

Assessing Risk of Pediatric Back-over Injuries in Residential Driveways by Vehicle Type

Kerrie Pinkney, MD, MPH, FAAP

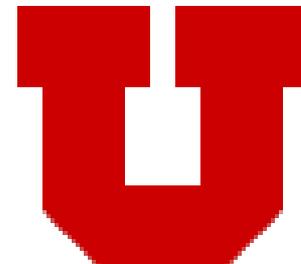
Andrew Smith, MD

N. Clay Mann, PhD, MS

Gary Mower, BS



NEMSiS
TECHNICAL ASSISTANCE CENTER

The logo for NEMSiS Technical Assistance Center features the word "NEMSiS" in a stylized font. "NEM" is in blue, "Si" is in red, and "S" is in blue with a small star above the dot. Below it, "TECHNICAL ASSISTANCE CENTER" is written in a smaller, blue, sans-serif font.

PEC 22(6);2006 p 402-07.

ORIGINAL ARTICLE

Risk of Pediatric Back-over Injuries in Residential Driveways by Vehicle Type

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Objective: Research suggests that children experience driveway back-over injuries at a significant rate, and the severity of the resulting injuries differ by type of vehicle. Yet, no US study attempted to quantify “back-over risk” for classes of vehicles because of the difficulties with determining exposure. Using vehicle registration information, we set out to estimate the relative risk of driveway back-over injuries to children by type of vehicle.

Methods: Driveway back-over events were identified from state police reports and medical records from the state level 1 pediatric trauma center and compared with vehicle registration information to estimate injury incidence for 4 classes of vehicles (passenger cars, trucks, sport utility vehicles, and minivans) during 6 years in the state of Utah.

Results: Reported driveway back-over injuries represent an incidence of 7.09 per 100,000 children (<10 years old) per year. Overall, passenger cars account for 1.62 injuries per 100,000 registered

country.^{1,2} Children younger than 4 years old are at greatest risk, with 1 in 3 deaths related to a pedestrian-motor vehicle injury.^{3,4} The bulk of pediatric pedestrian deaths occur in nontraffic situations, such as residential driveways.^{3,4} Data from the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) and the KIDS’N CARS program suggest that as many as 9160 nonfatal and 80 fatal nontraffic injuries occur among children every year, with 27% of these events involving a motor vehicle backing over a child.⁵ Unfortunately, driveway-related injuries are not typically reported by police and, if reported, are often miscoded.⁴ This has led to an underrecognition of the magnitude of the problem of driveway back-over injuries.⁶ A more recent investigation, using a probabilistic sample of US emergency departments (EDs), estimates that approximately 2492 children (≤14 years) seek treatment in US hospital EDs (per year) for nonfatal injuries resulting from motor vehicle

Background

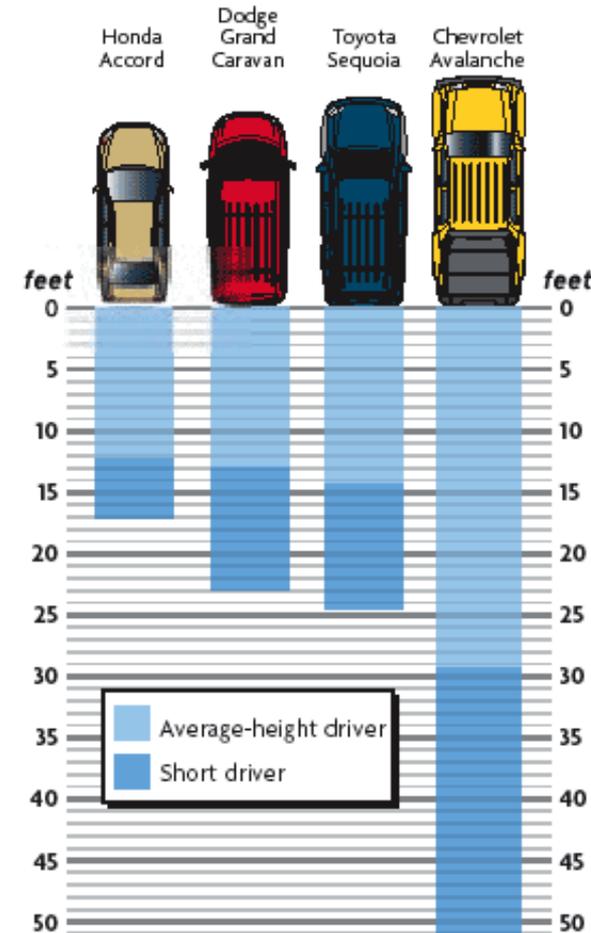
The logo for the Journal of the American Medical Association (JAMA), consisting of the letters "JAMA" in a bold, red, sans-serif font, enclosed within a thin black rectangular border.

Nonfatal Motor-Vehicle–Related Backover Injuries Among Children—United States, 2001-2003. 2005;293:1444-1445.

“During 2001-2003; 7,475 children (2,492 per year) aged 1-14 years were treated for non-fatal MV backover injuries in U.S. hospital emergency departments”

Background

- Current Research
 - Vehicle Design
 - Depth of blind spot
 - Height/weight of vehicle
 - Injury Characteristics
 - Environmental attributes
 - Severity of injury
 - Vehicle types



Objectives

- Statewide incidence of back-over injury
- Risk of back-over injury by vehicle type
- Severity of injury by vehicle type



Methods

- Study Design
 - Epidemiological study of prevalence
 - Jan. 1998 to Dec. 2003
 - < 10 yrs, residential driveway, in reverse.
- Study Sample
 - SoU Investigating Officer's Traffic Accident Report (DI-9 form)
 - Medical records from Level-1 Pediatric Trauma Center

Methods

- Measurement of Prevalence
 - Numerator (number of cases)
 - Two independent lists:
 - State of Utah DI-9 forms
 - Pediatric Trauma Center medical records
 - Denominator (number exposed)
 - Number of registered vehicles
 - Polk National Vehicle Profile (July 1, each year)
 - Passenger cars, minivans, trucks, SUV
 - » Minivans, trucks, SUV = LTV

