Building the tools for estimating the global burden of injuries

Kavi Bhalla

Harvard Initiative for Global Health

This work is supported by a grant from the World Bank Global Road Safety Facility

Summary: Estimating road traffic injuries in developing countries

Key Ideas:

- Make the most of existing sources of information

- Boldly make estimates in the face of poor quality data

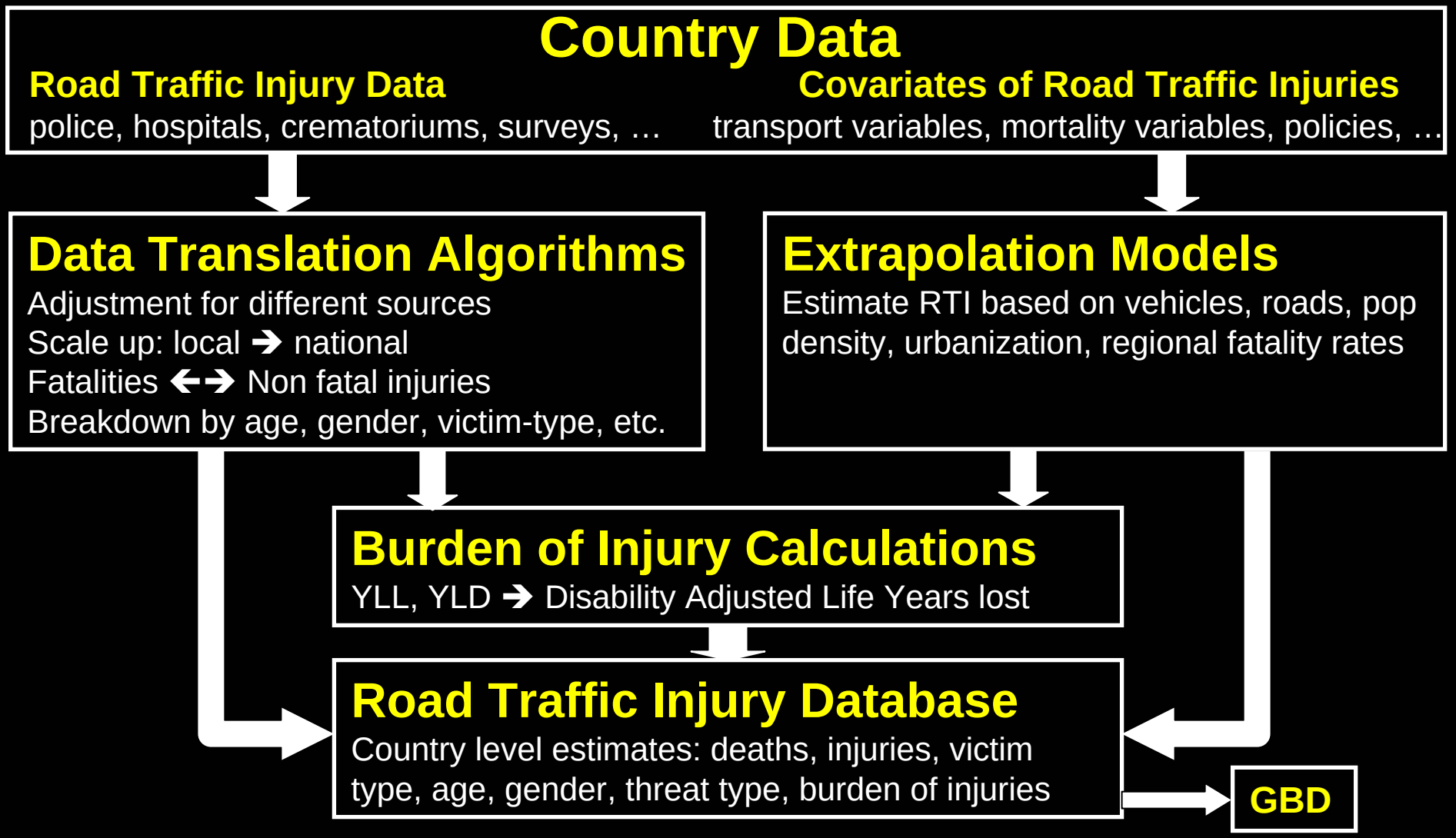
Talk Outline

1. Building country estimates of the burden of injuries from road traffic crashes
   - Estimates for 2 developing countries: Iran, Mexico
   - Example of the technical challenges
     - Estimating the external causes of injuries from the injuries recorded in hospital databases
2. Building global estimates of the burden of injuries
   - Data sources in all countries
   - Global Burden of Disease Injuries Expert Group

