit 2: Which Emergency Department did you visit?
Visit 2: Please describe the reason for your visit:
Visit 2: Do you remember the date of this visit?  
☐ Yes  ☐ No
Visit 2: What was the date of the visit?

Visit 3: Which Emergency Department did you visit?
Visit 3: Please describe the reason for your visit:
Visit 3: Do you remember the date of this visit?  
☐ Yes  ☐ No
Visit 3: What was the date of the visit?

COMMENTS:

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#### Admitted to Hospital

Since your child’s Emergency Department visit on ________ (date), has □ Yes □ No □ NA your child been admitted to hospital?

OR

Since our last phone call on ________ (date), has your child been admitted to hospital?

Why NA?

How many times were they admitted to hospital?

☐ 1

☐ 2

☐ 3

Admission 1: Which hospital were they admitted to?

Admission 1: Please describe the reason for the admission:

Admission 1: Do you remember the date of this admission? □ Yes □ No

Admission 1: What was the date of admission?

Admission 2: Which hospital were they admitted to?

Admission 2: Please describe the reason for the admission:

Admission 2: Do you remember the date of this admission? □ Yes □ No

Admission 2: What was the date of admission?

Admission 3: Which hospital were they admitted to?

Admission 3: Please describe the reason for the admission:

Admission 3: Do you remember the date of this admission? □ Yes □ No

Admission 3: What was the date of admission?

#### Health Professional

Since your child’s Emergency Department visit on ________ (date), □ Yes □ No □ NA

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has your child seen a health professional other than in the Emergency Department or in-hospital?

OR

Since our last phone call on (date) has your child seen a health care professional other than in the Emergency Department or in-hospital?

Why NA?

How many visits with a health professional have you had?

Visit 1: What type of health professional did you see?

Visit 1: If specialist, please specify:

Visit 1: If other, please specify:

Visit 1: Please describe the reason for your visit:

Visit 1: Do you remember the date of this visit?

Visit 1: What was the date of this visit?

Visit 2: What type of health professional did you see?

Visit 2: If specialist, please specify:

Visit 2: If other, please specify:

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Visit 2: Please describe the reason for your visit:

Visit 2: Do you remember the date of this visit?
☐ Yes  ☐ No

Visit 2: What was the date of this visit?

Visit 3: What type of health professional did you see?
☐ Family Doctor
☐ Specialist
☐ Nurse Practitioner
☐ Chiropractor
☐ Physiotherapist
☐ Other

Visit 3: If specialist, please specify:

Visit 3: If other, please specify:

Visit 3: Please describe the reason for your visit:

Visit 3: Do you remember the date of this visit?
☐ Yes  ☐ No

Visit 3: What was the date of this visit?

Problem Resolved

Did the problem your child had on your Emergency Department visit resolve?
☐ Yes  ☐ No  ☐ NA

Why NA?

Can you tell me what happened?

What did you do?

New Health Problems

Since your Emergency Department visit, has your child had any new health problems develop?
☐ Yes  ☐ No  ☐ NA

OR

Since our last phone call on (date), has your child had any new health problems develop??

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Why NA?

Please describe the problem(s) (i.e. when did it start? what are the symptoms?)

What do you think is/are the cause(s) of this problem(s)?

What did you do?

For the new health problem: On a scale of 0-5 (0 = not serious at all, 5 = very serious), how seriously is this problem affecting your child’s quality of life?

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

Worsening Pre-existing Health Problems

Since your/your child’s Emergency Department visit, has your child had any worsening of pre-existing health problems?

☐ Yes  ☐ No  ☐ NA

OR

Since our last phone call on (date), has your child had any worsening of pre-existing health problems?

Why NA?

Please describe the problem(s) (i.e. when did it start? what are the symptoms?)

What do you think is/are the cause(s) of this problem(s)?

What did you do?

For the worst pre-existing health problem: On a scale of 0-5 (0 = not serious at all, 5 = very serious), how seriously is this problem affecting your child’s quality of life?

☐ 0
☐ 1
☐ 2

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☐ 3
☐ 4
☐ 5

Mental Health Questions – ONLY IF PATIENT PRESENTED WITH A MENTAL HEALTH ISSUE (includes family conflict, behavioural changes, alcohol, intoxication, ingestion, anxiety, depression, etc.)