Analysis

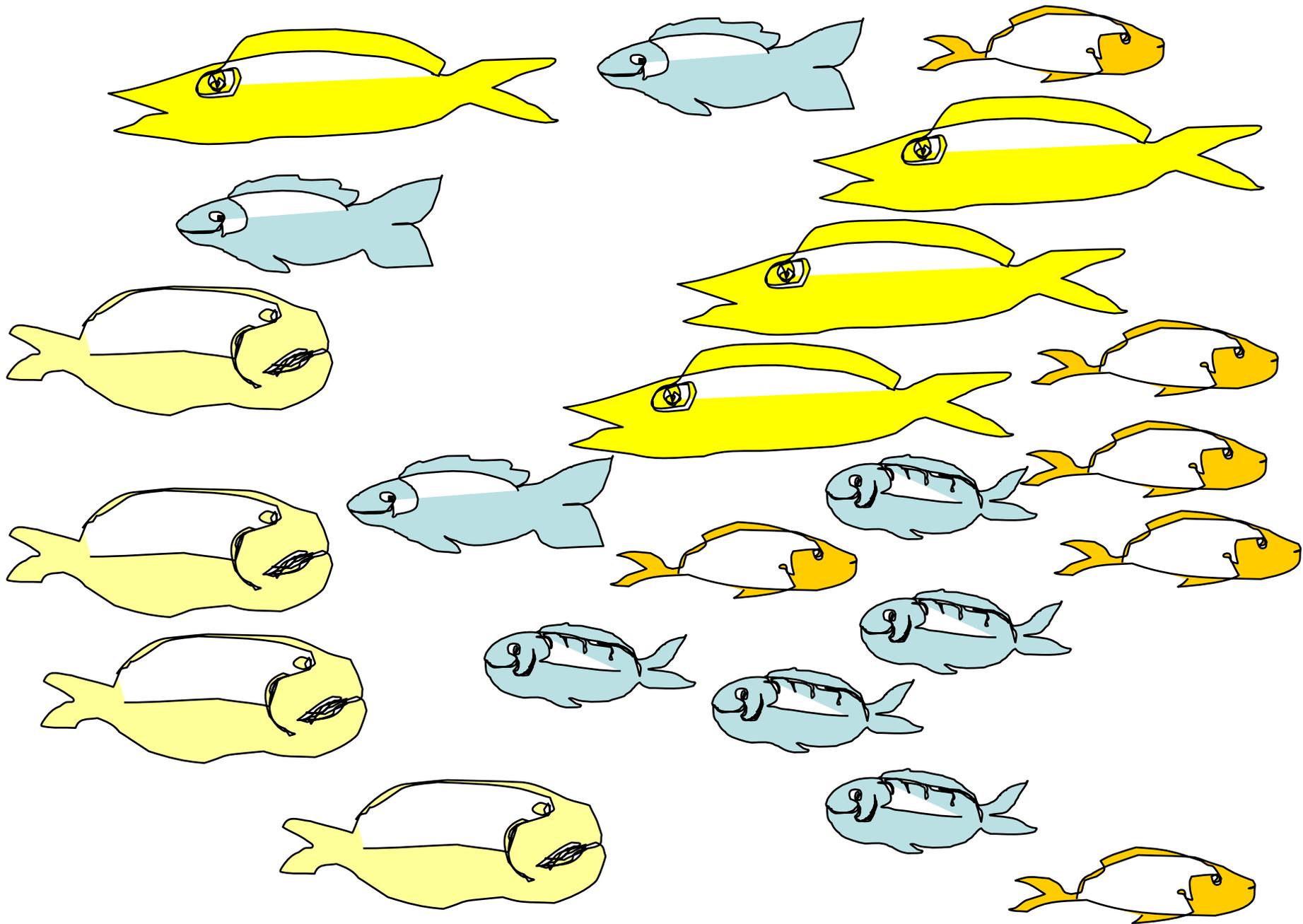
- Counting Cases

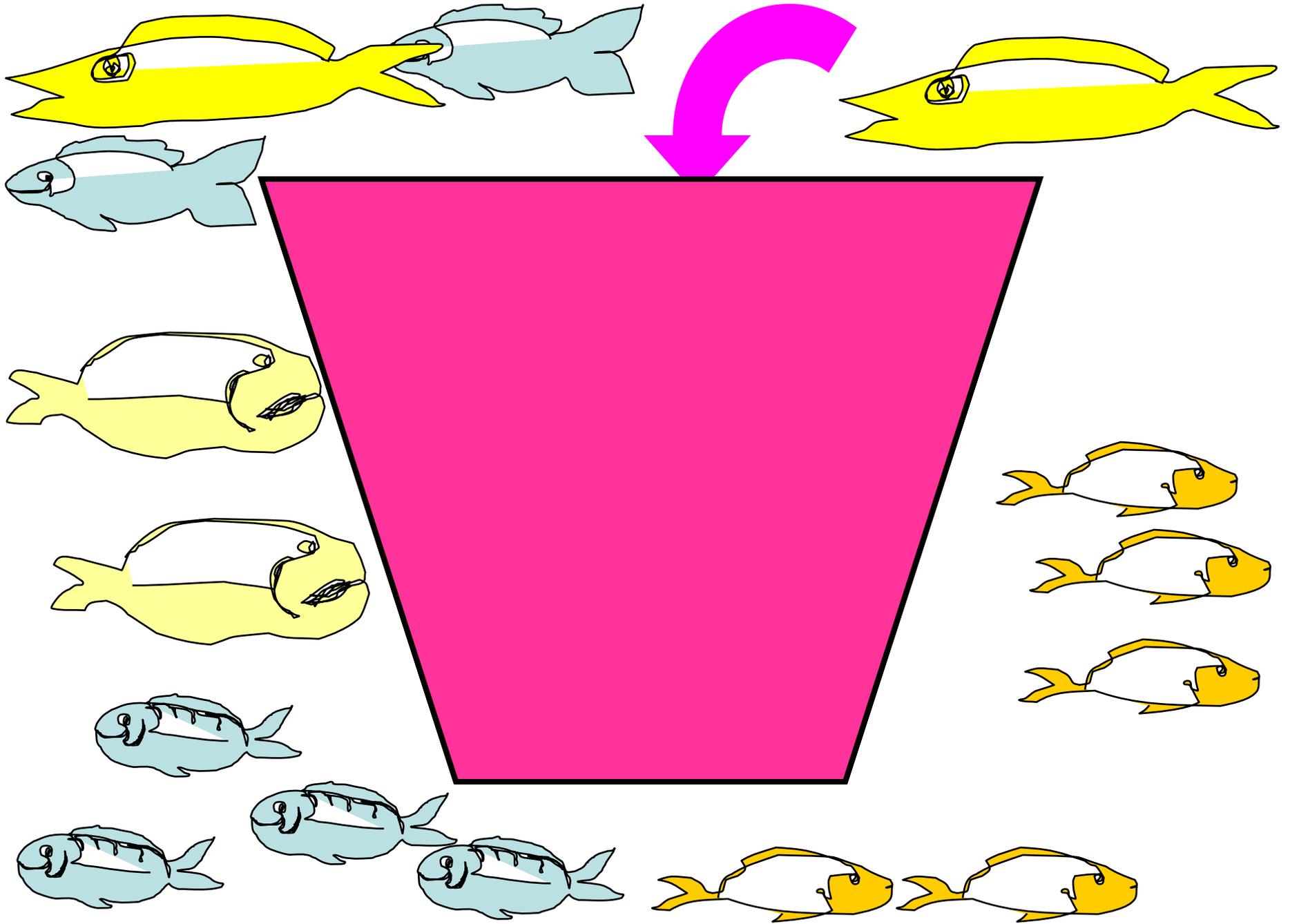
How do you estimate the total number of cases from two incomplete lists?

