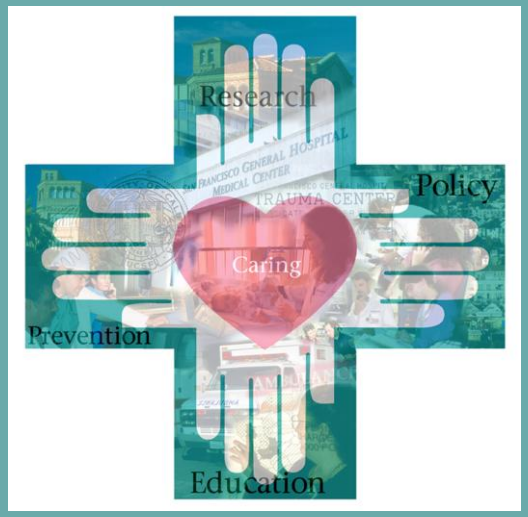


San Francisco Injury Center

UCSF
University of California
San Francisco
advancing health worldwide™

Using Trauma Center Data to Identify Missed Bicycle Injuries and Their Associated Costs

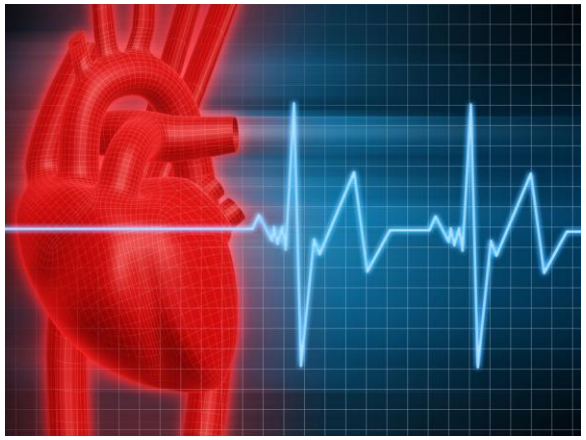
Presented by:
Dahianna Lopez, RN, MSN, MPH

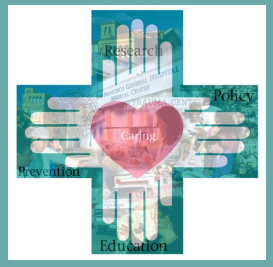
Co-Authored by:
Dharma Sunjaya, BS
Shirley Chan
Kimen Balhotra
Wendy Max, PhD
Rochelle Dicker, MD

UCSF
University of California
San Francisco

Background

- **Bicycling and walking have become increasingly important modes of transportation**



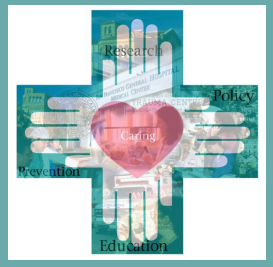


UCSF
University of California
San Francisco

Background

- Shift in transportation mode share → increase in bicycle + pedestrian injuries

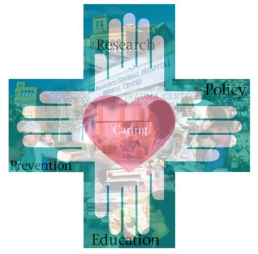
- In 2009 (US):
  - 630 bicyclists killed
  - 51,000 injured
  - Based on NHTSA



UCSF
University of California
San Francisco

Background

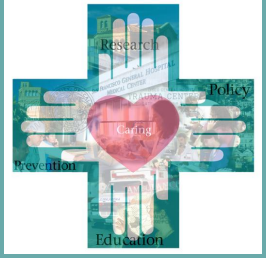
- First step to prevention is problem ID (Public Health Model)
- Police reports are the industry standard for assessing transportation-related collisions
- Previous studies have suggested that police reports miss a substantial number of bike crashes
- Trauma centers and hospitals may be the only current source of data for these injuries



UCSF
University of California
San Francisco

Aims

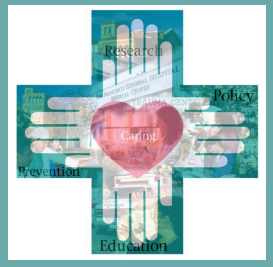
- To ascertain the rate of match between bike injuries reported by police and trauma center
- To describe the outcomes of cyclist-only and BVA injuries based on hospital records (incidence, injury severity, admission rate, cost)
- To question the utility and validity of the current surveillance mechanism for bike injuries



UCSF
University of California
San Francisco

Definitions

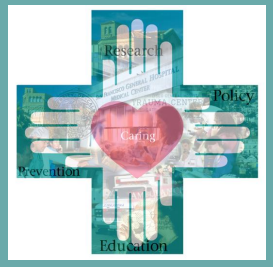
- **Cyclist-Only**
  - Injury from bike fall, not involving an auto (Ecode)
- **BVA**
  - Bike versus auto injury (Ecode)
- **SWITRS**
  - (Police Data) Statewide Integrated Traffic Record System in California
- **SFGH**
  - San Francisco General Hospital & Trauma Center



