Collaborative Sciences Center for ROAD SAFETY

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Health and Transportation Data Linkage in North Carolina

Transportation Research Board Annual Meeting

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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.

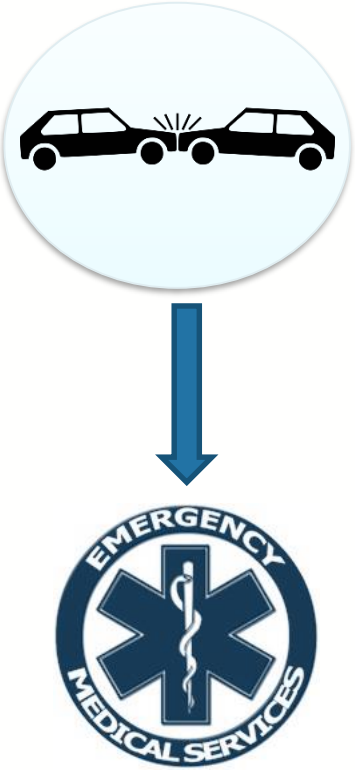
Data linkage is one step in the process of *data integration*, which is the ongoing, systematic linkage of data sources for the purpose of improved research, program management, evaluation, and policy development.

-However-

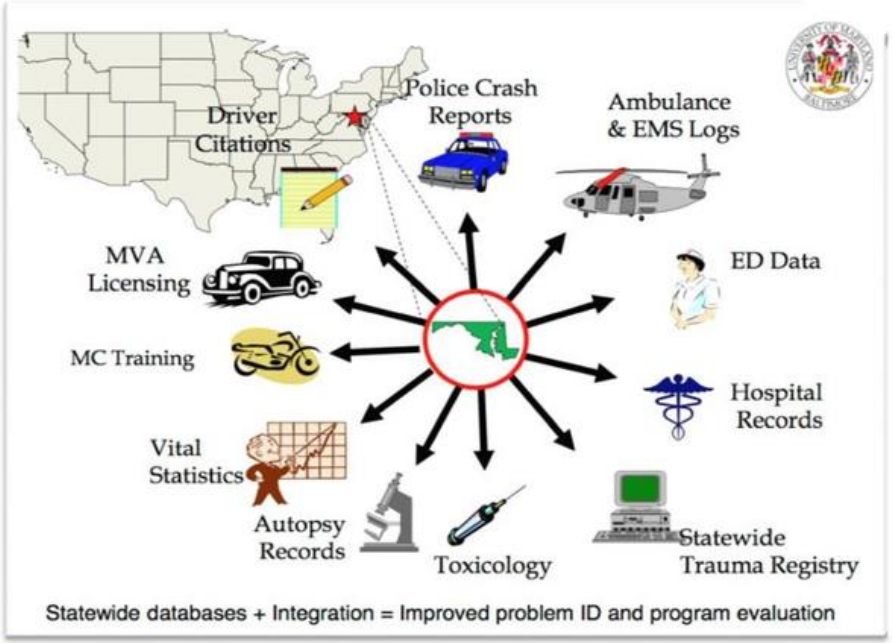
These terms are often used interchangeably.

Data Linkage Versus Integration

Data Linkage



Data Integration



UNIVERSITY of MARYLAND SCHOOL OF MEDICINE

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

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

Linkage variables | **Crash variables** | **Health outcome variables**

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

Internal injuries not visible to LE

BAC taken at hospital

Comorbidity – may complicate recovery

Mean US hospital charge for skull fracture (2010)[1]

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[3]

