Health and Transportation Data Linkage in North Carolina

Transportation Research Board Annual Meeting
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UNC Highway Safety Research Center
Chapel Hill, NC
What Do We Mean By Data Linkage & Integration?
What is Data Linkage/Integration?

**Definition:** A process of combining information believed to be related to the same person (or place, family, event, etc.) from two or more separate data sources.

*Data linkage* is one step in the process of *data integration*, which is the ongoing, systematic linkage of data sources for the purpose of improved research, program management, evaluation, and policy development.

-However-

These terms are often used interchangeably.
Data Linkage Versus Integration

**Data Linkage**

- Emergency Medical Services

**Data Integration**

- MVA Licensing
- MC Training
- Vital Statistics
- Autopsy Records
- Toxicology
- ED Data
- Hospital Records

Statewide databases + integration = improved problem ID and program evaluation

University of Maryland slide showing the need to go beyond crash and medical records data linkage

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Why Link Crash Data with Other Data Sources?

Most data sources are limited in scope; by linking multiple data sources, we create a much richer dataset that can then be used to answer important questions.
## Hypothetical Linked Crash-Health Outcome Record

<table>
<thead>
<tr>
<th>Name</th>
<th>DOB</th>
<th>Zip Code</th>
<th>Time of Crash</th>
<th>Person Type</th>
<th>KABC</th>
<th>Location</th>
<th>Alc Test Status</th>
<th>Striking Vehicle Type</th>
<th>Diagnosis 1</th>
<th>Diagnosis 2</th>
<th>Diagnosis 3</th>
<th>Transport</th>
<th>Disposition</th>
<th>Payment</th>
<th>Hospital Charges for Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Smith</td>
<td>1/1/1950</td>
<td>27705</td>
<td>20:00</td>
<td>Pedestrian</td>
<td>B</td>
<td>Marked crosswalk at intersection</td>
<td>No test</td>
<td>SUV</td>
<td>S02.101, Fracture of base of skull, right side</td>
<td>Y90.5 -Blood alcohol level of 100-119 mg/100 ml</td>
<td>E11.9 -Type 2 diabetes mellitus without complications</td>
<td>Ground ambulance</td>
<td>Admitted to hospital</td>
<td>Medicare</td>
<td>$95,000</td>
</tr>
</tbody>
</table>

*Comorbidity – may complicate recovery*

**BAC taken at hospital**

**Mean US hospital charge for skull fracture (2010)**

Internal injuries not visible to LE
How Are Linked Crash-Health Outcome Data Used?
How Are Linked Crash-Health Outcome Data Used?

• In the 2000s, NHTSA funded 11 states to link crash and health outcome data as part of the Crash Outcome Data Evaluation System (CODES).*

• These data were used to address many transportation safety problems at the state and national level.

• For example, these data† were used to describe the epidemiology of MVC-related injuries among children 1-12 years of age.²,³

*Study utilized CODES data from 11 states (Connecticut, Georgia, Kentucky, Maryland, Minnesota, Missouri, Nebraska, New York, Ohio, South Carolina, and Utah).

†Data sources used for this specific study were linked crash, emergency department discharge, and hospital discharge data.
90th Percentile Hospital Charges (2008 Dollars) Among Children Aged 1-12 Years Injured in MVCs, Backseat Crashes, Only: CODES 2005-2008

<table>
<thead>
<tr>
<th>Age group</th>
<th>Restrained - Optimal</th>
<th>Restrained - Suboptimal</th>
<th>Unrestrained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 years</td>
<td>$1,336</td>
<td>$1,766</td>
<td>$9,432</td>
</tr>
<tr>
<td>4-7 years</td>
<td>$1,630</td>
<td>$2,036</td>
<td>$9,957</td>
</tr>
<tr>
<td>8-12 years</td>
<td>$2,256</td>
<td>N/A</td>
<td>$8,922</td>
</tr>
</tbody>
</table>

On average, unrestrained children had hospital charges that were six times greater than optimally restrained children.
How Are Linked Crash-Health Outcome Data Used?