** FOR RA ONLY** Was the child’s visit due to a mental health issue?
☐ Yes ☐ No

Since your child’s visit on ________ (date) did they attempt any self-harm?
☐ Yes ☐ No

OR

Since our last phone call on ________ (date) did your child attempt any self-harm?
☐ Yes ☐ No

What happened? (i.e. when, the event, injuries)

Since your child’s visit on ________ (date) did they attempt to harm anyone else?
☐ Yes ☐ No

OR

Since our last phone call on ________ (date), did your child attempt to harm anyone else?
☐ Yes ☐ No

What happened? (i.e. when, the event, injuries)

Since our last phone call on ________ (date) did anyone harm or attempt to harm your child?
☐ Yes ☐ No

What happened? (i.e. when, the event, injuries)

Did the child or family need to contact the police since their visit to the ED?
☐ Yes ☐ No

OR

Did the child or family need to contact the police since our last phone call?
☐ Yes ☐ No

What happened? (i.e. when, the event, etc.)

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Did the child or family contact a mental health crisis line since their visit to the ED?
☐ Yes  ☐ No

OR
Did the child or family contact a mental health crisis line since the last phone call?

Please elaborate:

**Possible Adverse Events Identified by Family – Please read the following script:**

“For the next section, I am going to describe a possible medical scenario and ask whether or not you believe your child experienced this during their ED visit”

_A medication problem occurs_ when a medication is not given exactly as it was meant to be given. For example, a medication may be given in the incorrect amount or the patient had an allergic reaction to the medication.

Do you think a medication problem occurred or was stopped before occurring?
☐ Yes  ☐ No  ☐ NA

Why NA?

Please describe the medication problem:

_A complication of care occurs_ when there is unwanted result of treatment. For example, unexpected bleeding occurred; the patient was transferred to the intensive care unit because of a complication.

Do you think a complication of care occurred or was stopped before occurring?
☐ Yes  ☐ No  ☐ NA

Why NA?

Please describe the complication of care:

_An equipment problem_ occurs when equipment fails or is not used correctly. For example, equipment not available when needed; an intravenous line leaked or became blocked.

Do you think an equipment problem occurred or was stopped before occurring?
☐ Yes  ☐ No  ☐ NA

Why NA?

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Please describe the equipment error:

A miscommunication between staff occurs when members of the staff give or receive information from other staff about diagnosis, treatment, or care that is inadequate (not enough information), conflicting (information that is different from what someone else gave) or incorrect. For example a test was repeated because the original result was lost or destroyed; a test was cancelled by mistake.

Do you think a miscommunication between staff occurred or was stopped before occurring?

☐ Yes ☐ No ☐ NA

Why NA?

Please describe the miscommunication:

Miscommunications between staff and your family occur when you or your family gives or receives information from staff about diagnosis, treatment or care that is inadequate (not enough information), conflicting (information that is different from what someone else gave) or incorrect. Examples: Medication instructions were not explained to you or your family.

Do you think a miscommunication between your family and staff occurred or was stopped before occurring?

☐ Yes ☐ No ☐ NA

Why NA?

Please describe the miscommunication:

Was there any other action that may have caused health care problems for your child? For example, the child fell off a stretcher?

☐ Yes ☐ No ☐ NA

Why NA?

Please describe the other action:

COMMENTS:

End of Interview

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Supplementary material 4: Outcome and preventability scales

Outcome assessment: confidence that outcome is related to health care received

1. No evidence for causation
2. Slight evidence for causation
3. Management causation <50-50 but close call
4. Management causation >50-50 but close call
5. Strong evidence for management causation
6. Certain evidence for management causation

Preventability scale: Confidence that outcome was preventable

1. Definitely not preventable
2. Probably not preventable
3. Probably preventable
4. Definitely preventable

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Supplementary material 5: Baseline characteristics for eligible, non-enrolled patients (N=369) and comparison to enrolled patients

