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Early Warning/Intervention Systems (presentation slides from NACOLE Symposium 2016 held at John Jay College)

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Early Warning/Intervention Systems
Predicting Adverse Incidents Between Police and the Public

Center for Data Science & Public Policy

in collaboration with Charlotte-Mecklenburg Police Department, White House OSTP
White House Police Data Initiative

1. Open Data
2. Early Intervention/Warning Systems to prevent adverse interactions

These are two separate programs!
Defining Adverse Interactions

- Citizen Complaint
- Officer Complaint

Non-Complaint Related Incidents
- Use of Force
- Pursuits
- Rules of Conduct Violation
- Raid and Search
- Accidents
- Injuries

Internal Affairs

Sustained/Not Justified/Preventable?

Our definition of an "adverse" interaction
# Current EIS

## Early Intervention System

<table>
<thead>
<tr>
<th>EIS Status Summary For:</th>
<th></th>
<th>Freedom Division</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accidents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Frame</td>
<td>180 Days</td>
<td></td>
</tr>
<tr>
<td>No of Accidents</td>
<td>0</td>
<td>No of Complaints</td>
</tr>
<tr>
<td>Threshold</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Threshold</td>
</tr>
<tr>
<td><strong>Injuries</strong></td>
<td>100 Days</td>
<td></td>
</tr>
<tr>
<td>Time Frame</td>
<td>100 Days</td>
<td>Use of Force</td>
</tr>
<tr>
<td>No of Injuries</td>
<td>1</td>
<td>Time Frame</td>
</tr>
<tr>
<td>Threshold</td>
<td>2</td>
<td>No of Uses of Force</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Threshold</td>
</tr>
<tr>
<td><strong>Pursuits</strong></td>
<td>180 Days</td>
<td>Combinations</td>
</tr>
<tr>
<td>Time Frame</td>
<td>180 Days</td>
<td>Time Frame</td>
</tr>
<tr>
<td>No of Pursuits</td>
<td>1</td>
<td>No of Events</td>
</tr>
<tr>
<td>Threshold</td>
<td>2</td>
<td>Threshold</td>
</tr>
<tr>
<td><strong>Sick Leave/Days Off</strong></td>
<td>90 Days</td>
<td>Sick Leave/Vacation</td>
</tr>
<tr>
<td>Time Frame</td>
<td>90 Days</td>
<td>Time Frame</td>
</tr>
<tr>
<td>No of Events</td>
<td>0</td>
<td>No of Events</td>
</tr>
</tbody>
</table>

### Complaints

- **Time Frame**: 180 Days
- **No of Complaints**: 2
- **Threshold**: 3
Issues with Threshold-based EIS

• Not effective at providing early warning, which results in interventions being punitive and not preventive
  – **False positives**: ~40% of officers were flagged at some point in a one year time period
  – **Missed adverse interactions**: Only ~50% of those officers that went on to have an adverse incident in that time period were flagged by the system

• At least one vendor hard codes the thresholds and indicators into their systems, making changes difficult and costly.
Prioritization and Gaming

• Threshold-based systems assign yes/no flags rather than continuous risk scores

• Risk scores enable the department to:
  – Prioritize officers by risk
  – Explicitly tradeoff between accuracy and false positives

• Prone to gaming by officers
Our Approach: Data Science based Early Intervention System

• Use data science methods from other industries (both corporate and government) for early warning prediction systems

• Use historical data from adverse interactions, officer demographics, and behaviors to build predictive models that can predict:
  – Risk score for each officer at arbitrary time periods in the future (in the next 3 months, 6 months, 2 years, etc.)

• Human experts come up with ‘seed’ indicators and the algorithms expands them, creates, validates, and tunes the predictive model that adapts and improves over time.
CMPD Data

- 2002
  - Traffic Stops (1.6M)
  - Dispatches (13M)
  - Internal Affairs (20K)
  - Arrests (350K)
  - Crime Reports (1M)

- 2015
  - Field Interviews (180K)
  - Census/ACS
    - + Personnel and Organization
Validation Methodology

• Pretend it’s December 31, 2009:
  – build a model using the data available on that day,
  – see how well it predicts for 2010

• Pretend it’s December 31, 2010:
  – build a model using the data available on that day,
  – see how well it predicts for 2011

• Move forward a year and repeat
Results: We can reduce false positives by ~30% while increasing accuracy by ~10-15%

<table>
<thead>
<tr>
<th>Description</th>
<th>Improvement in DSaPP model over threshold system</th>
</tr>
</thead>
<tbody>
<tr>
<td>True positives - Officers correctly flagged</td>
<td>+12%</td>
</tr>
<tr>
<td>False Positives - Officers incorrectly flagged</td>
<td>-32%</td>
</tr>
<tr>
<td>True negatives - Officers correctly not flagged</td>
<td>+25%</td>
</tr>
<tr>
<td>False negatives - Officers incorrectly not flagged</td>
<td>-8%</td>
</tr>
</tbody>
</table>
Predictive Officer-Level Indicators

• Features related to prior history of problems increase risk:
  – Adverse incidents, complaints, suspensions, unjustified uses of force in the past
  – Notes in IA relating to concerns about communication or tactics

• Features related to stress increase risk:
  – High numbers of suicide calls, domestic violence calls
  – Calls with low mean victim age

• Some trainings decrease risk:
  – Less than lethal weapons training
Predictive EIS can support predictions at different levels

- Officer level
- Dispatch level
- Group level
Contact Information

Center for Data Science & Public Policy

http://dsapp.org

Interested in participating?

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Project Manager: Lauren Haynes  lnhaynes@uchicago.edu
Tradeoff: False positives and true positives
Predictive Officer Level Characteristics

**Officer 1**
- High number of prior adverse incidents in last 15 years
- Officer was suspended in last 15 years
- High number of counseling interventions after special investigations
- IA noted concerns with communication
- High number of special investigations correctives written in last 15 years

**Officer 2**
- High number of arrests in last year
- High number of rule of conduct violations in last 15 years
- High number of prior adverse incidents in last 15 years
- IA noted concerns with tactics
- High number of sustained complaints in the last 15 years

**Officer 3**
- High number of prior adverse incidents in last 1 year
- High number of rule of conduct violations in last 15 years
- Officer was suspended in last 15 years
- Officer uses pepper spray often
- High number of sustained complaints in the last 15 years

**Officer 4**
- High number of accidents in last 1 year
- IA noted concerns with communication
- High number of accidents in last 15 years
- Officer has dealt with high number of suicide incidents
- High number of preventable accidents in last 1 year

**Officer 5**
- Officer has dealt with high number of domestic violence incidents
- High number of preventable accidents in last 1 year
- Officer uses weapons often
- Officer was suspended in last 15 years
- High number of prior adverse incidents in last 15 years
Other Benefits

- Flag low-risk officers as part of a Performance Management System
- Flag groups for designing new group interventions
- Train supervisors
- Improve dispatch decisions
- Cheaper to build, implement, maintain
Implementation
Discussion: Can we specify a set of requirements EIS systems should follow?

• Data that should be used
• Customizable
• Adaptive
• Able to prioritize officers
• Interpretable/Auditable
• Validation Process?
  – How early it can predict?
  – At what levels of:
    • Accuracy
    • False positive rate
• How effective are the interventions?