Citywide Totals
Pedestrian: all times
Fatalities: 103
Injures: 8,974

http://www.nycvzv.info/
North Carolina Motor Vehicle Crash Injury Surveillance System (NC-CISS)
Project Timeline

- **Year 0**
  - Crash/ED/EMS linkage pilot*

- **Year 1**
  - Convene stakeholders
  - Develop strategic implementation plan

- **Year 2**
  - Crash/EMS linkage pilot**

- **Year 3**
  - Crash/hospital encounter linkage pilot**
  - Crash/ED linkage pilot**

- **Year 4**
  - Crash/trauma registry linkage pilot
  - Crash/Medicaid linkage pilot†
  - Crash/ED/death linkage
  - Ped/bike linkage

- **Year 5?**
  - Develop research advisory board
  - Develop public facing data tool
  - Develop sustainability plan
  - Demonstrate success

*Wake county MVCs, only.
**Pedestrians/bicyclists, only.
†Pedestrians/bicyclists/motorcyclists, only.
How Are Linked Crash-Health Outcome Data Used (NHTSA)?

1. To describe transportation safety data problems.
2. To support transportation safety decisions, programs, and policies.
3. To educate decision-makers and the public about transportation safety.
4. To facilitate collaborations across organizations.
5. To improve data quality across crash and health outcome data sources.
Describe Transportation Safety Problems

The number of North Carolina pedestrian fatalities has increased >50% since 2009.

Number of NC Pedestrian Fatalities: 2009-2018

![Graph showing the number of NC pedestrian fatalities from 2009 to 2018, with a trend line indicating an increase.]
Describe Transportation Safety Problems

For each pedestrian fatality,

7-10 pedestrians are treated in the emergency department.*

*Police-reported crashes, only.
Describe Transportation Safety Problems

Frequency of pedestrians treated at NC emergency departments, by vehicle type and pedestrian injury severity* (n=6,923): Crash/NC DETECT, Oct. 2010 – Sept. 2015†

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Percent of Patients w/ Serious/Fatal Injuries</th>
<th>Percent of Patients w/ Non-Serious Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Car</td>
<td>37%</td>
<td>63%</td>
</tr>
<tr>
<td>Van</td>
<td>38%</td>
<td>62%</td>
</tr>
<tr>
<td>SUV</td>
<td>41%</td>
<td>59%</td>
</tr>
<tr>
<td>Pickup Truck</td>
<td>43%</td>
<td>57%</td>
</tr>
<tr>
<td>Other Truck</td>
<td>42%</td>
<td>58%</td>
</tr>
<tr>
<td>Other Vehicle**</td>
<td>43%</td>
<td>57%</td>
</tr>
</tbody>
</table>

*Fatal/serious injury based on NTSB definition.  
†See NC DETECT data attribution and disclaimer (slide 38).  
**Includes emergency response vehicles, buses, motorcycles, and other types of motor vehicles.
Describe Transportation Safety Problems

Number of pedestrians treated at NC emergency departments, by age group and pedestrian injury severity* (n=6,923): Crash/NC DETECT, Oct. 2010 – Sept. 2015†

- **Number of patients**
- **Percent w/ serious or fatal injury**

*Fatal/serious injury based on NTSB definition.†
†See NC DETECT data attribution and disclaimer (slide 38).
Describe Transportation Safety Problems

Frequency of pedestrians treated at NC emergency departments, by expected source of payment (n=6,923): Crash/NC DETECT, Oct. 2010 – Sept. 2015†

55% of pedestrians treated in NC EDs had expected sources of payment of Medicaid, Medicare, or self-pay.

Insurance Co. 26%
Self-Pay 28%
Medicaid 19%
Medicare 8%
Other* 19%

*Other forms of payment include workers’ compensation, no charge, other government payment, and other types of payment.
†See NC DETECT data attribution and disclaimer (slide 38).
% of pedestrians diagnosed with lower leg injuries: 17% (36% admitted/died)

% of pedestrians diagnosed with fractures to the hand: 1.5% (29% admitted/died)

% of pedestrians diagnosed with TBIs: 9% (58% admitted/died)

*See NC DETECT data attribution and disclaimer (slide 38).*
How are we using linked crash-health outcome data?