UCSF
University of California
San Francisco

Method

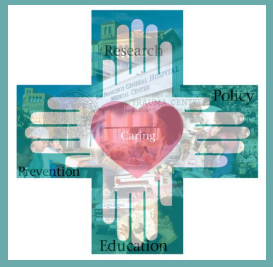
- **Retrospective Cohort Study**
- **10 Years (2000 – 2009)**
- **Bicycle-related injuries**
  - 813.6 (Road vs. Pedal cyclist)
  - 826.1 (Motor Vehicle vs. Pedal cyclist)
- **Presenting to only trauma center in SF**
- **Excluded:**
  - Injuries not occurring in San Francisco
  - Injuries incorrectly coded as “bicycle” injuries
- **Statistics**
  - Appropriate parametric & non-parametric tests



UCSF
University of California
San Francisco

Data Sources

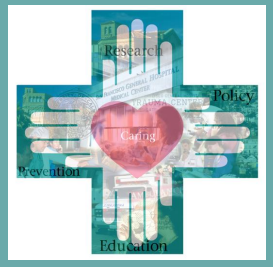
- **Identify cohort:**
  - SFGH Trauma Registry
- **Hospital charges, professional fees and payments:**
  - SF DPH Billing Information System
- **Collision location and rate of match:**
  - Paper EMS medical record, SWITRS database
- **Supervisorial District:**
  - SF Geographic Information System



UCSF
University of California
San Francisco

Injury Cost Calculation

- **Charge vs. Cost**
- **Direct medical cost calculated by summing:**
  - Ambulance Costs
  - Hospital Costs
  - Professional Fee Costs
- **Then multiplied by Consumer Price Indices to allow for comparisons across years**
- **Used 2009 dollars**



UCSF University of California San Francisco

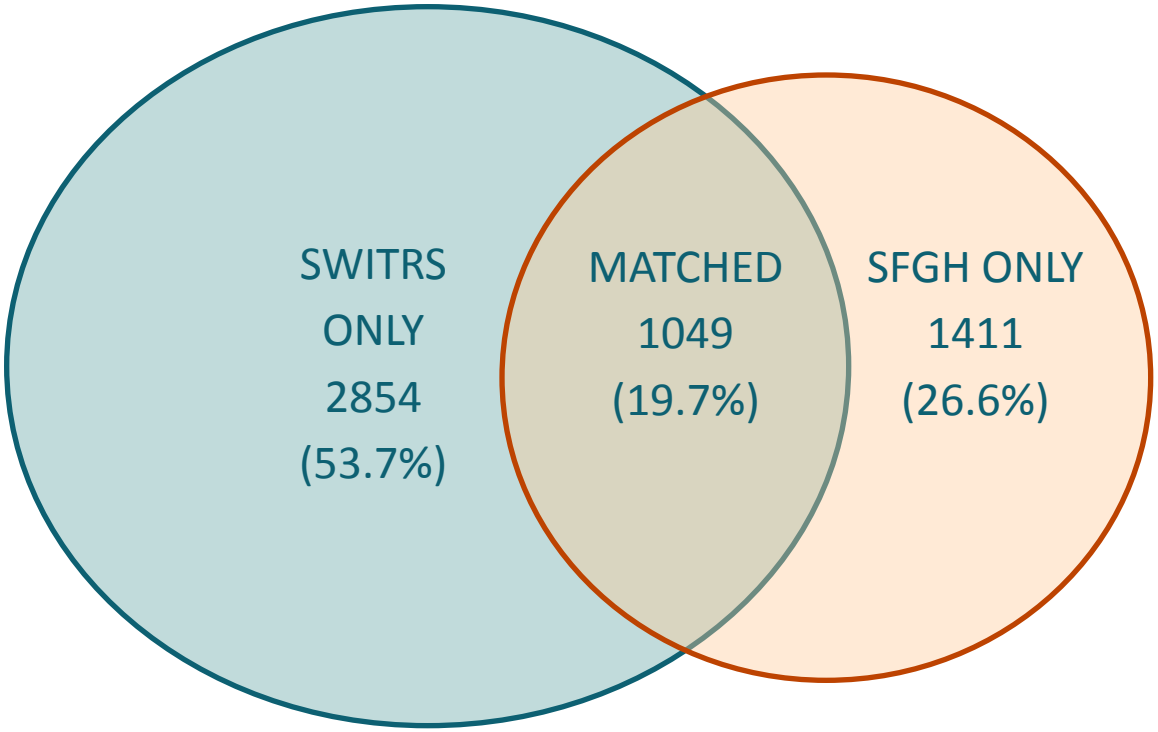
Findings

- **5314 bicycle-related injury crashes identified (2000-2009)**
  - 3903 (police)
  - 2460 (hospital)
  - Some overlap
- **Bicycle injuries at SFGH constituted 6% of total trauma in 2009**