Country estimates of road traffic injuries in developing countries

Harvard-WB* RTI metrics project

A standardized cross-national database for road traffic injuries and covariates



*World Bank Global Road Safety Facility

FOCUS COUNTRIES

M. East & N. Africa
- Iran *(done)*
- Egypt

Latin America
- Mexico *(done)*
- Argentina
- Colombia (*done)*

South Asia
- India
- Sri Lanka

High Income
- Greece
- USA

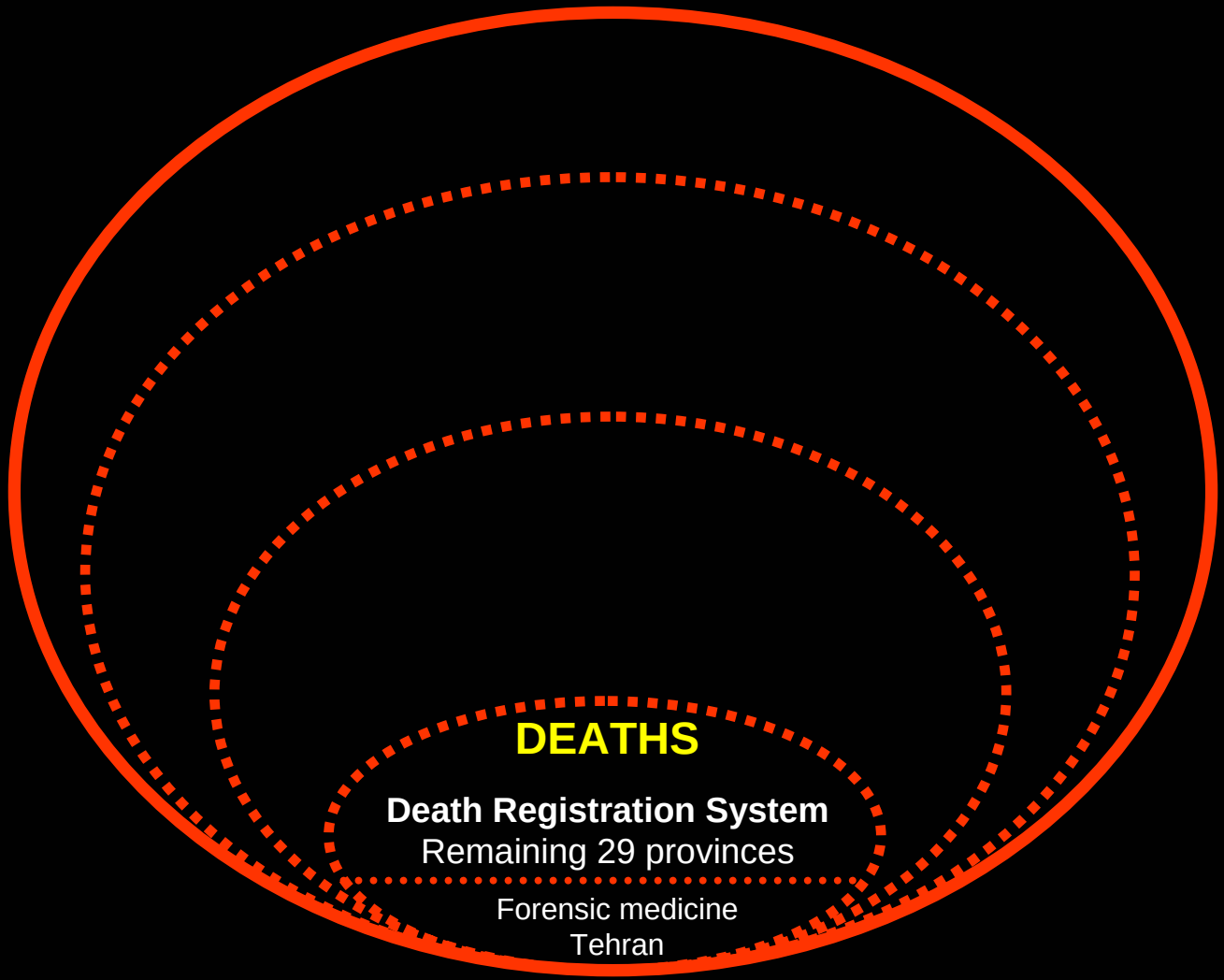
Sub Saharan Africa
- Kenya
- Ghana
- Mozambique

East Asia & Pacific
- China
- Thailand
- Vietnam

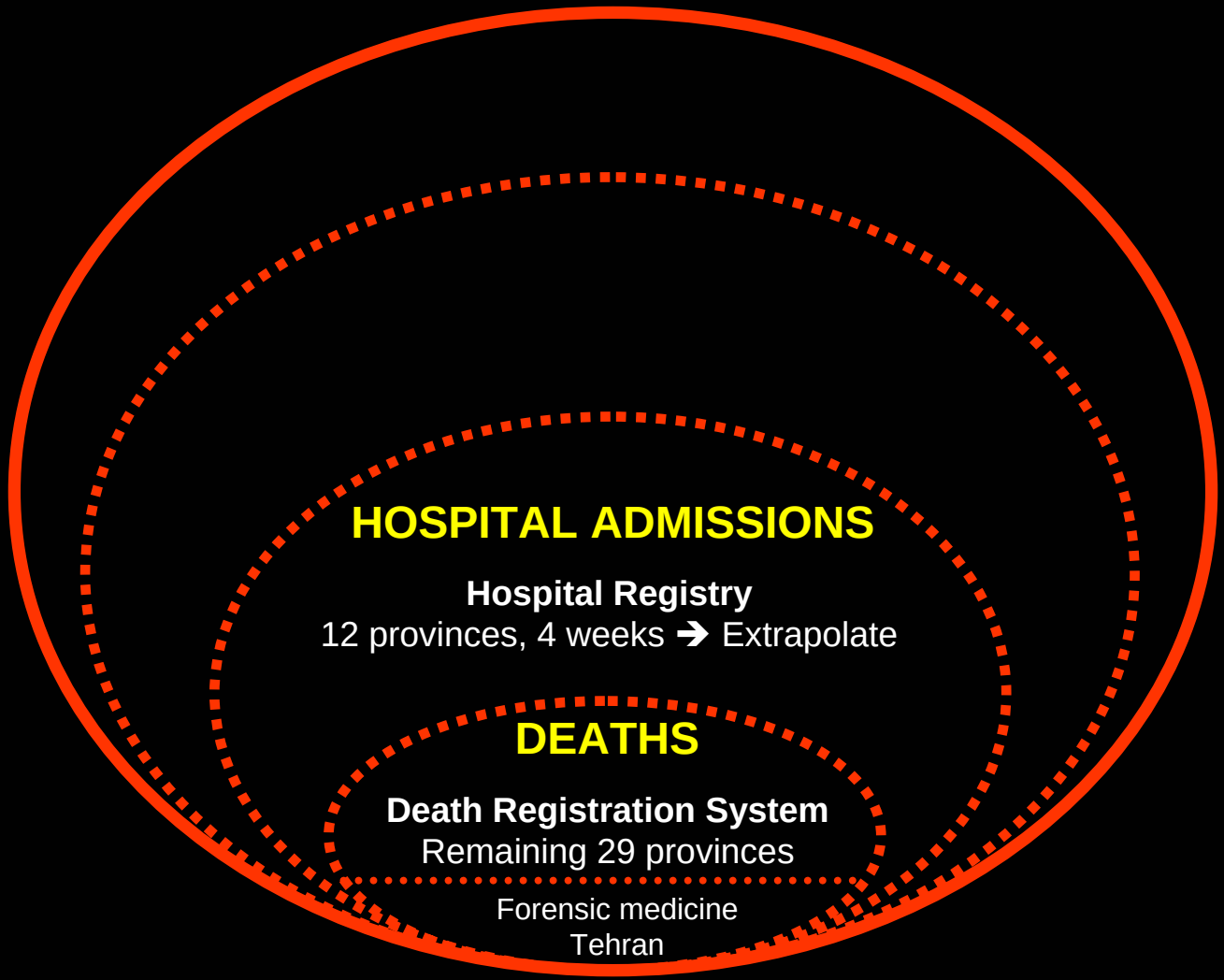
Europe & C. Asia
- Poland
- Armenia
- Russian Federation