1. To describe transportation safety data problems.
2. To support transportation safety decisions, programs, and policies.
3. To educate decision-makers and the public about transportation safety.
4. To facilitate collaborations across organizations.
5. To improve data quality across crash and health outcome data sources.¹
Support Transportation Safety Decisions

• In 2016, North Carolina updated their crash injury severity rating (KABCO) to be consistent with the Model Minimum Uniform Crash Criteria (MMUCC).
• NC DOT requested that we use health outcome data to assess new KABCO.
Support Transportation Safety Decisions

KABCO and Maximum Abbreviated Injury Scale (MAIS): Crash/NCHA (n=810), 2017 (Pedestrians, Only)

KABCO

<table>
<thead>
<tr>
<th>KABCO</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>K - Fatal injury</td>
<td>18</td>
<td>3%</td>
</tr>
<tr>
<td>A - Serious injury</td>
<td>77</td>
<td>12%</td>
</tr>
<tr>
<td>B - Minor injury</td>
<td>300</td>
<td>45%</td>
</tr>
<tr>
<td>C - Possible injury</td>
<td>248</td>
<td>37%</td>
</tr>
<tr>
<td>O - No injury</td>
<td>21</td>
<td>3%</td>
</tr>
</tbody>
</table>

MAIS

<table>
<thead>
<tr>
<th>MAIS</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 - Not survivable</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>5 - Critical injury</td>
<td>12</td>
<td>2%</td>
</tr>
<tr>
<td>4 - Severe injury</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>3 - Serious injury</td>
<td>64</td>
<td>10%</td>
</tr>
<tr>
<td>2 - Moderate injury</td>
<td>174</td>
<td>26%</td>
</tr>
<tr>
<td>1 - Minor injury</td>
<td>362</td>
<td>55%</td>
</tr>
<tr>
<td>0 - No injury</td>
<td>21</td>
<td>7%</td>
</tr>
</tbody>
</table>

KABCO had relatively similar distributions to MAIS.
How are we using linked crash-health outcome data?

1. To describe transportation safety data problems.
2. To support transportation safety decisions, programs, and policies.
3. To educate decision-makers and the public about transportation safety.
4. To facilitate collaborations across organizations.
5. To improve data quality across crash and health outcome data sources.¹
Educate Decision-Makers & the Public

Brief Report: A Demonstration Project Examining Linkage Report Data For Motor Vehicle Crashes Involving Pedestrians & Bicyclists

As part of a larger Governor’s Highway Safety Program (GHSP) funded project to link motor vehicle and health outcome data, we performed a demonstration project examining the utility of link (NC) Office of Emergency Medical Services (OEMS) and crash reports collected by the NC Division of Vehicle (DIV) for describing the health outcomes of pedestrians and bicyclists involved in motor vehicle crashes.

The main objectives of this study were to:
- Identify the strengths/limitations of the NC OEMS data for data linkage,
- Identify and describe the methods used to link the NC OEMS and NC DIV data,
- Review the results of the linked NC OEMS and NC DIV data for pedestrian and bicyclist crashes, and
- Make recommendations for future data linkages involving NC OEMS and NC DIV data.

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http://cchi.web.unc.edu/transportation-health-data/
How are we using linked crash-health outcome data?

1. To describe transportation safety data problems.
2. To support transportation safety decisions, programs, and policies.
3. To educate decision-makers and the public about transportation safety.
4. To facilitate collaborations across organizations.
5. To improve data quality across crash and health outcome data sources.¹
Facilitate Collaboration

• NC-CISS consists of a multi-organizational, multidisciplinary project team:
  – Injury & Violence Prevention Branch (NC DPH), Carolina Center for Health Informatics (UNC School of Medicine), the UNC Highway Safety Research Center, & the UNC Injury Prevention Research Center.

• To date, we have partnered with the following organizations:
  – Communicable Disease Branch (NC DPH)
  – NC Office of Emergency Medical Services (NC OEMS)
  – NC Trauma Registry
  – UNC Trauma Center
  – North Carolina Healthcare Association
  – UNC Sheps Center
Facilitate Collaboration

- In addition, we hold annual half-day meetings with project stakeholders representing an additional ~20 organizations in North Carolina.
  - E.g. NC Governors Highway Safety Program, NC Division of Motor Vehicles, NC State Highway Patrol, Institute for Transportation Research and Education.
How are we using linked crash-health outcome data?

1. To describe transportation safety data problems.
2. To support transportation safety decisions, programs, and policies.
3. To educate decision-makers and the public about transportation safety.
4. To facilitate collaborations across organizations.
5. To improve data quality across crash and health outcome data sources.¹
### Improve Data Quality

Develop (& maintain) standardized documentation for key North Carolina data sources for MVC and health outcome data linkage.