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Non-enrolled patients</th>
<th>Enrolled patients</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, median (IQR)</strong></td>
<td>369</td>
<td>1367</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>6.21 (1.90-12.85)</td>
<td>4.34 (1.50-10.57)</td>
<td></td>
</tr>
<tr>
<td><strong>Female Sex</strong></td>
<td>369</td>
<td>1367</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>175 (47.4)</td>
<td>676 (49.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Disposition</strong></td>
<td>367</td>
<td>1367</td>
<td>0.03</td>
</tr>
<tr>
<td>Discharged</td>
<td>324 (88.3)</td>
<td>1281 (93.7)</td>
<td></td>
</tr>
<tr>
<td>Admitted</td>
<td>35 (9.5)</td>
<td>68 (5.0)</td>
<td></td>
</tr>
<tr>
<td>Left without being seen/against medical advice</td>
<td>8 (2.2)</td>
<td>18 (1.3)</td>
<td></td>
</tr>
<tr>
<td><strong>PedsCTAS</strong></td>
<td>1367</td>
<td></td>
<td>0.004</td>
</tr>
<tr>
<td>1 – Resus</td>
<td>4 (1.1)</td>
<td>4 (0.3)</td>
<td></td>
</tr>
<tr>
<td>2 – Emergent</td>
<td>53 (14.4)</td>
<td>84 (6.1)</td>
<td></td>
</tr>
<tr>
<td>3 – Urgent</td>
<td>167 (45.4)</td>
<td>691 (50.5)</td>
<td></td>
</tr>
<tr>
<td>4 – Semi Urgent</td>
<td>115 (31.3)</td>
<td>495 (36.2)</td>
<td></td>
</tr>
<tr>
<td>5 – Non Urgent</td>
<td>29 (7.9)</td>
<td>93 (6.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Presenting complaint</strong></td>
<td>368</td>
<td>1367</td>
<td></td>
</tr>
<tr>
<td>(4 most common)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>44 (12.0)</td>
<td>207 (15.1)</td>
<td>0.99</td>
</tr>
<tr>
<td>Difficulty breathing/ SOB</td>
<td>28 (7.6)</td>
<td>108 (7.9)</td>
<td>0.99</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>24 (6.5)</td>
<td>72 (5.3)</td>
<td>0.99</td>
</tr>
<tr>
<td>Cough/congestion</td>
<td>24 (6.5)</td>
<td>135 (9.9)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

*unless otherwise indicated

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Supplementary material 6: Description of flagged up and triggers identified among 584 patients.

<table>
<thead>
<tr>
<th></th>
<th>Flagged outcomes, n=1244*</th>
<th>Triggers, n =14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unplanned admission</td>
<td>n=31</td>
<td>Transfer to higher level care, n=1</td>
</tr>
<tr>
<td>Return ED visit</td>
<td>n=169</td>
<td>Intubation/accidental extubation, n=1</td>
</tr>
<tr>
<td>Unplanned visit to health care provider</td>
<td>n=153</td>
<td>Unplanned surgery, n=1</td>
</tr>
<tr>
<td>Unresolved symptoms</td>
<td>n=619</td>
<td>Hospital acquired infection, n=3</td>
</tr>
<tr>
<td>New symptoms</td>
<td>n=138</td>
<td>Transfusion of blood products, n=2</td>
</tr>
<tr>
<td>Worsening of pre-existing condition</td>
<td>n=7</td>
<td>Abrupt drop in hemoglobin, n=3</td>
</tr>
<tr>
<td>Self-harm/ harm to others/police/crisis line</td>
<td>n=20</td>
<td>Low/high potassium, n=2</td>
</tr>
<tr>
<td>Family identified concern</td>
<td>n=107</td>
<td>Dissatisfaction with care, n=1</td>
</tr>
</tbody>
</table>

*Patients and families could report triggers on any of three phone calls. For example, one patient could report “unresolved symptoms” on each of three calls.
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Supplementary material 7: Probability of adverse event by age
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Supplementary material 8: Results of multivariate logistic regression* for variables associated with occurrence of adverse events

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Odds ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Linear term</td>
<td>0.96 (0.87-1.05)</td>
<td></td>
</tr>
<tr>
<td>Quadratic term</td>
<td>1.02 (1.01-1.04)</td>
<td></td>
</tr>
<tr>
<td>Mental health visit</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.28 (0.40-8.96)</td>
<td></td>
</tr>
<tr>
<td>Arrival by Ambulance</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.87 (0.86-7.71)</td>
<td></td>
</tr>
<tr>
<td>Time to discharge or admission</td>
<td>1.09 (0.96-1.19)</td>
<td>0.17</td>
</tr>
<tr>
<td>Weekend</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>No (Mon-Fri)</td>
<td>Ref</td>
<td></td>
</tr>
<tr>
<td>Yes (Sat-Sun)</td>
<td>0.40 (0.13-0.99)</td>
<td></td>
</tr>
</tbody>
</table>

* All logistic regression analyses adjusted for shift (day, evening, night) to account for oversampling of night shifts