Road traffic injuries in Iran

Iran – building a national snapshot

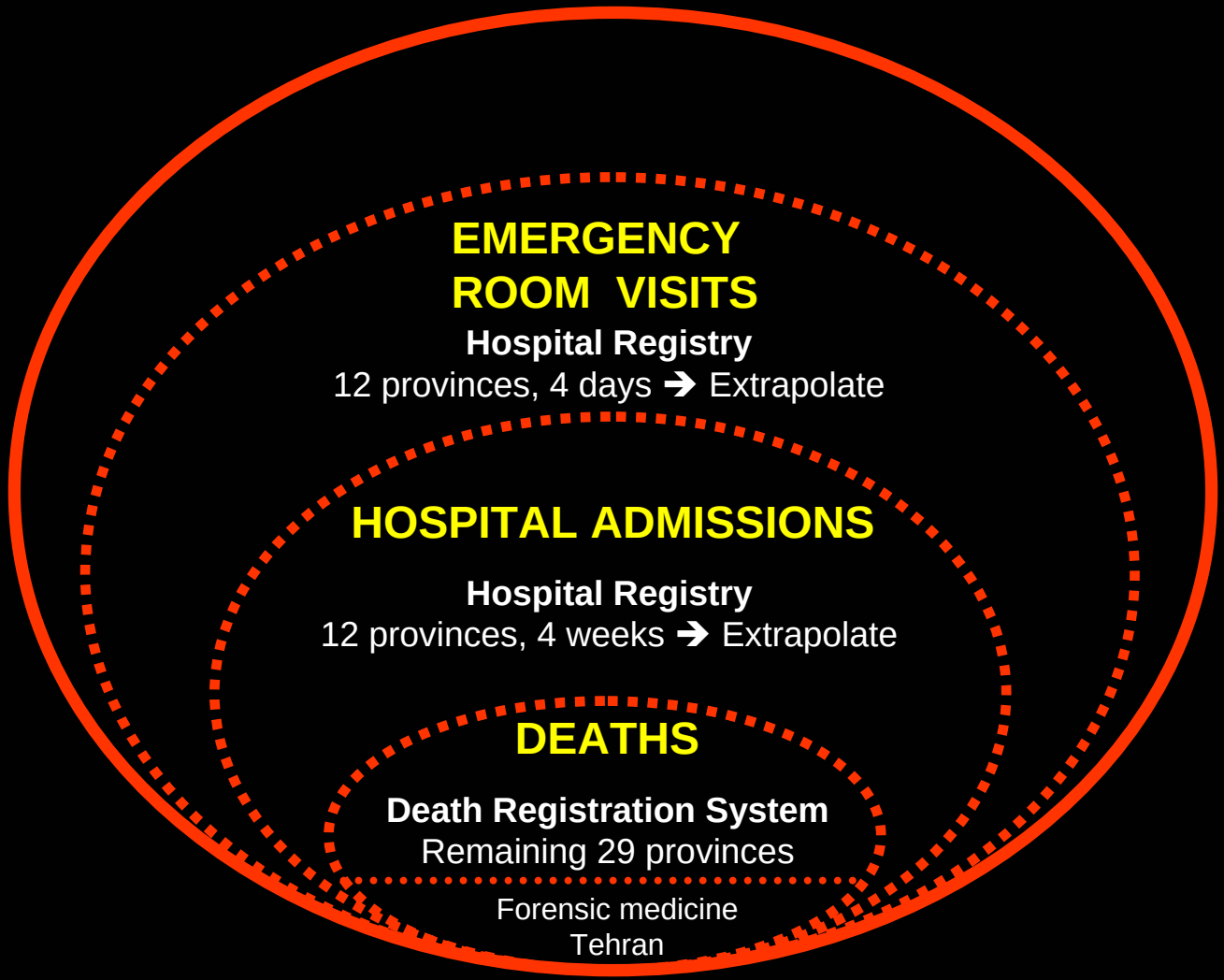


Iran – building a national snapshot



“Extrapolate” : apply age-sex-victim type incidence rates to entire population

Iran – building a national snapshot



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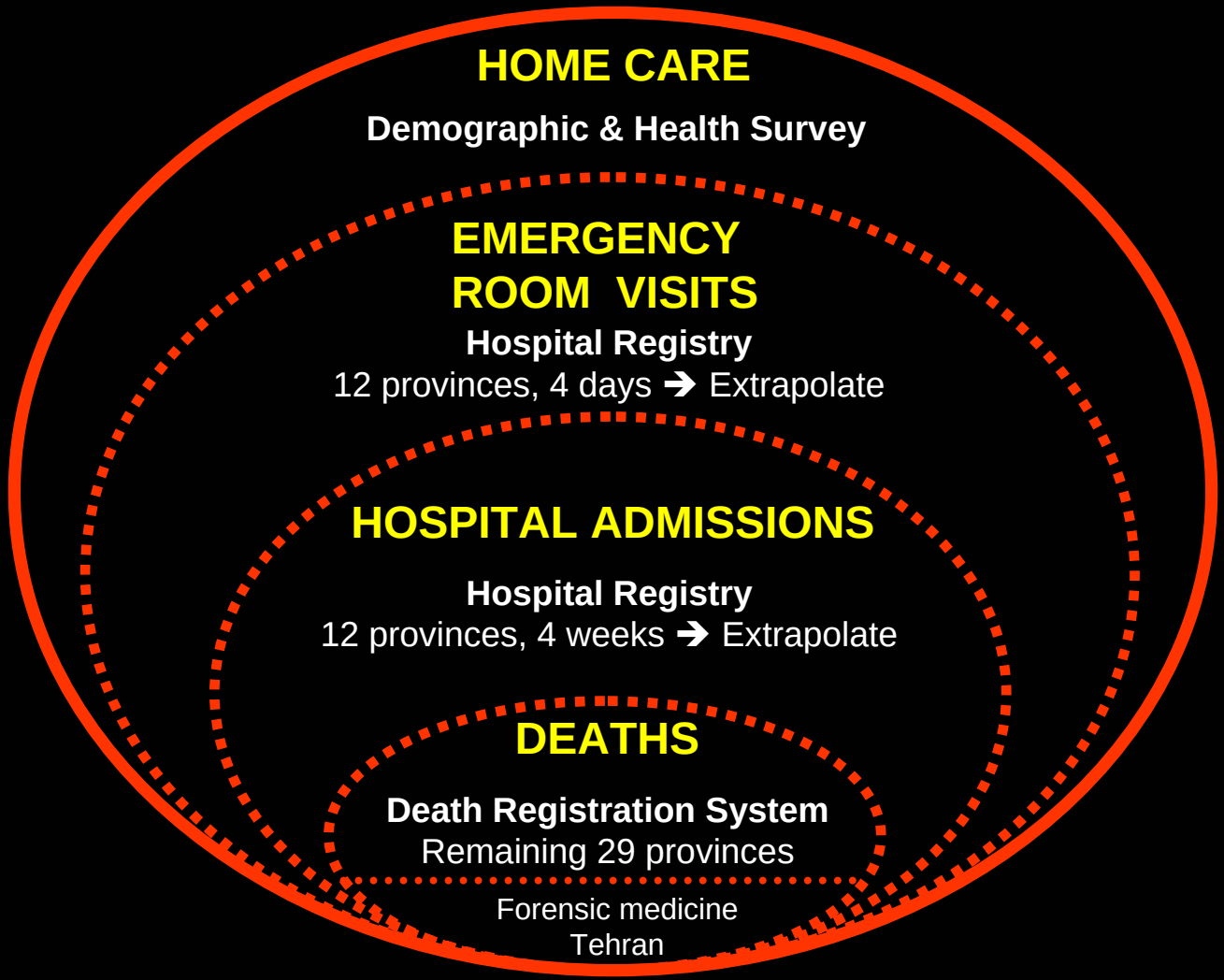
Iran – building a national snapshot