UCSF
University of California
San Francisco

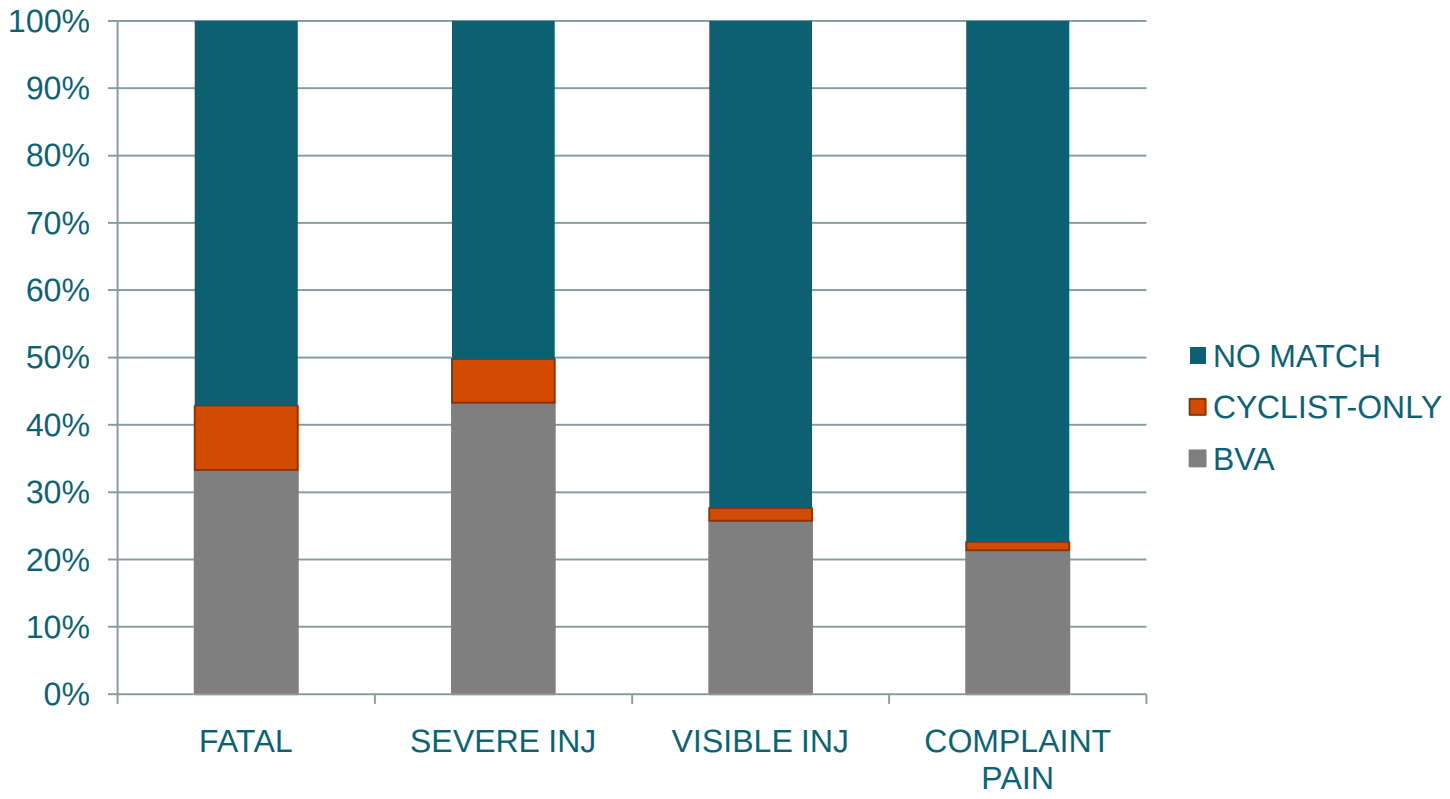
Results (Police vs. Hospital)

26% Underestimation by SWITRS (2000 – 2009)



Results (Police vs. Hospital)

Percent Match – Hospital Injuries to Police Records



20-40% Match (BVA)
1-7% Match (Cyclist-Only)

UCSF University of California San Francisco

Results (Police vs. Hospital)

	Matched		SFGH Only		SWITRS Only		p-value
Year	N	%	N	%	N	%	
2000	87	8.4	111	7.9	398	13.9	**0.001‡**
2001	90	8.5	85	6.0	363	12.7	
2002	45	4.3	66	4.7	358	12.5	
2003	84	8.1	125	8.9	275	9.6	
2004	90	8.5	136	9.6	179	6.3	
2005	97	9.2	138	9.8	185	6.5	
2006	87	8.2	170	12.0	185	6.5	
2007	145	13.7	213	15.1	231	8.1	
2008	143	13.5	167	11.8	248	8.7	
2009	181	17.6	200	14.2	432	15.1	
Total	1049	100.0	1411	100.0	2854	100.0	