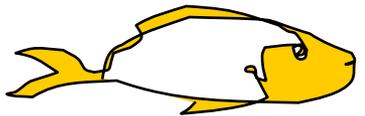
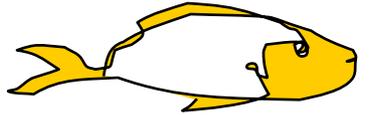
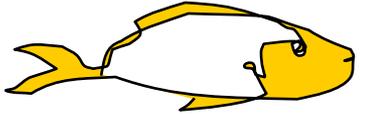
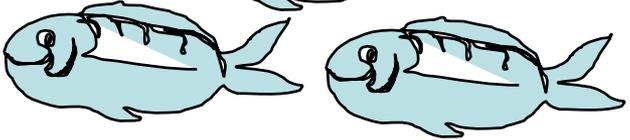
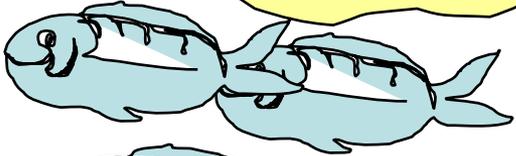
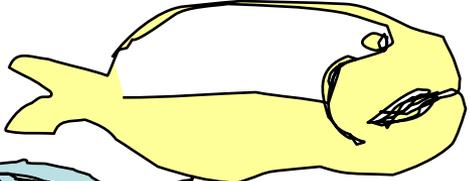
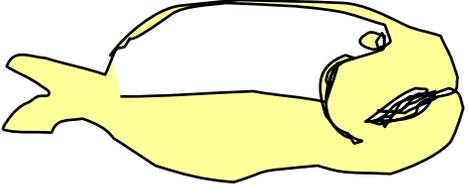
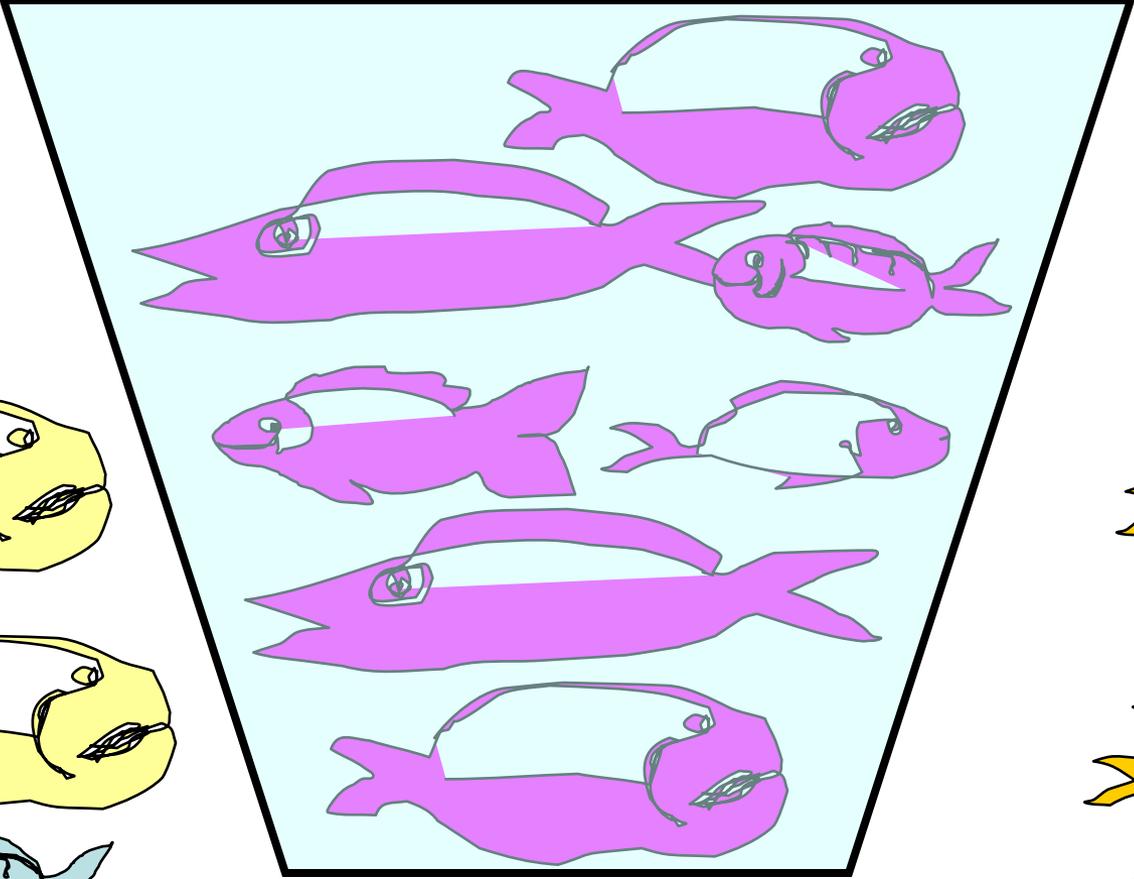
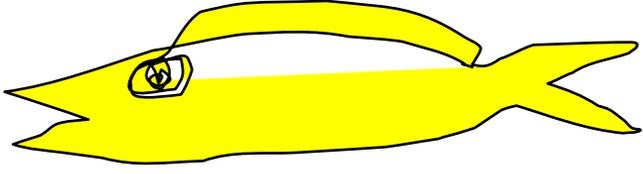
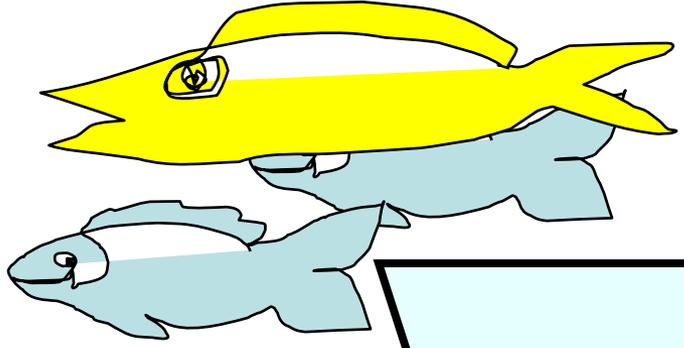
State of Utah DI-9 forms

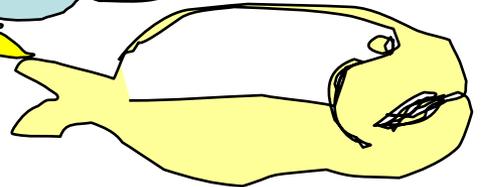
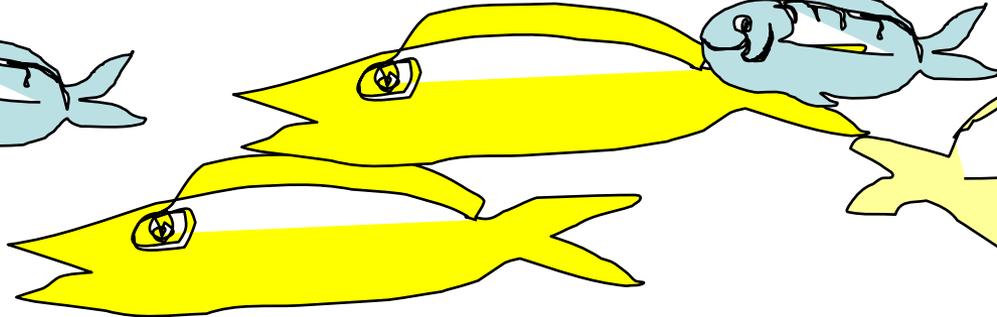
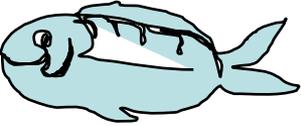
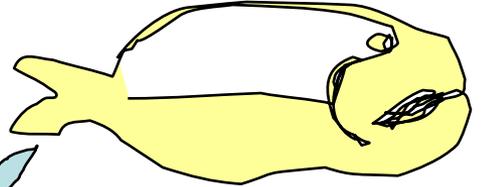
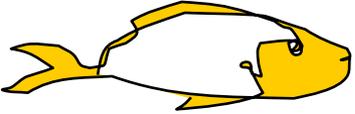
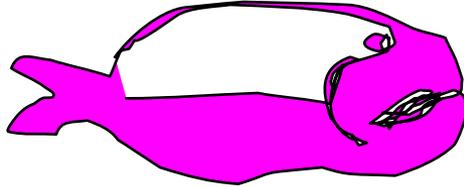
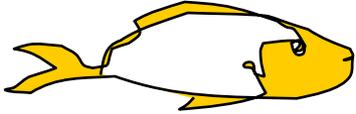
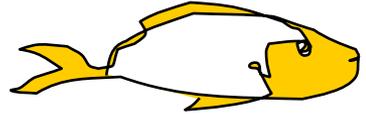
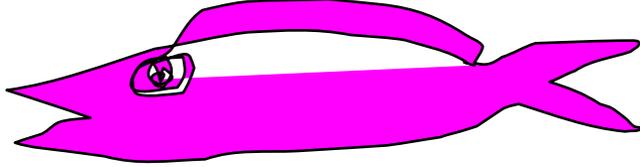
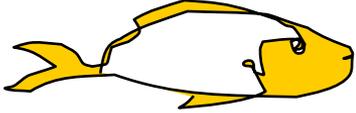
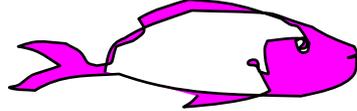
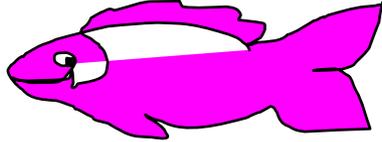
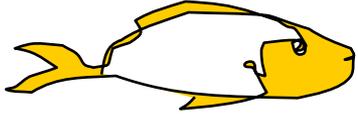
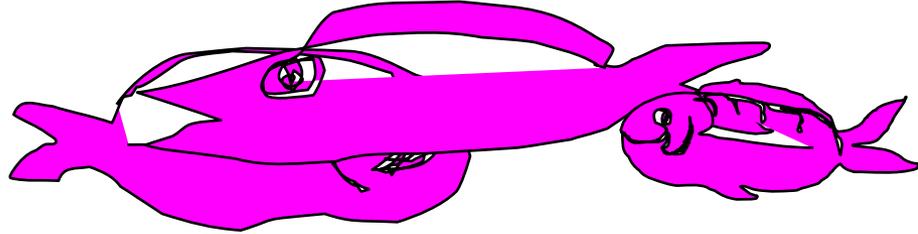
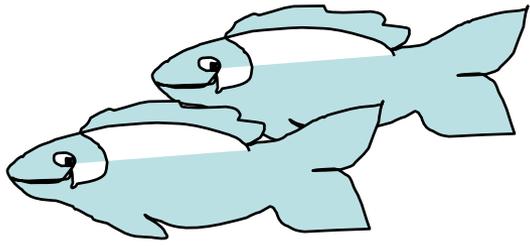
Pediatric Trauma Center medical records