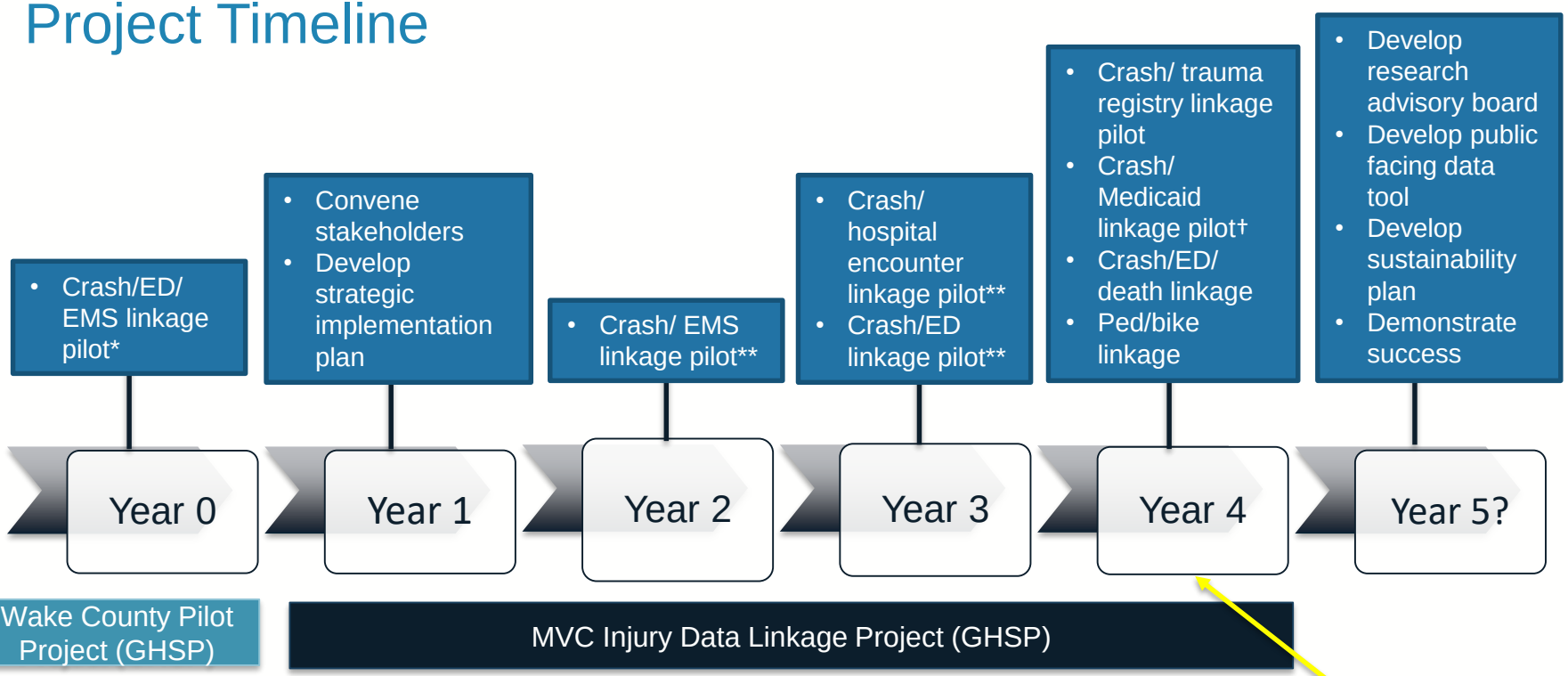
Age group	Restrained - Optimal	Restrained - Suboptimal	Unrestrained
1-3 years	$1,336	$1,766	$9,432
4-7 years	$1,630	$2,036	$9,957
8-12 years	$2,256	N/A	$8,922

On average, unrestrained children had hospital charges that were **six times** greater than optimally restrained children.

How Are Linked Crash-Health Outcome Data Used?

North Carolina Motor Vehicle Crash Injury Surveillance System (NC-CISS)