Two sides of the story…

UCSF University of California San Francisco

Results (Police vs. Hospital)

	Matched		SFGH Only		SWITRS Only		p-value
Age	N	%	N	%	N	%	
Median	30		31		30		0.29†
1 - 17	58	5.5	117	8.3	180	6.3	0.001‡
18 - 64	978	93.2	1266	89.7	2549	89.3	
65 and Above	13	1.2	27	1.9	124	4.3	
Missing	0	0.0	1	0.1	1	0.0	
Total	1049	100.0	1411	100.0	2854		

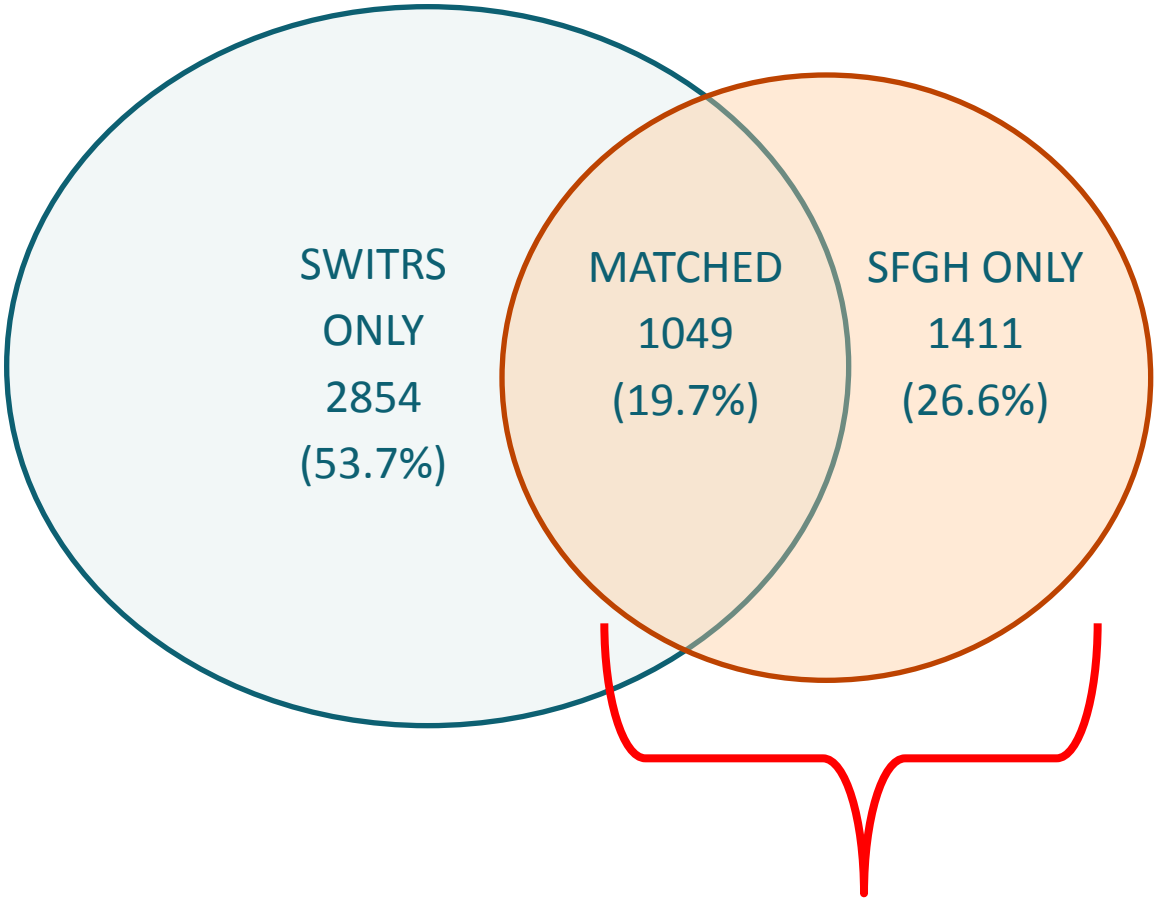
Cycling injuries in SF – An adult problem for an adult population

SWITRS – more sensitive in capturing elderly cycling injuries.