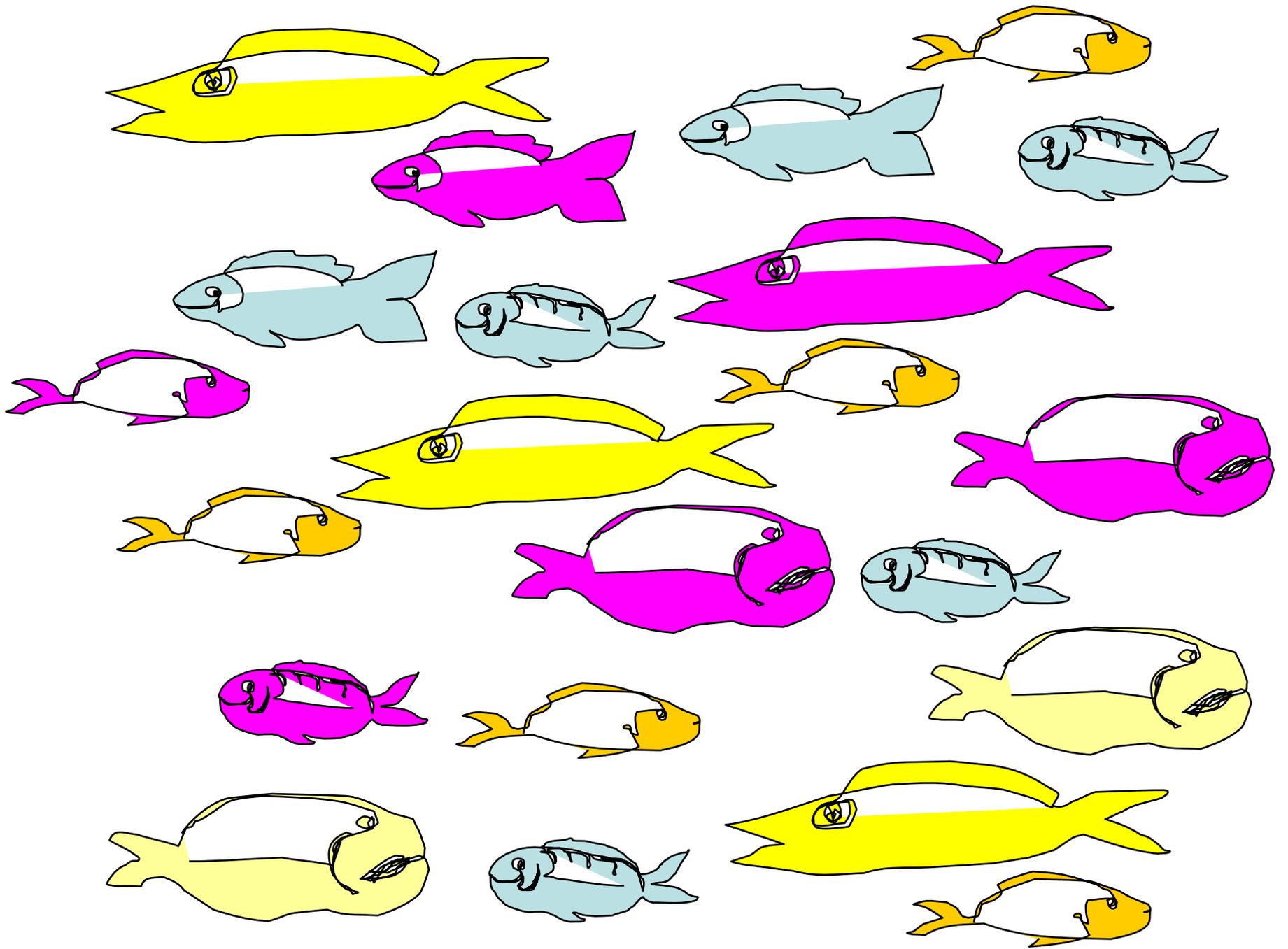
Capture – Recapture Model

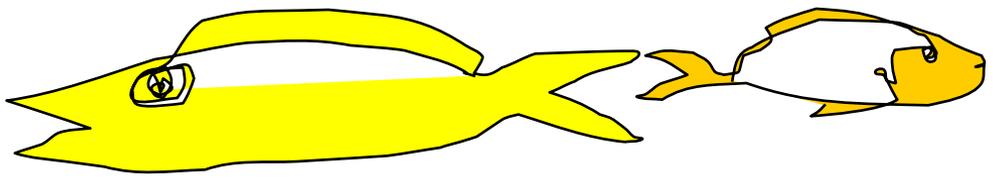
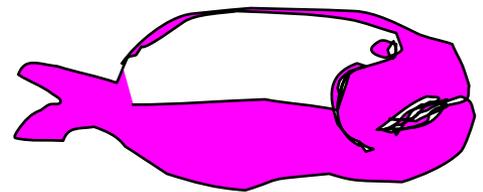
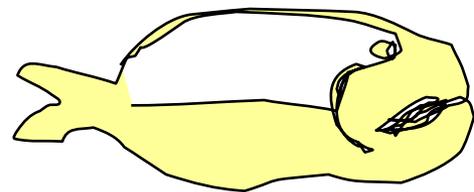
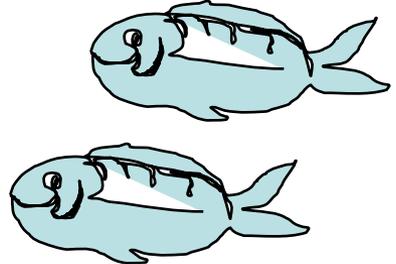
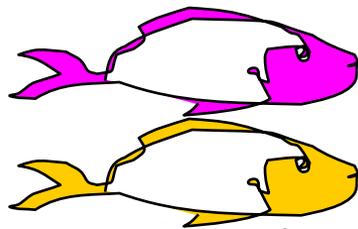
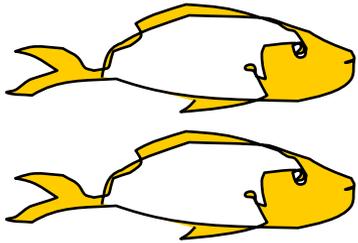
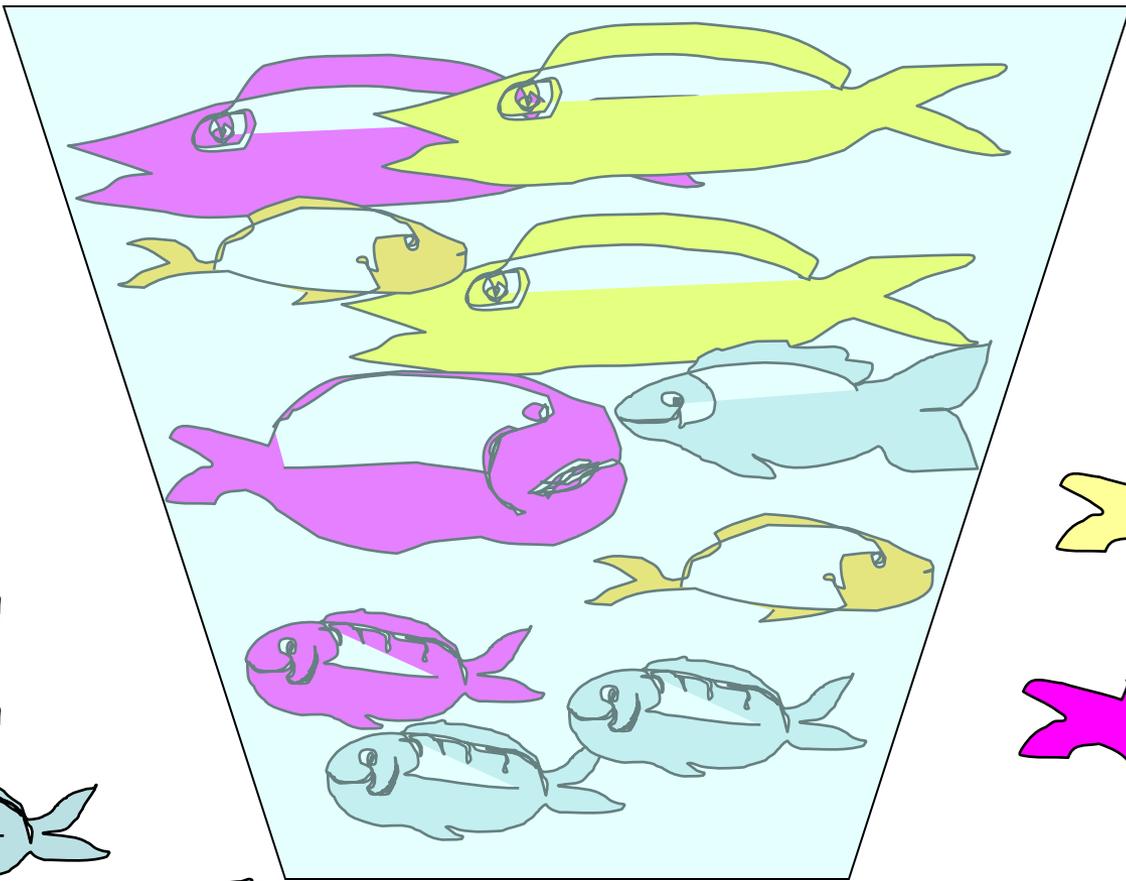
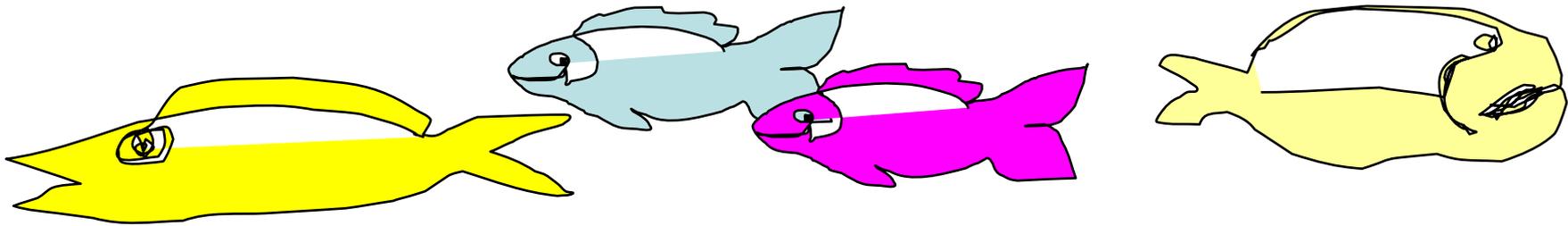