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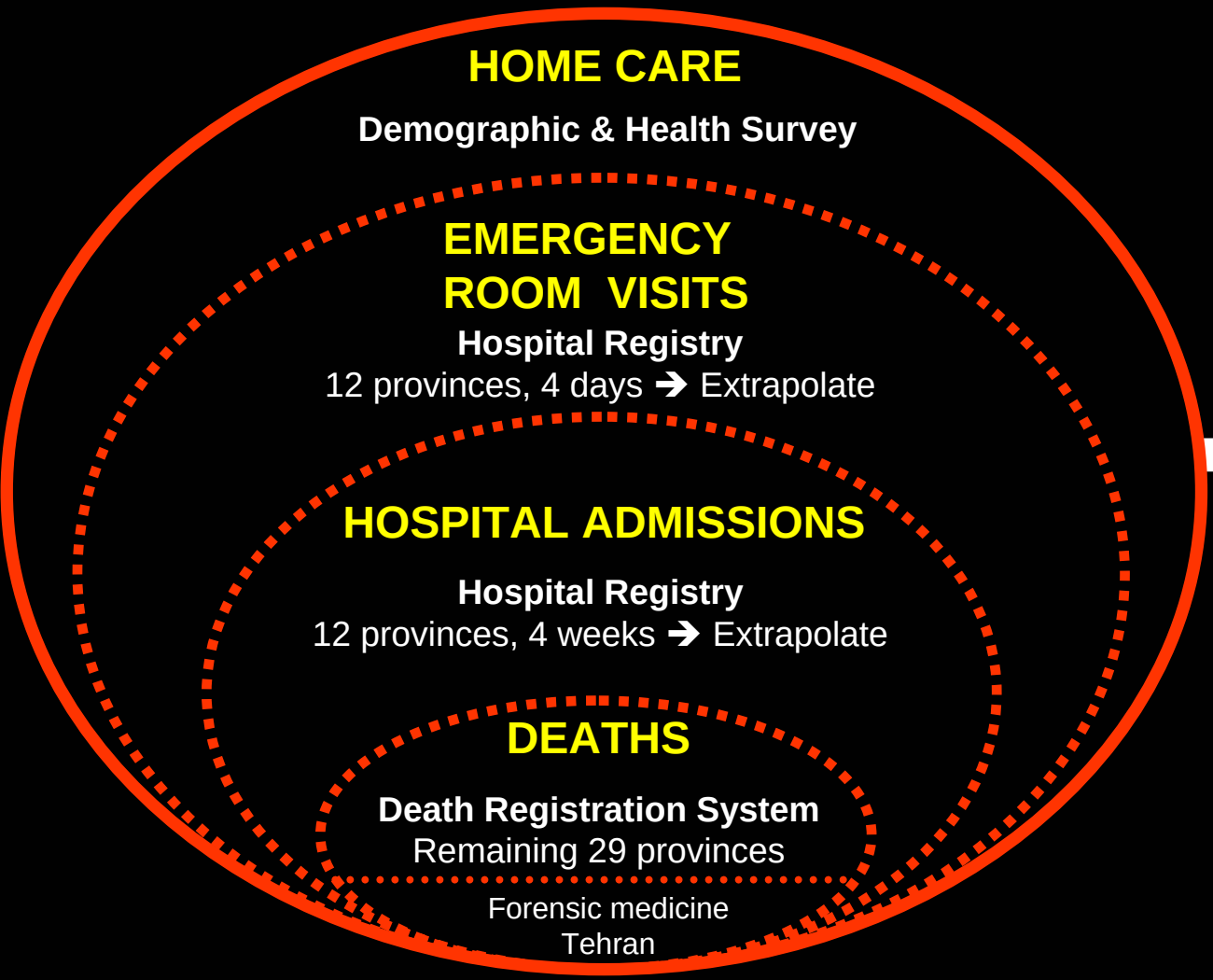
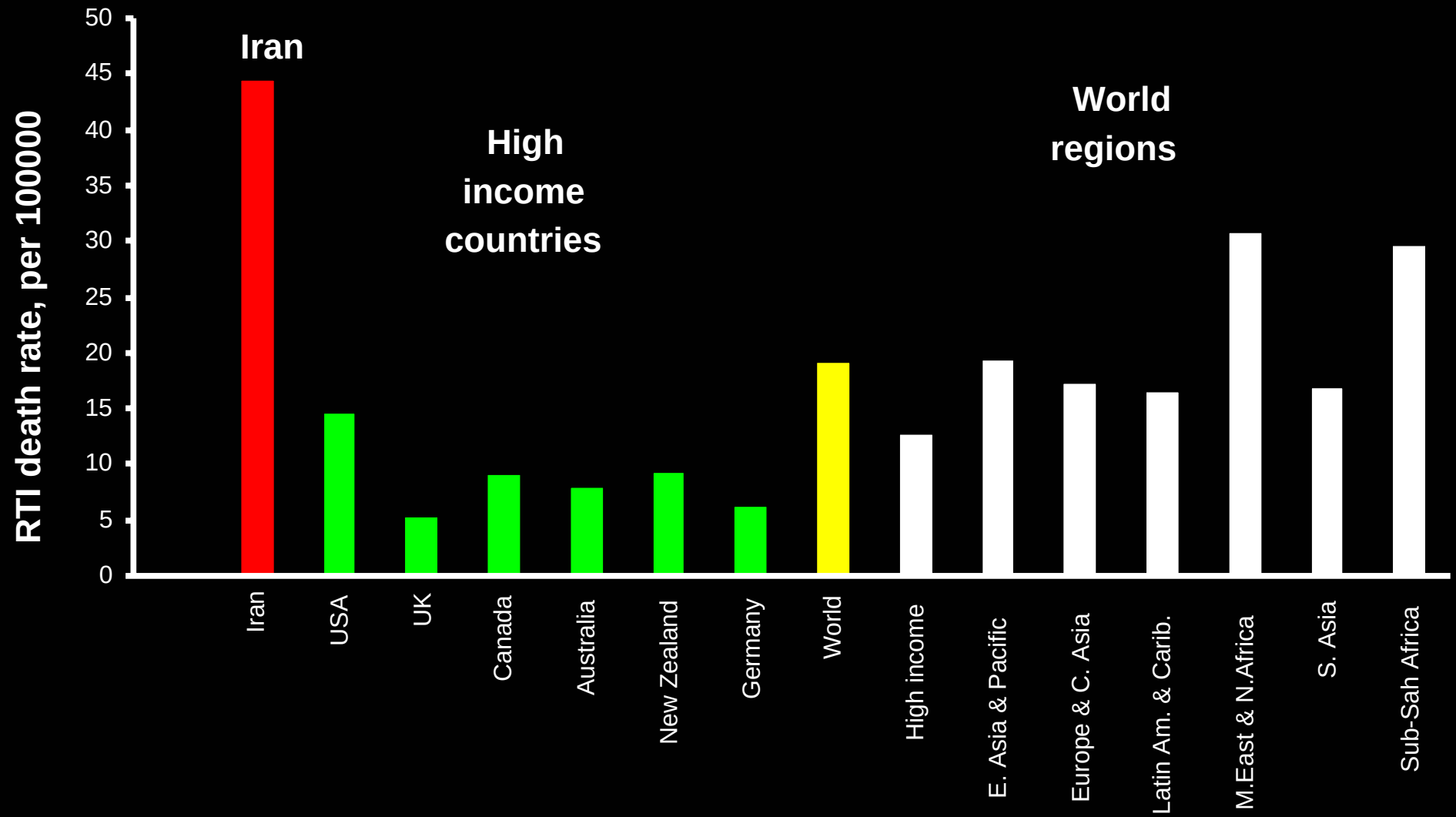