UCSF University of California San Francisco

Results (Police vs. Hospital)

26% Underestimation by SWITRS (2000 – 2009)



UCSF University of California San Francisco

Results (BVA vs. Cyclist-Only)

	BVA		Cyclist-Only		p-value
Year	N	%	N	%	0.001‡
2000	138	7.6	60	9.3	
2001	118	6.5	57	8.9	
2002	62	3.4	49	7.6	
2003	141	7.8	68	10.6	
2004	176	9.7	50	7.8	
2005	189	10.4	46	7.2	
2006	199	10.9	58	9.0	
2007	285	15.7	73	11.4	
2008	236	13.0	74	11.5	
2009	274	15.1	107	16.7	
Total	1818	100.0	642	100.0	

Proportion of both types of injuries has nearly doubled over a decade

Cyclist-only injuries more erratic

Results (BVA vs. Cyclist-Only)

		BVA	%	Cyclist-Only	%	p-value
Age						
	Median	30.0		35.0		**<0.001†**
Sex						
	M	1457	80.1	499	77.7	**0.107‡**
	F	361	19.9	143	22.3	
	Total	1818	100.0	642	100.0	
Race						
	White	1090	60.0	427	66.5	**0.02‡**
	African Am.	193	10.6	47	7.3	
	Hispanic	257	14.1	81	12.6	
	Other	278	15.3	87	13.6	
	Total	1818	100.0	642	100.0	

Cyclist-only group slightly older

Minor differences in race proportions by group (similar to SF population)

Results (BVA vs. Cyclist-Only)

Higher proportion of cyclist-only group was admitted

More cyclist-only patients self-transport to hospital (bypassing 911 or ambulance system)

Cyclist-only has slightly longer LOS

		BVA	%	Cyclist-Only	%	p-value
Admission						
	Admitted	335	18.4	327	50.9	**0.000‡**
	ED Only	1483	81.6	315	49.1	
	Total	1818	100.0	642	100.0	
Arrival Method						
	Self	35	5.8	46	12.3	**0.002‡**
	Ambulance	557	92.8	325	86.7	
	Unknown	8	1.3	4	1.1	
	N	600	100.0	375		
Hospital Days						
	Median	2.0		3.0		**<0.001†**
	N	570		377		
ICU Days						
	Median	0.0		0.0		**0.267†**
	N	335		327		
Expired						
	No	323	96.4	322	98.47	**0.076‡**
	Yes	12	3.6	5	1.53	
	N	335	100.0	327	100.00	
Disposition						
	Home	501	89.8	337	91.1	**0.513‡**
	Other Hosp	57	10.2	33	8.9	
	N	558	100.0	370	100.0	
Insurance						
	Public	232	69.3	228	69.7	**0.481‡**
	Private	103	30.7	99	30.3	
		335	100.0	327	100.0	

UCSF University of California San Francisco

Results (BVA vs. Cyclist-Only)

		BVA	%	Cyclist-Only	%	p-value
ISS						
	Median	9.00		10.0		<0.001†
	N	468		347		
ISS Category						
	1 to 15	344	73.5	241	69.5	0.053‡
	16 to 30	102	21.8	97	28.0	
	>30	22	4.7	9	2.6	
	Total	468	100.0	347	100.0	
AIS Region						
	Head	182	38.9	185	53.3	0.000‡
	Face	78	16.7	88	25.4	0.002‡
	Chest	81	17.3	58	16.7	0.450‡
	Abdomen	49	10.5	32	9.2	0.320‡
	Extremities	179	38.2	155	44.7	0.038‡
	Skin	241	51.5	205	59.1	0.019‡