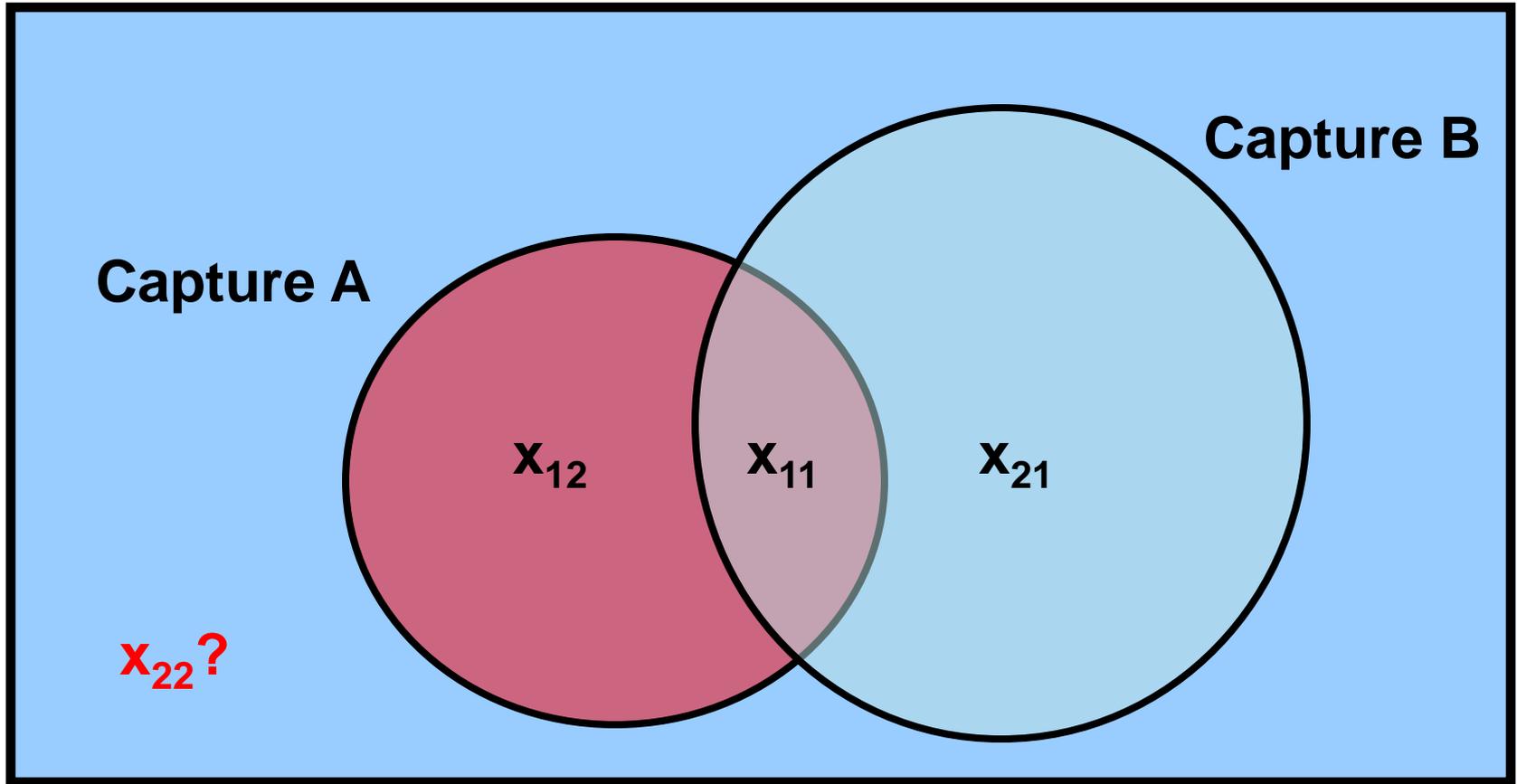








Two Fish Captures

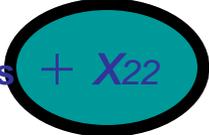


Capture (A) and Recapture (B)

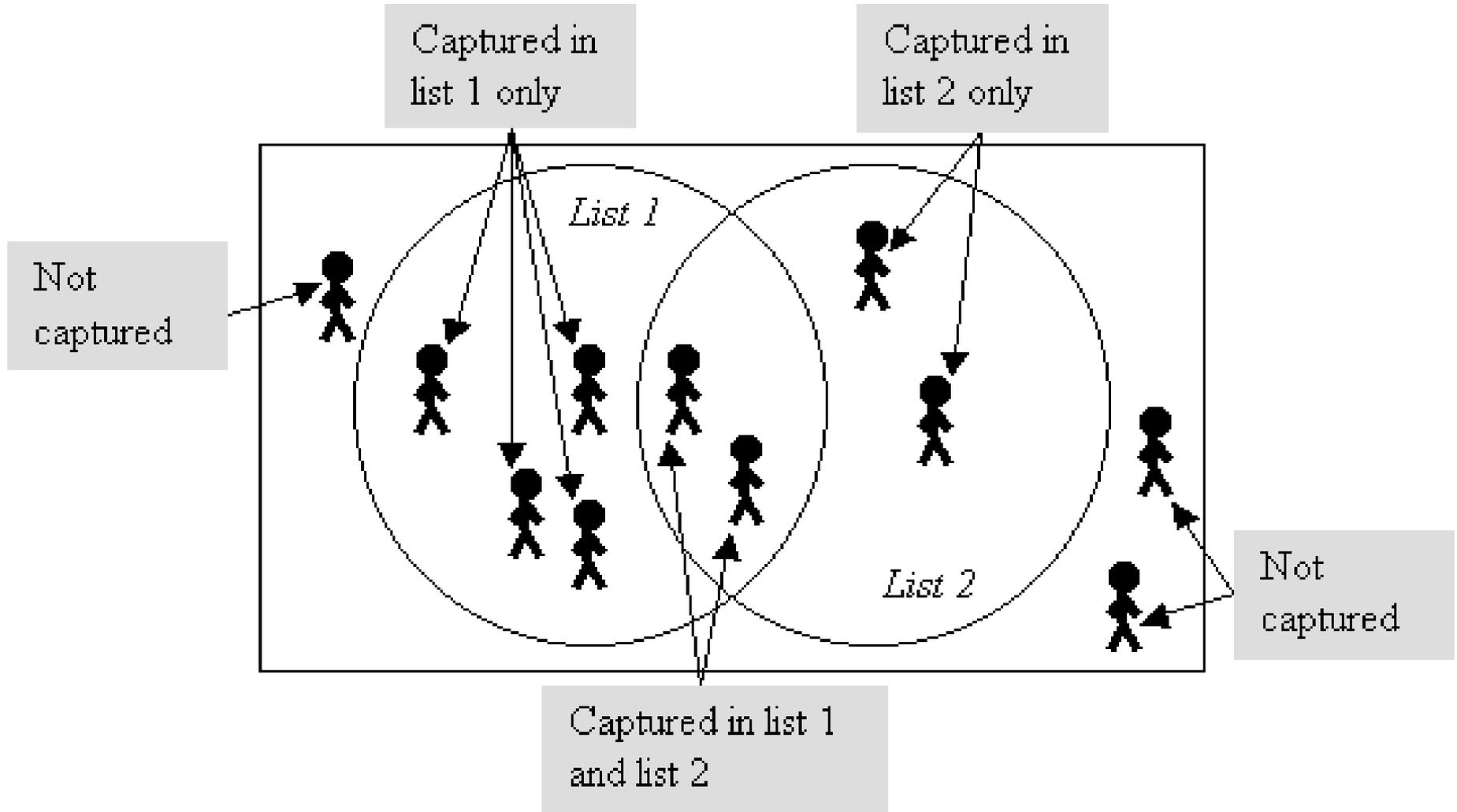
		Capture A		
		+	-	
Capture B	+	X_{11}	X_{21}	N_2
	-	X_{12}	X_{22}	
		N_1		$N = X_{11} + X_{21} + X_{12} + X_{22}$ $= N_{obs} + X_{22}$

$$X_{22} = \frac{X_{12} X_{21}}{X_{11}}$$

Estimated conditionally to number of cases observed in other cells



Capture-Recapture with Independent Lists



Another Approach

The total cases, n , can be calculated by Chapman's formula,¹⁵ which is as follows:

$$n = \frac{(L_1 + 1)(L_2 + 1)}{(d + 1)} - 1$$

where L_1 and L_2 are the numbers in the two lists, respectively, and d is the duplicates. Similarly, 95% CIs can be calculated as:

$$n \pm 1.96 \sqrt{\frac{(L_1 + 1)(L_2 + 1)(L_1 - d)(L_2 - d)}{(d + 1)^2(d + 2)}}$$

C-R Assumptions

- Need at least two lists
- Population is be closed
 - There is no change in population during investigation
- Cases sampled can be matched
- Each case has equal chance of inclusion (in both samples)
- Lists are independent of each other

Dependency of lists

- Only two lists – likely biased!
 - Three or more suggested
 - Use of Poisson Log-linear modeling
 - Estimates missing cases
 - Magnitude of dependence
 - Use of GLIM program
 - How many lists needed?
 - “Many” no better than three
 - Collapse many lists

Results

- Statewide incidence of back-over injury
 - Traffic Accident Report (DI-9 form)
 - 102 children (45% minor injuries, 10% Died)
 - Level-1 Pediatric TC medical records
 - 100 children (85% admitted, 40% ICU, 73 NF)
 - (4.0 / 100,000 / year)
 - Combined data $n=175$ (7.1 / 100,000 / year)
 - Capture Model (~190 unascertained cases)
 - (14.8 / 100,000 / year)
 - CDC estimate (3.1 / 100,000 / year)