Project Timeline



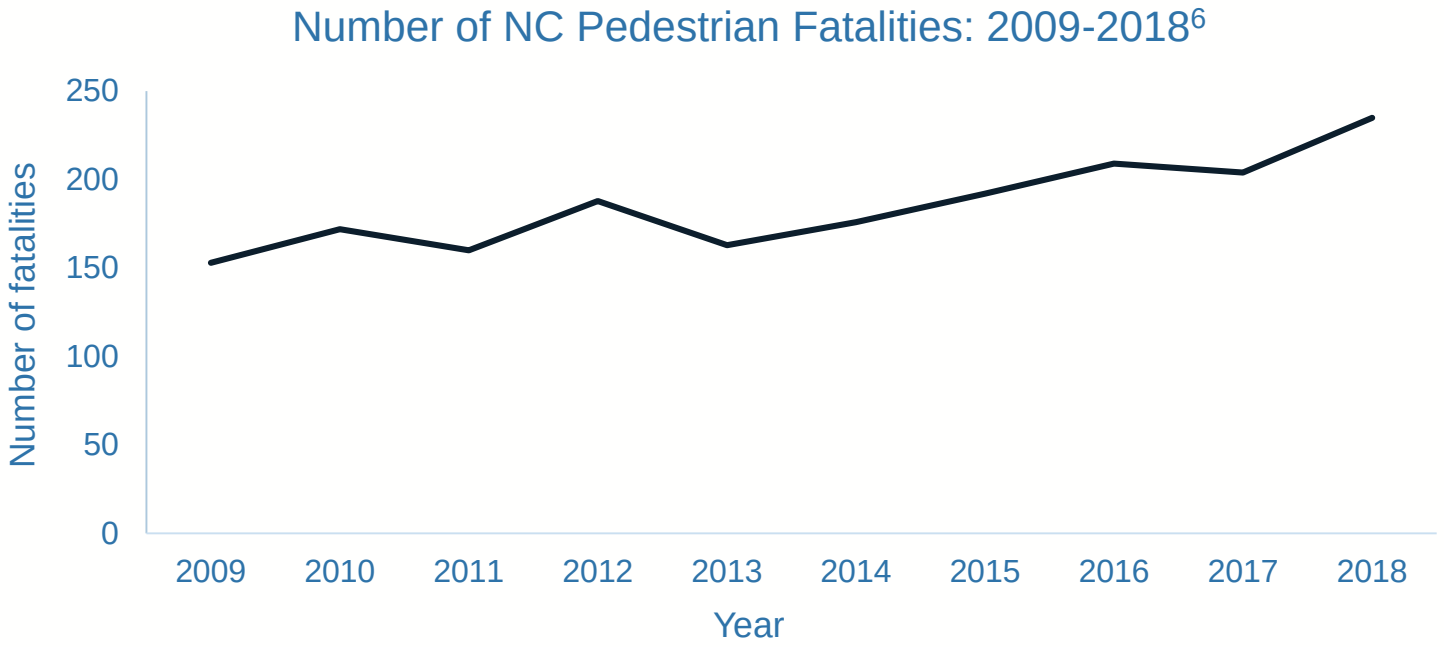
*Wake county MVCs, only.
**Pedestrians/bicyclists, only.
†Pedestrians/bicyclists/motorcyclists, only.

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.[1]**

Describe Transportation Safety Problems

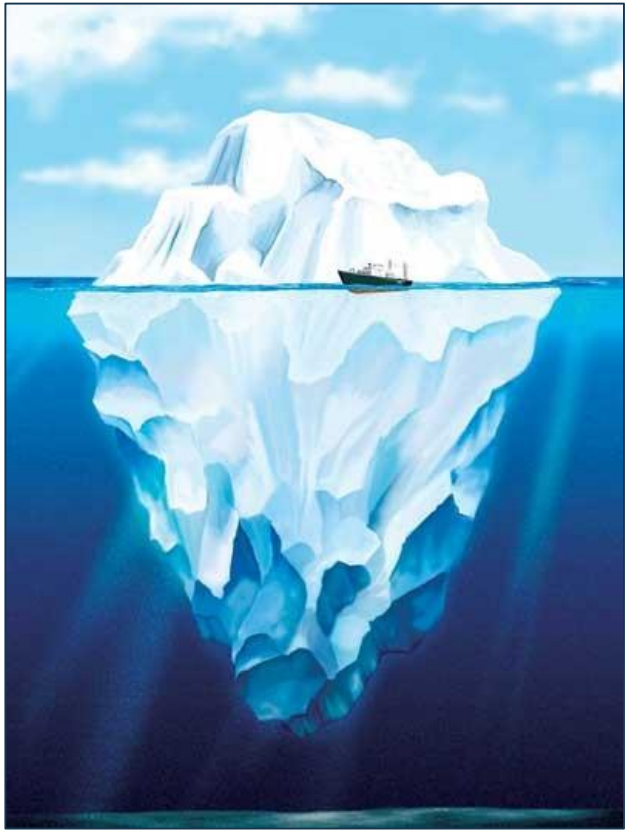
The number of North Carolina pedestrian fatalities has increased >50% since 2009.