Statistical (but no clinical) difference in ISS

Cyclist only has greater proportion of head, face, extremity, skin injuries

UCSF University of California San Francisco

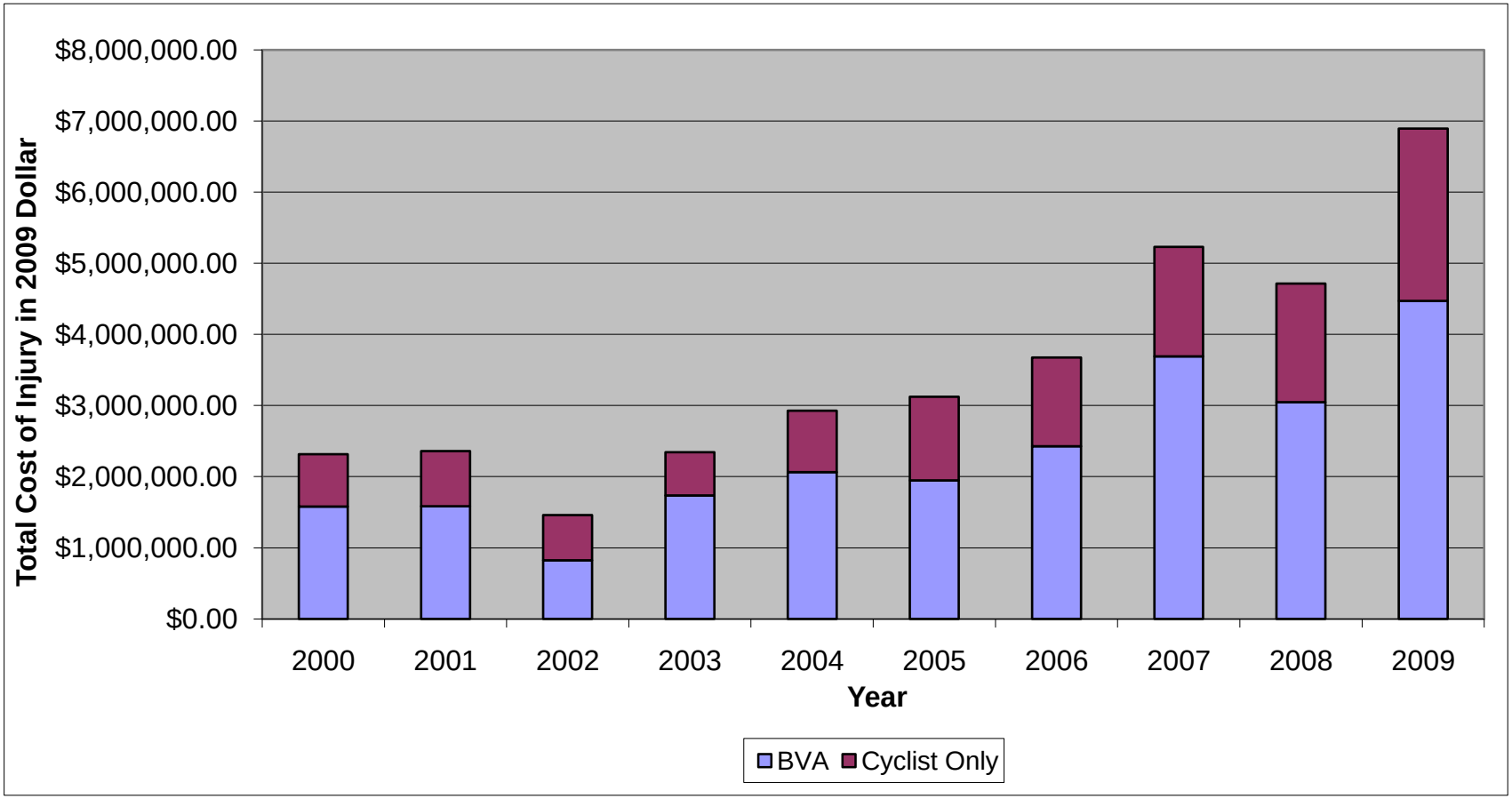
Results (BVA vs. Cyclist-Only)

SFGH: Hospital Cost	Total Cost	%
BVA	$23,369,808	**66.7**
Cyclist-Only	$11,677,077	**33.3**
Grand Total	$35,046,886	**100.0**

Cyclist-only not only accounted for 26% of total injuries, but also 33% of the total cost of bike injury.

UCSF University of California San Francisco

Results



UCSF University of California San Francisco

Results (BVA vs. Cyclist-Only)

	BVA		Cyclist-Only		p-value
	N	Median	N	Median	
Admit	335	$21,076	327	$18,060	**0.003†**
ER Visit	1483	$3,958	315	$4,695	**0.000†**
Total	1818	$4,369	642	$7,340	