National Emergency Medical Services Information System

Current Standing of NEMESIS Registry

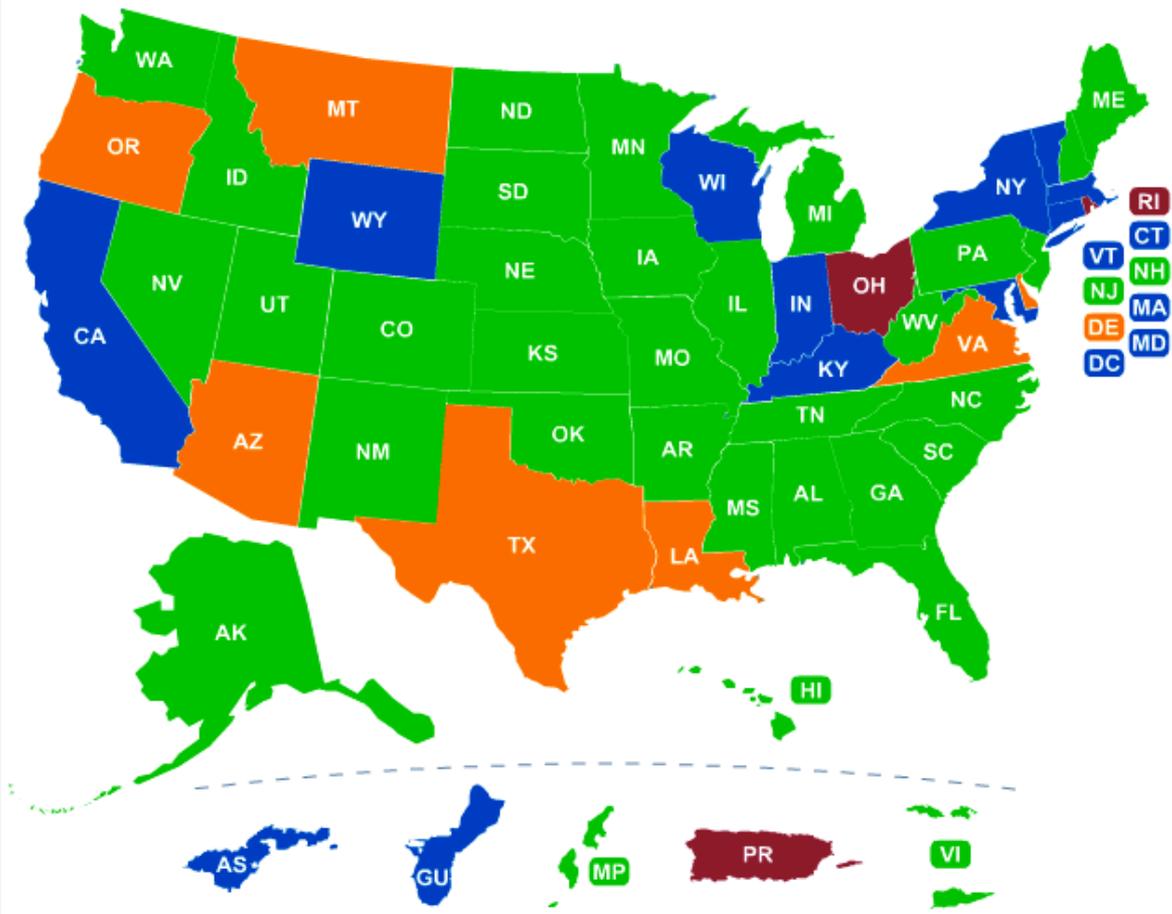
Current Composition of the NEMESIS Data Warehouse

Data warehouse last updated on: 10/28/2011 2:37:57 PM

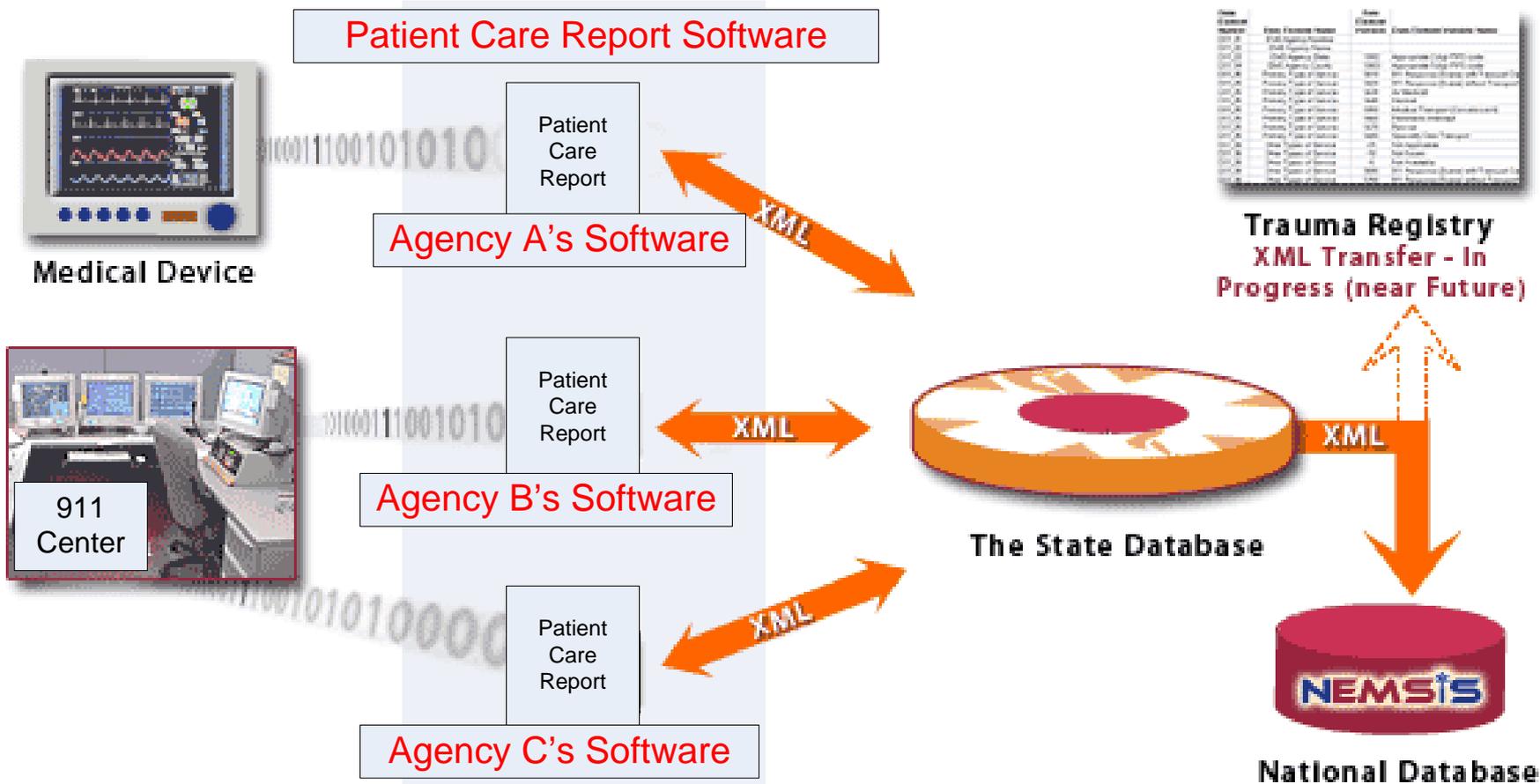
States:	2009				2010				2011				Total
	1	2	3	4	1	2	3	4	1	2	3	4	
Alabama	105,188	121,087	124,867	113,833	116,592	120,572	106,875	97,872	103,655	105,578	100,355	21,074	1,237,548
Alaska			595	2,596	5,091	7,298	7,601	7,274	7,165	7,299			44,919
Arkansas	47,843	53,657	53,191	45,847	56,233	75,121	75,611	65,016	50,458	52,083			575,060
Colorado	80,625	86,371	96,960	87,708	78,104	67,743	77,646	76,874	68,732	84,912			805,675
Florida	260,805	255,974	277,772	298,247	355,909	360,480	364,167	357,791	418,637	236,377			3,186,159
Georgia									29,955				29,955
Hawaii	25,610	25,160	24,670	25,186	25,971	25,042	26,144	27,404	28,437	27,292			260,916
Idaho	6,864	12,491	14,400	14,137	13,089	18,659	17,535	20,491	21,857	16,827			156,350
Illinois							3,659	13,631	18,494				35,784
Iowa	17,950	34,910	40,204	42,946	40,481	39,732	36,600	38,944	42,810	40,601			375,178
Kansas		8,070	7,944	9,765	10,310	11,443	12,289	12,886	15,108	15,860			103,675
Maine	40,475	13,843	40,336	37,270	41,232	41,638	43,156	54,159	49,924				362,033
Michigan	7,497	32,600	35,423	124,411	177,539	177,227	241,925	253,123					1,049,745
Minnesota	86,936	94,033	97,031	99,338	94,574	100,987	106,434	106,711	114,917	114,653			1,015,614
Mississippi		50,935	63,740	62,769	78,074	70,763	65,934	56,394					448,609