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

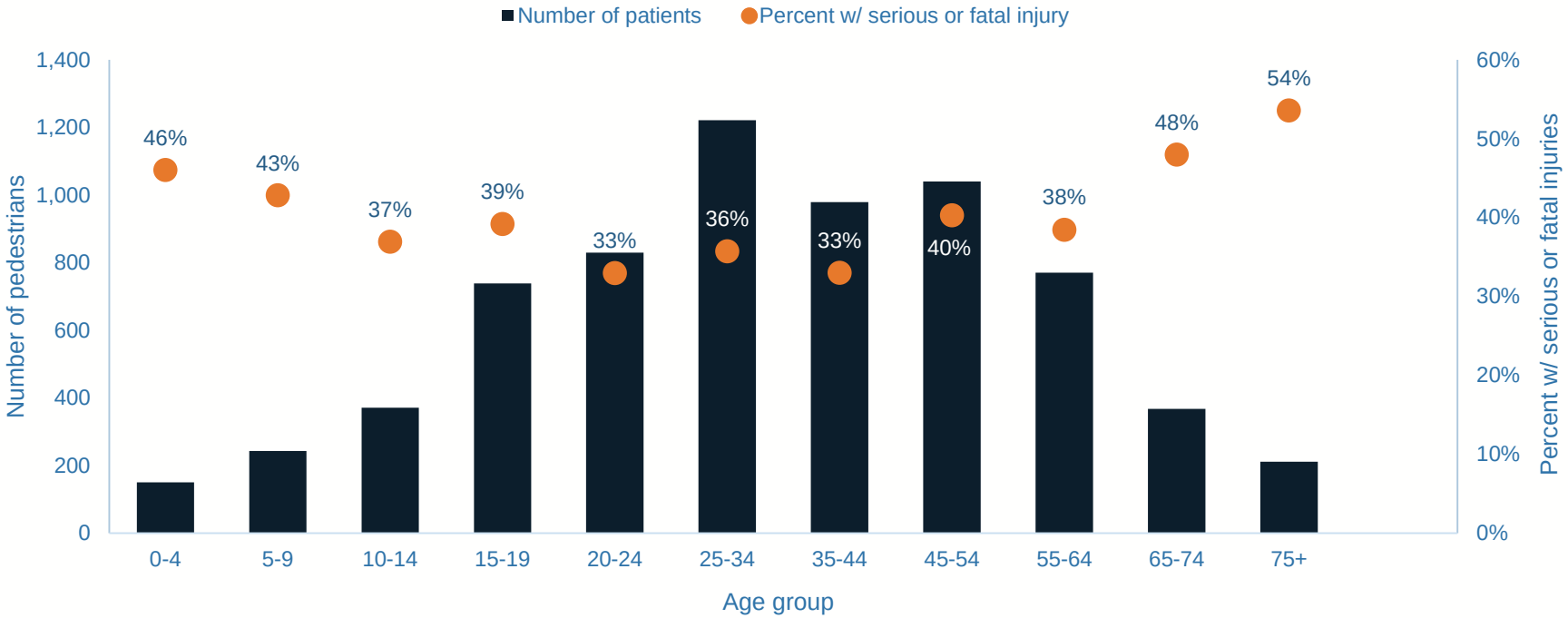
Frequency of pedestrians treated at NC emergency departments, by vehicle type and pedestrian injury severity* (n=6,923): Crash/NC DETECT, Oct. 2010 – Sept. 2015†

Vehicle Type	Percent of Patients w/ Serious/Fatal Injuries	Percent of Patients w/ Non-Serious Injuries
Passenger Car	37%	63%
Van	38%	62%
SUV	41%	59%
Pickup Truck	43%	57%
Other Truck	42%	58%
Other Vehicle**	43%	57%

*Fatal/serious injury based on NTSB definition.[7]
†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†