BVA admission cost was higher than Cyclist-Only

Cyclist-Only visits were more expensive than BVA

UCSF University of California San Francisco

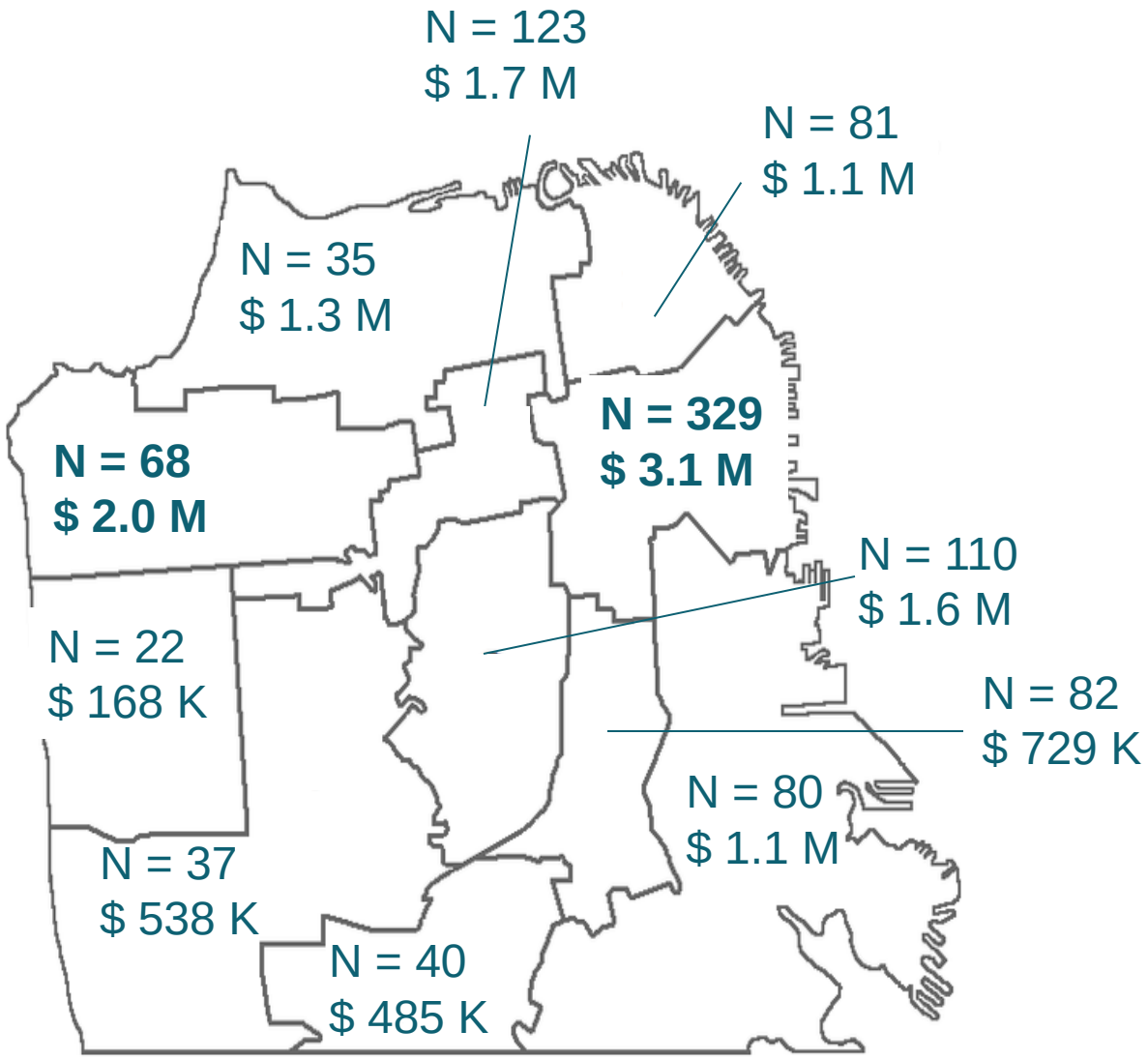
Results (Cost)

TOTAL COST OF BICYCLE INJURY BY SF DISTRICT IN 2009 DOLLARS (2000-2009)

District	N	Mean	Median	Sum
-1	1809	$4,878.5	$4,094.2	**$8,825,270.7**
1	42	$67,382.0	$16,933.0	$2,830,044.1
2	32	$51,625.4	$14,888.4	$1,652,012.3
3	53	$33,080.3	$19,515.9	$1,753,254.3
4	11	$71,140.3	$23,479.5	$782,543.2
5	59	$42,926.3	$27,649.8	$2,532,652.3
6	129	$34,225.3	$19,187.4	$4,415,064.3
7	24	$30,915.1	$15,252.7	$741,961.7
8	47	$51,069.6	$22,984.6	$2,400,271.4
9	38	$29,111.0	$20,625.7	$1,106,217.5
10	55	$38,091.7	$21,986.2	$2,095,042.9
11	16	$40,804.8	$17,466.5	$652,877.3
999	145	$36,326.8	$17,655.1	$5,259,674.3
Total	**2460**	**$14,246.7**	**$4,864.8**	**$35,046,886.2**

-1 MISSING

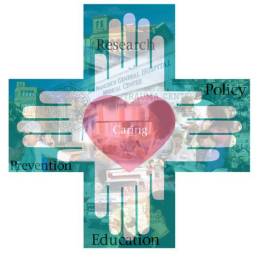
UCSF
University of California
San Francisco



UCSF
University of California
San Francisco

Conclusions

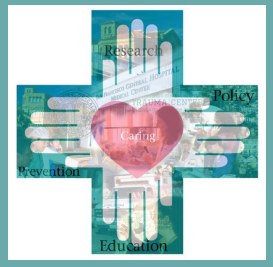
- Police records underreport severe bicycle-related injuries by 26%
- $35 million was spent on medically treating bicycle injuries in San Francisco over a decade
- For 70% of the patients, costs were charged to public funds
- Proportion of bicycle-related injuries and their costs appear to be increasing over time



UCSF
University of California
San Francisco

Conclusions

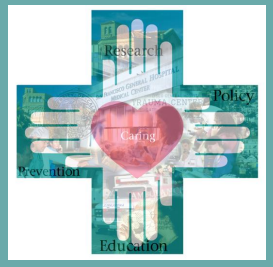
- **Cyclist-only injuries:**
  - Were admitted at almost 3 times the rate of BVA injuries
  - Accounted for half of all bicycle-related admissions
  - Had higher % of head, face, extremity, and skin injuries compared to BVA
  - Were especially unlikely to be police-reported
  - Accounted for 1/3 of the total cost of bike injury



UCSF
University of California
San Francisco

Recommendations

- **Establish more holistic surveillance system to elucidate incidence, severity, and crash circumstances**
  - Help from trauma centers and ERs?
- **Vary prevention efforts to target diverse bicycle circumstances (do not focus solely on the automobile as offending agent)**
- **Explore helmet use policy among adults**
  - CA law requires helmet use by those <18



Thank you.