Missouri	27,520	18,047	20,750	24,827	31,942	36,819	38,751	57,447	65,719				321,822
Nebraska	14,187	14,657	16,264	16,094	14,970	22,964	24,516	20,931	19,869				164,452
Nevada	18,643	19,012	20,035	14,261	9,418	13,744	10,075	19,689	22,737	17,776			165,390
New Hampshire	23,644	16,563	28,924	27,944	24,697	33,179	39,073	39,607	45,782				279,413
New Jersey	86,393	94,962	121,916	137,551	186,654	209,553	209,707	222,108	256,106	255,798			1,780,748
New Mexico	19,092	26,318	25,522	30,969	69,105	67,867	74,744	68,758	70,661				453,036
North Carolina	302,230	342,418	339,080	339,071	360,603	366,383	371,960	367,941	364,173				3,153,859
North Dakota	8,046	7,787	8,258	8,077	7,731	6,557	8,909	11,816	12,005	12,681			91,867
Northern Mariana Islands							716	784	507				2,007
Oklahoma	35,953	61,262	51,673	79,780	82,424	90,765	93,160	76,464					571,481
Pennsylvania							7,221	1,112	9,296	31,904	141,824		191,357
South Carolina	33,373	45,266	67,733	123,810	259,852	282,106	269,157	278,430	285,648				1,645,375
South Dakota	8,313	9,818	10,554	8,940	10,793	11,534	12,524	11,117	10,027	10,454			104,074
Tennessee					634	1,855	16,402	14,343	21,510	45,743	30,375		130,862
Utah	40,279	42,796	40,909	38,644	44,799	51,535	53,712	49,690	49,300	50,422	29,202		491,288
Virgin Islands					1,767	1,688	1,859	1,779		1,426	1,602		10,121
Washington					15,745	14,976	19,487	21,285	21,603	19,843			112,939
West Virginia	6,134	13,846	22,607	65,489	95,686	111,068	120,284	104,799	119,301				659,222
Total	1,303,600	1,501,883	1,651,358	1,879,510	2,310,019	2,439,298	2,557,833	2,556,670	2,344,393	1,147,529	303,358	21,074	20,016,525