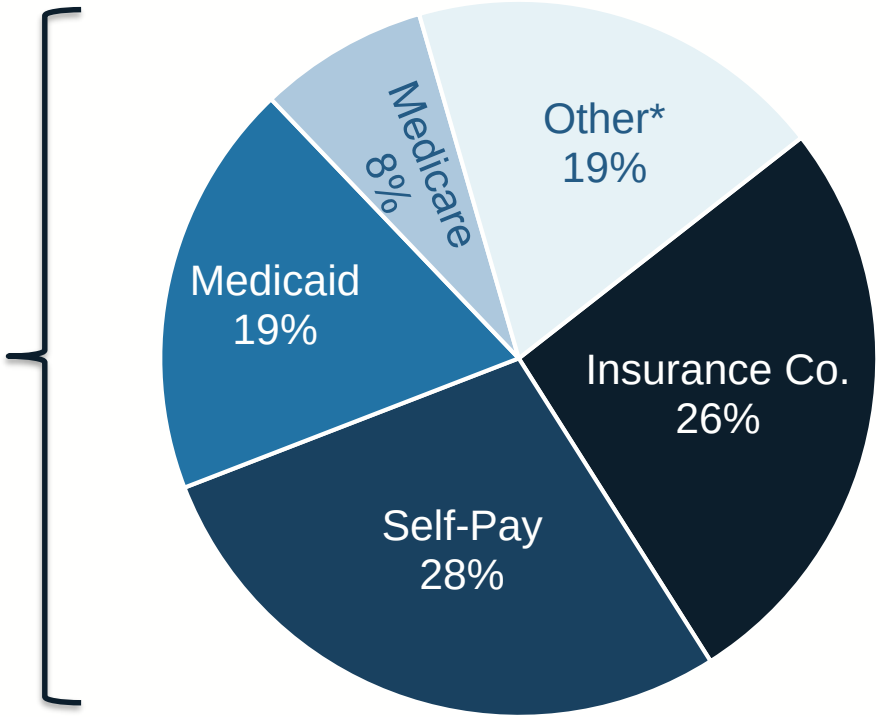
*Fatal/serious injury based on NTSB definition.[7]

†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.

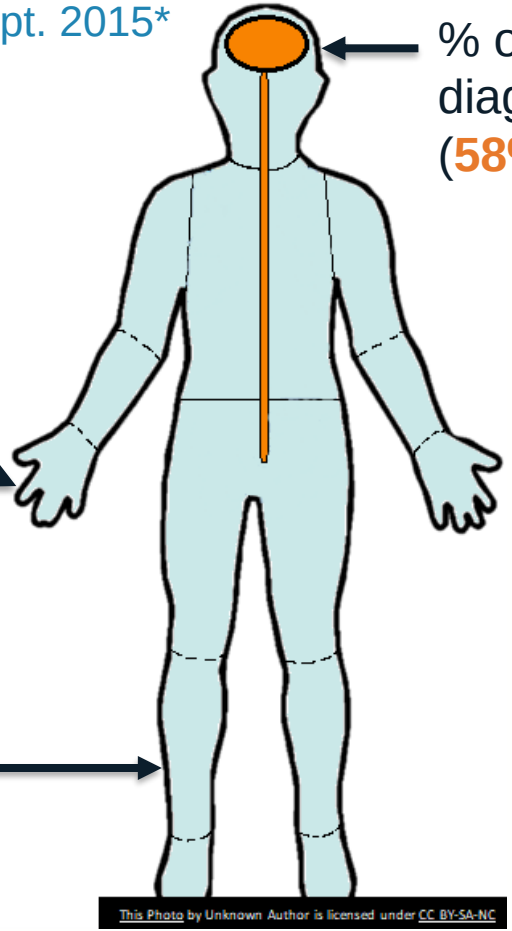


*Other forms of payment include workers' compensation, no charge, other government payment, and other types of payment.
†See NC DETECT data attribution and disclaimer (slide 38).

Frequency of pedestrians treated at NC emergency departments, by body region (n=6,923): Crash/NC DETECT, Oct. 2010 – Sept. 2015*

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

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



% of pedestrians diagnosed with lower leg injuries: **17%** (**36%** admitted/died)

*See NC DETECT data attribution and disclaimer (slide 38).

How are we using linked crash-health outcome data?