For further questions, please contact me!

Dahianna Lopez, RN, MSN, MPH

Prevention Director

lopezd@sfghsurg.ucsf.edu

UCSF

University of California
San Francisco

advancing health worldwide™

UCSF
University of California
San Francisco

School of Medicine

UCSF
University of California
San Francisco

School of Medicine

UCSF University of California San Francisco

Results

	Matched		SFGH Only		SWITRS Only		p-value
SFGH: ED Transported by*:	N	%	N	%	N	%	<0.001‡
Ambulance	363	97.1	519	86.4	-	-	
Unknown	2	0.5	10	1.7	-	-	
Self	9	2.4	72	12.0	-	-	
Total	374	100.0	601	100.0	-	-	

UCSF University of California San Francisco

Results

	Matched		SFGH Only		SWITRS Only		p-value
SFGH: HOS ISS score	N	%	N	%	N	%	
Median	10.0		10.0		-	-	**0.009†**
0 - 15	240	74.3	345	70.1	-	-	**0.233‡**
16 - 30	69	21.4	130	26.4	-	-	
> 30	14	4.3	17	3.5	-	-	

UCSF University of California San Francisco

Results

	Matched		SFGH Only		SWITRS Only		p-value
SFGH: Hospital Disposition	N	%	N	%	N	%	0.032‡
Home	332	87.4	510	89.6	-	-	
Other Hospital	36	9.5	54	9.5	-	-	
Expired	12	3.2	5	0.9	-	-	
Total	380	100.0	569	100.0	-	-	

UCSF University of California San Francisco

Results

	Matched		SFGH Only		SWITRS Only		p-value
SFGH: HOS body region	N	%	N	%	N	%	
Head & Neck	111	34.4	256	52.0	-	-	**0.00‡**
Face	51	15.8	115	23.4	-	-	**0.009‡**
Chest	61	18.9	78	15.9	-	-	**0.26‡**
Abdomen	38	11.8	43	8.7	-	-	**0.158‡**
Extremity	127	39.3	207	42.1	-	-	**0.434‡**
External	167	51.7	279	56.7	-	-	**0.16‡**

UCSF University of California San Francisco

Results

	Matched		SFGH Only		SWITRS Only		p-value
SFGH: Insurance Status†	N	%	N	%	N	%	
Public	166	70.9	294	68.7	-	-	**0.548‡**
Private	68	29.1	134	31.3	-	-	
Total	234		428		-	-	

Results (Police vs. Hospital)

	Matched		SFGH Only		SWITRS Only		p-value
SFGH:Race	N	%	N	%	N	%	
1 White	649	61.9	868	61.5	-	-	**0.69‡**
2 African American	111	10.6	129	9.1	-	-	
3 Hispanic	134	12.8	204	14.5	-	-	
4 All Others	155	14.8	210	14.9	-	-	
Total	1049	100.0	1411	100.0			

Over half on injured cyclists are White, but this distribution is similar to SF population.

Results (BVA vs. Cyclist-Only)

		Head Injury				
		Yes		No		p-Value
		N	%	N	%	
BVA	Helmet	37	39.4	57	60.6	0.199‡
	No Helmet	138	46.9	156	53.1	
Cyclist-Only	Helmet	52	46.8	59	53.2	0.003‡
	No Helmet	122	64.6	67	35.4	

Some evidence to suggest an association between helmet use and head injury in cyclist-only group.

Among this group, those wearing helmets had lower proportion of head injuries versus those not wearing them. (Vice versa with no helmet)

UCSF University of California San Francisco

Results (Police vs. Hospital)

		Matched		SFGH Only		SWITRS Only		p-value
Gender		N	%	N	%	N	%	<0.001‡
	Male	822	78.4	1134	80.4	1845	64.6	
	Female	227	21.6	277	19.6	819	28.7	
	Missing	0	0.0	0	0.0	190	6.7	
	Total	1049	100.0	1411	100.0	2854	100.0	

SWITRS reports a higher proportion of females and a lower proportion of males compared to SFGH.

Results (BVA vs. Cyclist-Only)

	BVA		Cyclist-Only		p-value
		%		%	
Helmet Use by Age					
1 to 17	2	3.3	8	28.6	**0.001‡**
18 to 64	89	12.5	101	32.0	**0.000‡**
65 and above	3	33.3	2	18.2	**0.617‡**
Total Helmet	94	12.0	111	31.3	**0.000‡**
Total No Helmet	688	88.0	244	68.7	**0.000‡**

Higher proportion of cyclist-only adults wore helmets

However, the majority of both user types did not wear a helmet