Broken down by

- age and sex groups
- urban/rural
- institutional care received
- injury severity
- victim mode (pedestrian, motorcycle, car occup, etc)
- impacting vehicle
- injuries (head, limb, etc)
- time of day
- type of road

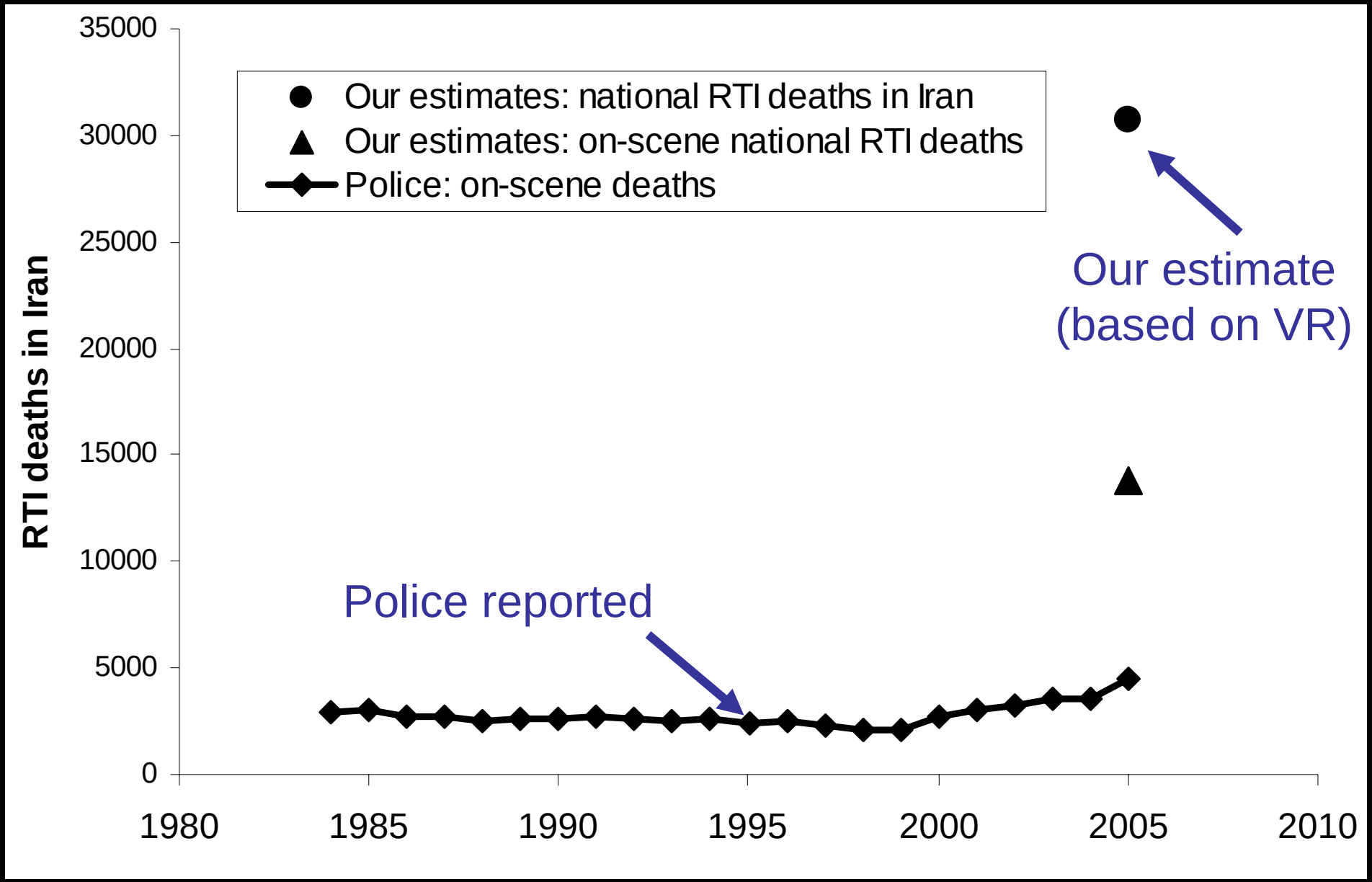
Results


RTI death rate, per 100000
50
45
40
35
30
25
20
15
10
5
0
Iran
High income countries
World regions
Iran
USA
UK
Canada
Australia
New Zealand
Germany
World
High income
E. Asia & Pacific
Europe & C. Asia
Latin Am. & Carib.
M.East & N.Africa
S. Asia
Sub-Sah Africa