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5. **To improve data quality across crash and health outcome data sources.**[1]

Support Transportation Safety Decisions

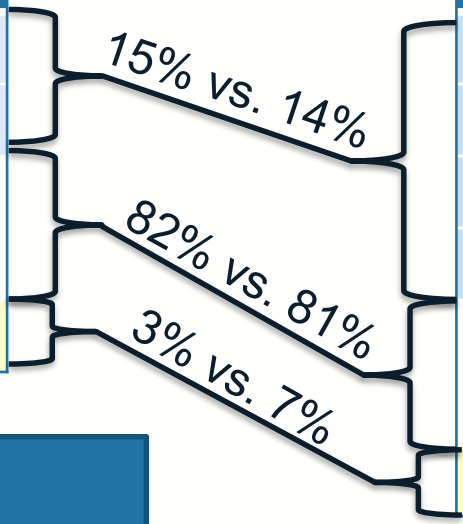
- In 2016, North Carolina updated their crash injury severity rating (KABCO) to be consistent with the Model Minimum Uniform Crash Criteria (MMUCC).
- NC DOT requested that we use health outcome data to assess new KABCO.

Support Transportation Safety Decisions

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

KABCO

KABCO	n	%
K - Fatal injury	18	3%
A - Serious injury	77	12%
B - Minor injury	300	45%
C - Possible injury	248	37%
O - No injury	21	3%



MAIS

MAIS	n	%
6 - Not survivable	0	0%
5 - Critical injury	12	2%
4 - Severe injury	4	1%
3 - Serious injury	64	10%
2 - Moderate injury	174	26%
1 - Minor injury	362	55%
0 - No injury	21	7%

KABCO had relatively similar distributions to MAIS.

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Educate Decision-Makers & the Public

Brief Report: A Demonstration Project Examining Linked Report Data For Motor Vehicle Crashes Involving Pede Bicyclists

As part of a larger Governor's Highway Safety Program (GHSP) funded project to link motor v 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 Div Vehicles (DMV) for describing the health outcomes of pedestrians and bicyclists involved in

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 DMV data,
- Describe the results of the linked NC OEMS and NC DMV data for pedestrian and b
- Make recommendations for future data linkages involving NC OEMS and NC DMV

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Evaluation of Pedestrian/Bicycle Crash Injury Case Definitions for Use with NC DETE

Harmon KJ[1,2,3], Bailey L[4], Bonifacio A[4], Ising A[3], Peticolas KA[3], Sandt L[1,2], Waller AE[3]

Highway Safety Research Center, Chapel Hill, NC
Collaborative Sciences Center for Road Safety, Chapel Hill, NC
Carolina Center for Health Informatics, Chapel Hill, NC
Trauma Program, UNC Health Care, Chapel Hill, NC

1 Introduction

- Since 2011, the number of NC pedestrian deaths have **increased an average of 6% per year**; reversing a 35-year trend.[1]
- Injury surveillance methods for pedestrian/bicycle crashes **need improvement**.
- We developed four **ICD-10-CM based pedestrian/bicycle crash injury case definitions for use with NC DETECT**, NC's syndromic surveillance system.[2]
- Objective: Evaluate ICD-10-CM pedestrian/bicycle crash case definitions by comparing to **Level I UNC Trauma Center** data ("gold standard").

2 Methods

- Linked to 2016-2017 UNC Trauma Center data using the variables date of visit, time of visit, and medical record number.
- Examined linked/unlinked UNC Trauma Center/NC DETECT data.

Flow chart of data linkage process

3 Results

Why were linked NC DETECT records not flagged as pedestrian/bicycle-related (n=102)?

Percent agreement for linked UNC Trauma ("gold standard") v NC DETECT records with mechanism codes (n=103)

List of pedestrian and bicycle crash injury-related keywords a

	Pedestrian	
Inclusive	PEDESTRIAN, 'PED STRUCK', 'PEDS STRUCK', 'PED VS MVC', 'PEDS VS MVC', 'PED VS CAR', or 'PEDS VS CAR'	
Exclusive	MOPED', 'SCOOTER', 'PEDAL', 'BICYCLE', or 'BIKE'	MOTORCYCLE, PEDAL PUSH BIKE', 'DIRT

Comparison of NC DETECT pedestrian/bicycle crash injury case of keywords

4

North Carolina Linkage Study for Motor Vehicle Crashes Involving Pedestrians and Bicyclists

UNC Highway Safety Research Center Cr
& NC Healthcare Association Hospital
Encounter Data