NEMSiS Participation

- Submitting data to NEMSiS
- Addressing barriers to NEMSiS
- Actively working with NEMSiS TAC
- Limited progress with NEMSiS



THE PORTABILITY OF DATA - the NEMSiS STANDARD.



V3 Elements

State

National

eDispatch.01 - Complaint Reported by Dispatch

Definition

The complaint dispatch reported to the responding unit.

National Element	Yes	Pertinent Negatives (PN)	No
State Element	Yes	NOT Values	No
Version 2 Element	E03_01	Is Nillable	No
Usage	Mandatory	Recurrence	1 : 1

Associated Performance Measure Initiatives

Airway Cardiac Arrest Pediatric Response STEMI Stroke Trauma

Code List

Code	Description
2301001	Abdominal Pain/Problems
2301003	Allergic Reaction/Stings
2301005	Animal Bite
2301007	Assault
2301009	Automated Crash Notification
2301011	Back Pain (Non-Traumatic)
2301013	Breathing Problem
2301015	Burns/Explosion
2301017	Carbon Monoxide/Hazmat/Inhalation/CBRN
2301057	Pregnancy/Childbirth/Miscarriage
2301059	Psychiatric Problem/Abnormal Behavior/Suicide Attempt
2301061	Sick Person
2301063	Stab/Gunshot Wound/Penetrating Trauma

V3 Elements

eInjury.01

State

National

eInjury.01 - Cause of Injury

Definition

The category of the reported/suspected external cause of the injury.

National Element	Yes	Pertinent Negatives (PN)	No
State Element	Yes	NOT Values	Yes
Version 2 Element	E10_01	Is Nillable	Yes
Usage	Required	Recurrence	1 : M

Associated Performance Measure Initiatives

Trauma

Attributes

NOT Values

7701003 - Not Recorded

7701001 - Not Applicable

Constraints

Pattern

[S-T]{1}[0-9]{2}(\.[A-Za-z0-9]{1,4})?[V-Y]{1}[0-9]{2}(\.[A-Za-z0-9]{1,4})?

Data Element Comment

Suggested code list is represented in ICD-10-CM: External Causes of Morbidity, Injury, Poisoning and Certain Other Consequences of External Causes with the range (S00 through T79.4 and V00 through Y38.9X2). It is not expected that EMS will utilize the 7th digit, often used to describe the type of encounter (A-Initial Encounter, D-Subsequent Encounter, S-Sequela). Thus, S through T and V through Y codes should be limited to 5 or 6 digits at the most.

Code list is represented in ICD-10 Codes.

Website - <http://uts.nlm.nih.gov>

Product - UMLS Metathesaurus

V3 Elements

eSituation.17

State

eSituation.17 - Patient Activity

Definition

The activity the patient was involved in at the time the patient experienced the onset of symptoms or experienced an injury.

National Element	No	Pertinent Negatives (PN)	No
State Element	Yes	NOT Values	Yes
Version 2 Element		Is Nillable	Yes
Usage	Recommended	Recurrence	0 : M

Attributes

NOT Values

7701003 - Not Recorded 7701001 - Not Applicable 7701005 - Not Reporting

Correlation ID

Data Type: String minLength: 0 maxLength: 255

Constraints

Pattern

[Y{1}[0-9]{2}(\[A-Za-z0-9]{1,4})?]

Data Element Comment

Code list is represented in ICD-10-CM: Diagnoses Codes. This list will only contain specific Y codes, see suggested NEMSIS list of activity codes (Y93).

Code list is represented in ICD-10 Codes.

Website - <http://uts.nlm.nih.gov>

Product - UMLS Metathesaurus

V3 Elements

eScene.09

State

National

eScene.09 - Incident Location Type

Definition

The kind of location where the incident happened

National Element	Yes	Pertinent Negatives (PN)	No
State Element	Yes	NOT Values	Yes
Version 2 Element	E08_07	Is Nillable	Yes
Usage	Required	Recurrence	1 : 1

Associated Performance Measure Initiatives

Airway Cardiac Arrest Pediatric Response STEMI Stroke Trauma

Attributes

NOT Values

7701003 - Not Recorded 7701001 - Not Applicable

Constraints

Pattern

Y92(\.[0-9]{1,3})?

Data Element Comment

Code list is represented in ICD-10-CM: Place of Occurrence of the external cause (Y92.0-Y92.9).

ICD-10-CM

Website - <http://uts.nlm.nih.gov>

Product - UMLS Metathesaurus

Questions?