Iran: RTI deaths vs other causes

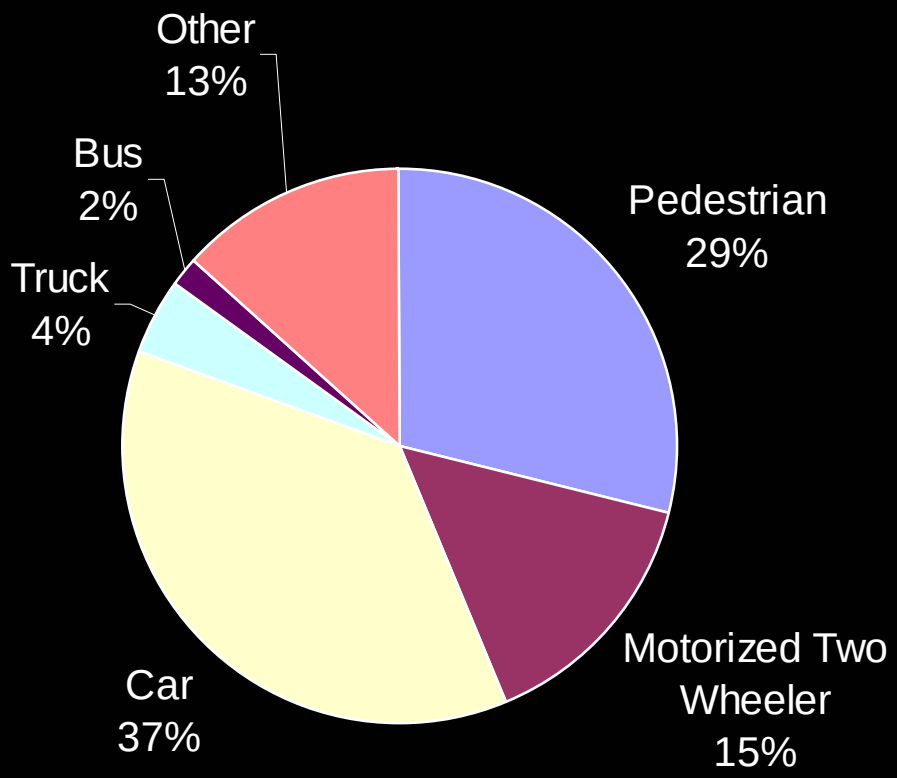
Rank	Cause of Death	# of deaths	% total deaths
	All causes	299338	100%
1	Myocardial infarction	68892	23%
2	Cerebral vascular diseases	33922	11.3%
3	Road traffic injuries	30721	10.3%
4	Other cardiac diseases	11459	3.8%
5	Stomach cancer	7799	2.6%
6	Chronic lung & bronchus disease	5297	1.8%
7	Cancer of trachea,bronchus & lung	4596	1.5%
8	Disorders related to short gestation and low birth weight	4443	1.5%
9	Pneumonia	4413	1.5%
10	Intentional self- harm	4344	1.5%