Katherine J. Harmon, PhD[1], Katherine Peticolas, PMP[2], and A
Waller, ScD[2]

01/07/2019

Carolina Center for Health Informatics | DRAFT | July 2019

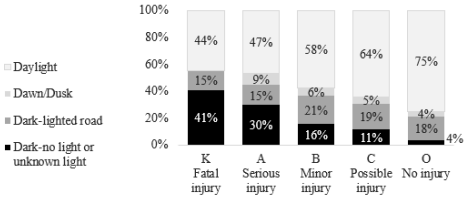
Pedestrian Injuries by Light Condition & Time of Day

Based on a Linked 2017 North Carolina Crash and NC Healthcare Association Hospital Encounter Dataset, n=810
All percentages have been rounded to the nearest integer value, so percentage totals may not sum to 100%

Law enforcement officers record the light condition at the scene of pedestrian injuries as part of their crash report. Injury data can be found in hospital encounter data.

Linked crash and health data provide metrics for examining the effects of light condition on pedestrian crash injuries.

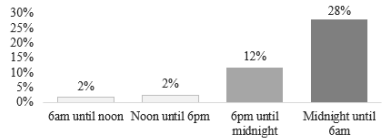
Law Enforcement-Assigned Injury Severity by Light Condition (n=799)*



Over one-half of all fatal and serious injuries occurred in low light conditions (dawn/dusk, dark-lighted, and dark-no light or unknown light).

* 11 records did not indicate injury severity

Percent of Pedestrians Suspected of Impairment by Time of Crash (n=810)



More than 1 in 4 pedestrian crash victims were suspected of impairment by law enforcement officers for late night crashes.

http://cchi.web.unc.edu/transportation-health-data/

North Carolina Motor Vehicle Crash Injury Surveillance: Pedestrians

Summary Data Based on a Pilot Study Linking 2017 Crash and Hospital Encounter Datasets

[1]University of North Carolina Highway Safety Research Center
[2]Carolina Center for Health Informatics, Department of Emergency Medicine, University of North Carolina School of Medicine

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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.

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Improve Data Quality

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

Finalized (11)

- NC DETECT Emergency Department Visit Data (NC DPH)
- NC Trauma Registry Data
- NC OEMS Data
- UNC Sheps Center Medicaid and BCBS Claims Data
- UNC Sheps Center Emergency Department/Hospital Discharge data
- NC State Center for Health Statistics Death Registration Data
- NC State Center for Health Statistics Emergency Department/Hospital Discharge Data
- Highway Safety Information System (HSIS) Data
- NC Pedestrian & Bicycle Crash Data (PBCAT)
- NC DMV Crash Report Data
- FARS

In Progress/ Under Review (1)

- Office of the Chief Medical Examiner Data

Not Participating (1)

- NC Healthcare Association Hospital Encounter Data

Improve Data Quality

Fields: Death registration data

Field	Field-Literal	Length	Source comments
Date of Death--Year	DOD_YR	4	4 digit year; current data year
State of Death	DSTATE	2	NCHS Instruction Manual Part 8
Certificate Number	CERTNUM	6	Not available for research outside of NC DHHS. 000001-999999
Decedent's Legal Name--First (Given)	GNAME	50	
Decedent's Legal Name--Middle Initial	MNAME	1	
Decedent's Legal Name--Last	LNAME	50	
Decedent's Legal Name--Suffix	SUFF	10	
Decedent's Legal Name--Alias	ALIAS		
Father's Lastname/Surname	FLNAME	50	
Sex	SEX	1	
M	Male		
F	Female		
U	Unknown		
Social Security Number	SSN	9	Requires approval for access. 000000000-999999999
Decedent's Age--Type	AGETYPE	1	
1	Years		
2	Months		
4	Days		
5	Hours		
6	Minutes		
9	Unknown (Not Classifiable)		
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

http://cchi.web.unc.edu/data-sources-for-motor-vehicle-crash-injury-in-north-carolina/

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:

- Collaboratives Sciences Center for Road Safety, 2019-2020.
- NC Division of Public Health/Centers for Disease Control & Prevention, 2019-2020.
- NC Governor's Highway Safety Program, 2016-2020.

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?

Contact Information

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