<table>
<thead>
<tr>
<th>Finalized (11)</th>
<th>In Progress/ Under Review (1)</th>
<th>Not Participating (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• NC DETECT Emergency Department Visit Data (NC DPH)</td>
<td>• Office of the Chief Medical Examiner Data</td>
<td>• NC Healthcare Association Hospital Encounter Data</td>
</tr>
<tr>
<td>• NC Trauma Registry Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• NC OEMS Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• UNC Sheps Center Medicaid and BCBS Claims Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• UNC Sheps Center Emergency Department/Hospital Discharge data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• NC State Center for Health Statistics Death Registration Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• NC State Center for Health Statistics Emergency Department/Hospital Discharge Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Highway Safety Information System (HSIS) Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• NC Pedestrian &amp; Bicycle Crash Data (PBCAT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• NC DMV Crash Report Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• FARS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• FARS
## Improve Data Quality

**Fields: Death registration data**

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Literal</th>
<th>Length</th>
<th>Source comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Death-Year</td>
<td>DOD_YR</td>
<td>4</td>
<td>4 digit year; current data year</td>
</tr>
<tr>
<td>State of Death</td>
<td>DSTATE</td>
<td>2</td>
<td>NCHS Instruction Manual Part 8</td>
</tr>
<tr>
<td>Certificate Number</td>
<td>CERTNUM</td>
<td>5</td>
<td>Not available for research outside of NC DHHS. 000001-999999</td>
</tr>
<tr>
<td>Decedent's Legal Name--First (Given)</td>
<td>GNAME</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Decedent's Legal Name--Middle Initial</td>
<td>MNAME</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Decedent's Legal Name--Last</td>
<td>LNAME</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Decedent's Legal Name--Suffix</td>
<td>SUFF</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Decedent's Legal Name--Alias</td>
<td>ALIAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father's Lastname/Surname</td>
<td>FLNAME</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>SEX</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

| Social Security Number     | SSN           | 9      | Requires approval for access. 00000000-9999999999         |

| Decedent's Age--Type       | AGETYPE       | 1      |                                                      |

| Decedent's Age--Units      | AGE           | 3      | 001-135,999                                          |
| Date of Birth-Year         | DOB_YR        | 4      | 4 digit year; <=year of death, 9999                  |
| Date of Birth-Month        | DOB_MO        | 2      | 01-12,99                                             |
| Date of Birth-Day          | DOB_DY        | 2      | 01-31 (based on month), 99                           |
| Birthplace--Country        | BPLACE_CNT    | 2      | NCHS Instruction Manual Part 8                       |
| Birthplace--State          | BPLACE_ST     | 2      | NCHS Instruction Manual Part 8                       |
| Decedent's Residence--City | CITYC         | 5      | NCHS Instruction Manual Part 8                       |
| Decedent's Residence--County | COUNTY      | 3      | NCHS Instruction Manual Part 8                       |

Conclusions

• Linking/integrating crash and health outcome data is an important transportation safety goal.

• However, it is challenging:
  – Requires data owner & user buy-in
  – Requires greater data privacy protections (HIPAA)
  – Requires transportation safety, statistical, epidemiological, and clinical expertise
  – Requires adequate time, personnel, planning, and other resources
  – Requires continued support to be successful over the long-term
  – Requires flexibility
Acknowledgments: Project Team

- **PI:** Anna Waller
- **Project Managers:** Kathy Peticolas & Erika Redding
- **Carolina Center for Health Informatics:** Dennis Falls, Amy Ising, Clifton Barnett
- **NC Division of Public Health:** Alan Dellapenna, Mike Fliss, Kendall Knuth, Scott Proescholdbell
- **NC Trauma Registry:** Sharon Schiro
- **UNC HSRC:** Kari Hancock, Seth LaJeunesse, Nancy Lefler, Eric Rodgman, Laura Sandt, Libby Thomas
- **UNC Injury Prevention Research Center:** Steve Marshall
- **Contributions from ~50 Project Stakeholders**
Acknowledgements: Funding

**Funding Sources:**

NC DPH Data Attribution & Disclaimer

NC DETECT is a statewide public health syndromic surveillance system, funded by the NC Division of Public Health (NC DPH) Federal Public Health Emergency Preparedness Grant and managed through collaboration between NC DPH and UNC-CH Department of Emergency Medicine’s Carolina Center for Health Informatics. The NC DETECT Data Oversight Committee does not take responsibility for the scientific validity or accuracy of methodology, results, statistical analyses, or conclusions presented.
Questions?

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(919) 962.0745
References