RTI deaths: Police vs death registration



Iran: victim mode of transport

Deaths



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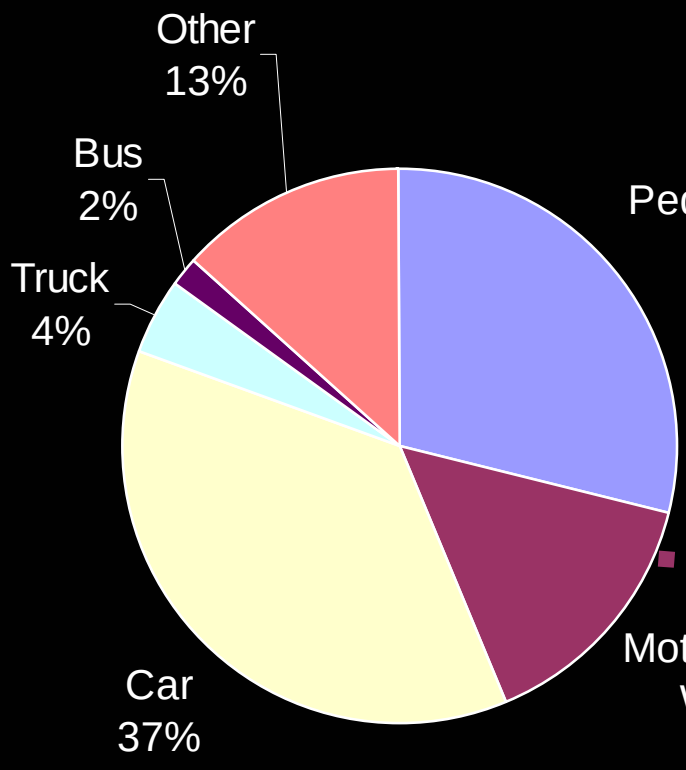
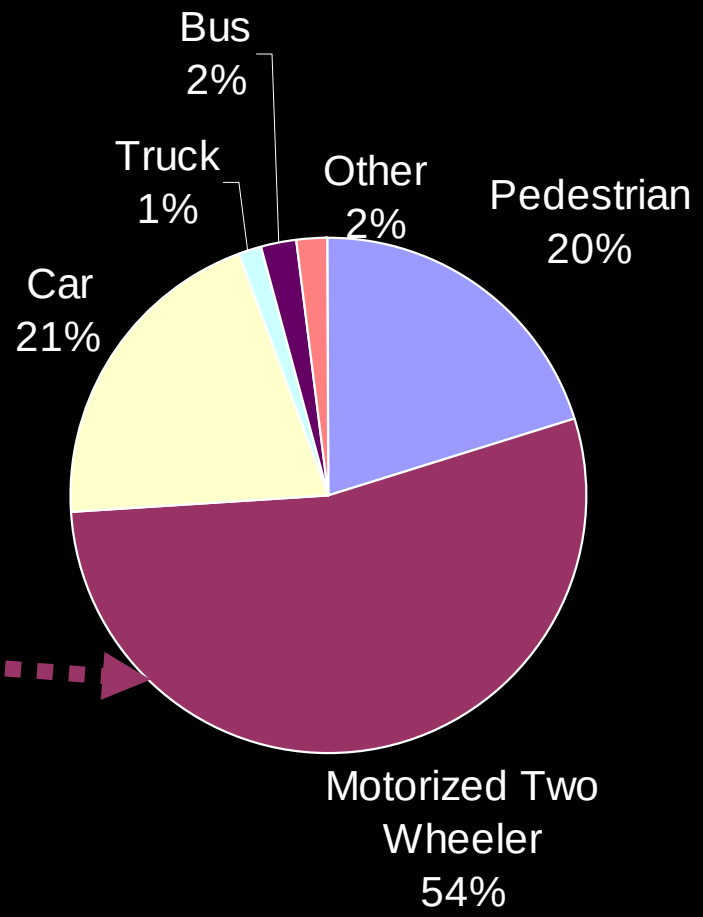
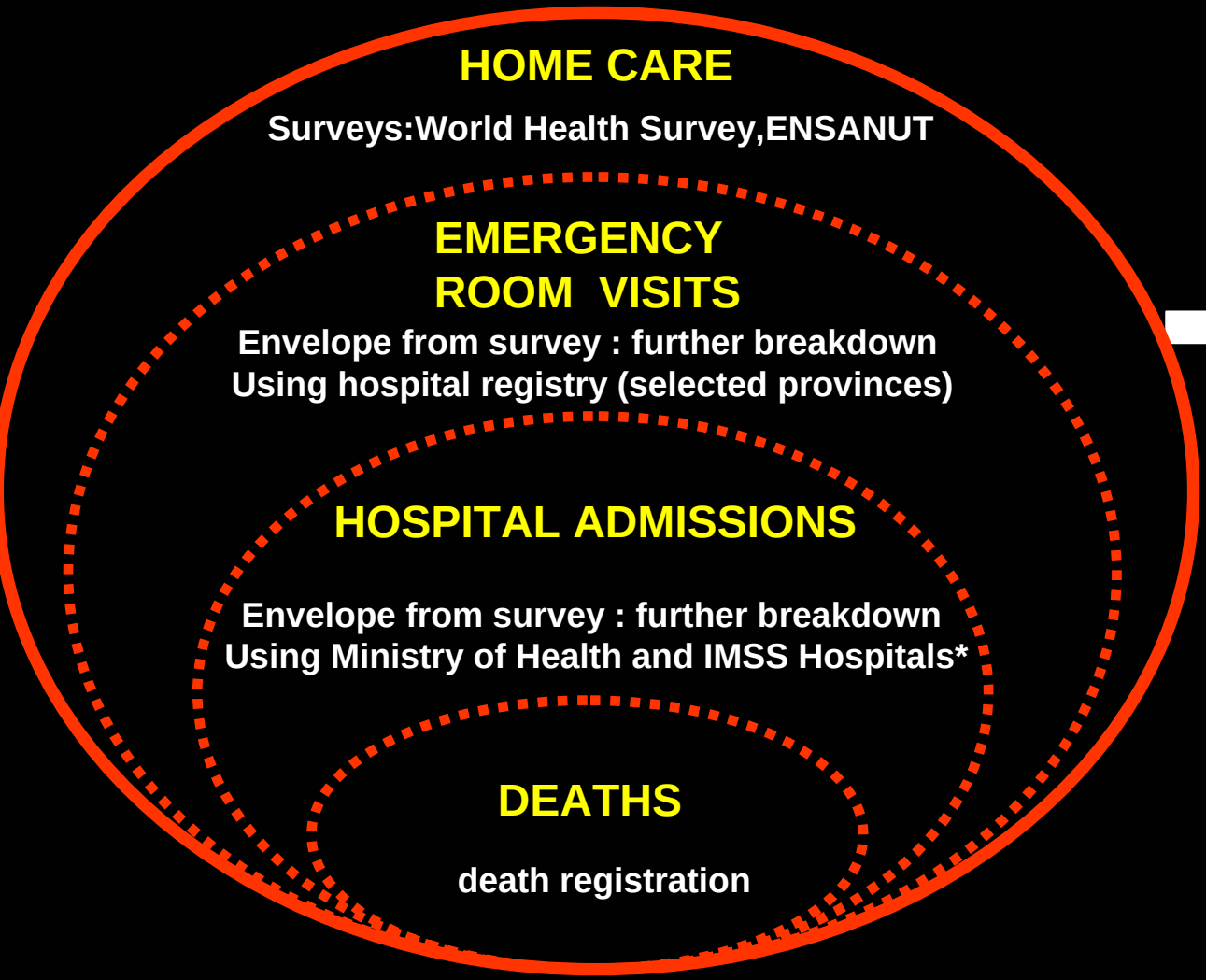


Hospital admissions



Road traffic injuries in Mexico

Mexico – building a national snapshot



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- time of day
- type of road

** IMSS does not report external causes*

Estimating external causes from injuries

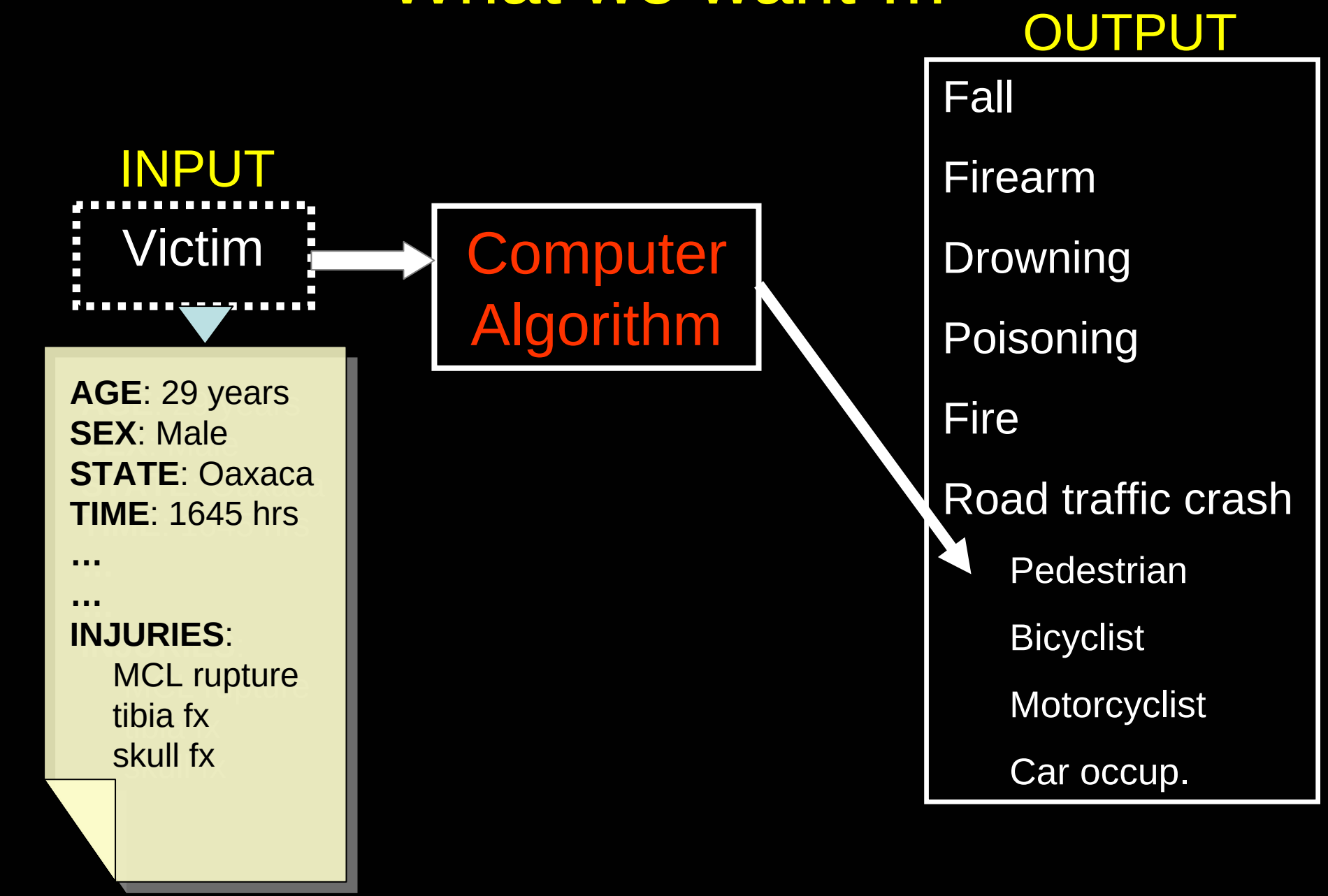
Problem:

- Hospitals record injuries
  (skull fx, ACL tear)
- But policy makers want external causes
  (Road traffic injuries, fall, drownings)

Solution:

- Estimate external causes from injuries

What we want …


INPUT
Victim
AGE: 29 years
SEX: Male
STATE: Oaxaca
TIME: 1645 hrs
…
…
INJURIES:
MCL rupture
tibia fx
skull fx
Computer Algorithm
OUTPUT
Fall
Firearm
Drowning
Poisoning
Fire
Road traffic crash
Pedestrian
Bicyclist
Motorcyclist
Car occup.

Bayesian Inference

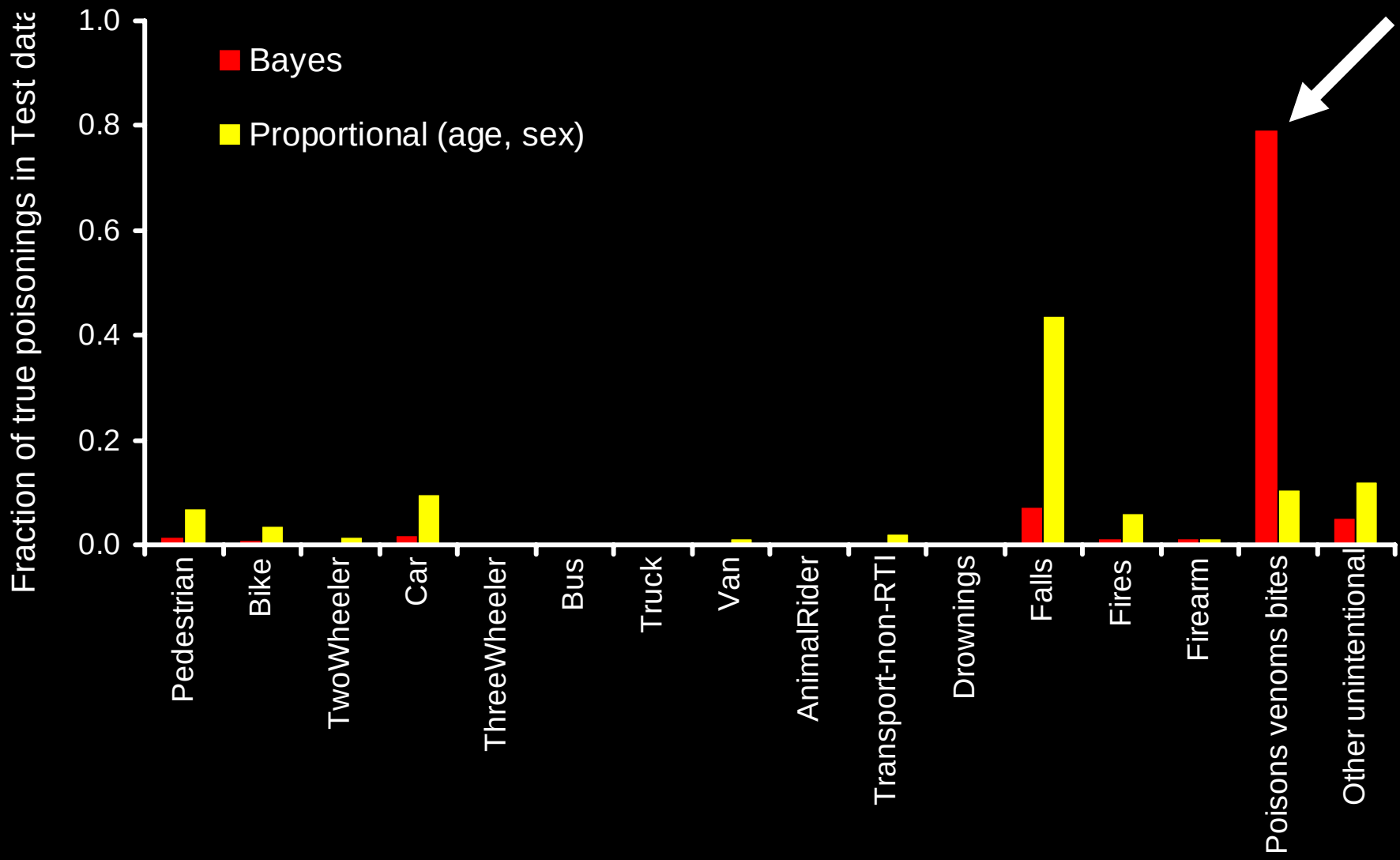
- Bayes theorem: updates prior knowledge (probability) using new knowledge
- For e.g.
  - Prior knowledge:
    - 10% of hospital admissions are from RTI
    - 80% of RTI victims have femur fractures
    - 20% of hospital admissions have femur fractures
  - New information: victim has a femur fracture
  - Bayes: *p(victim was an RTI)* = 80*10/20 = 40%

$$p\left(external.cause_i \middle| injury_j\right) = \frac{p(injury_j \middle| external.cause_i)\, p(external.cause_i)}{p(injury_j)}$$

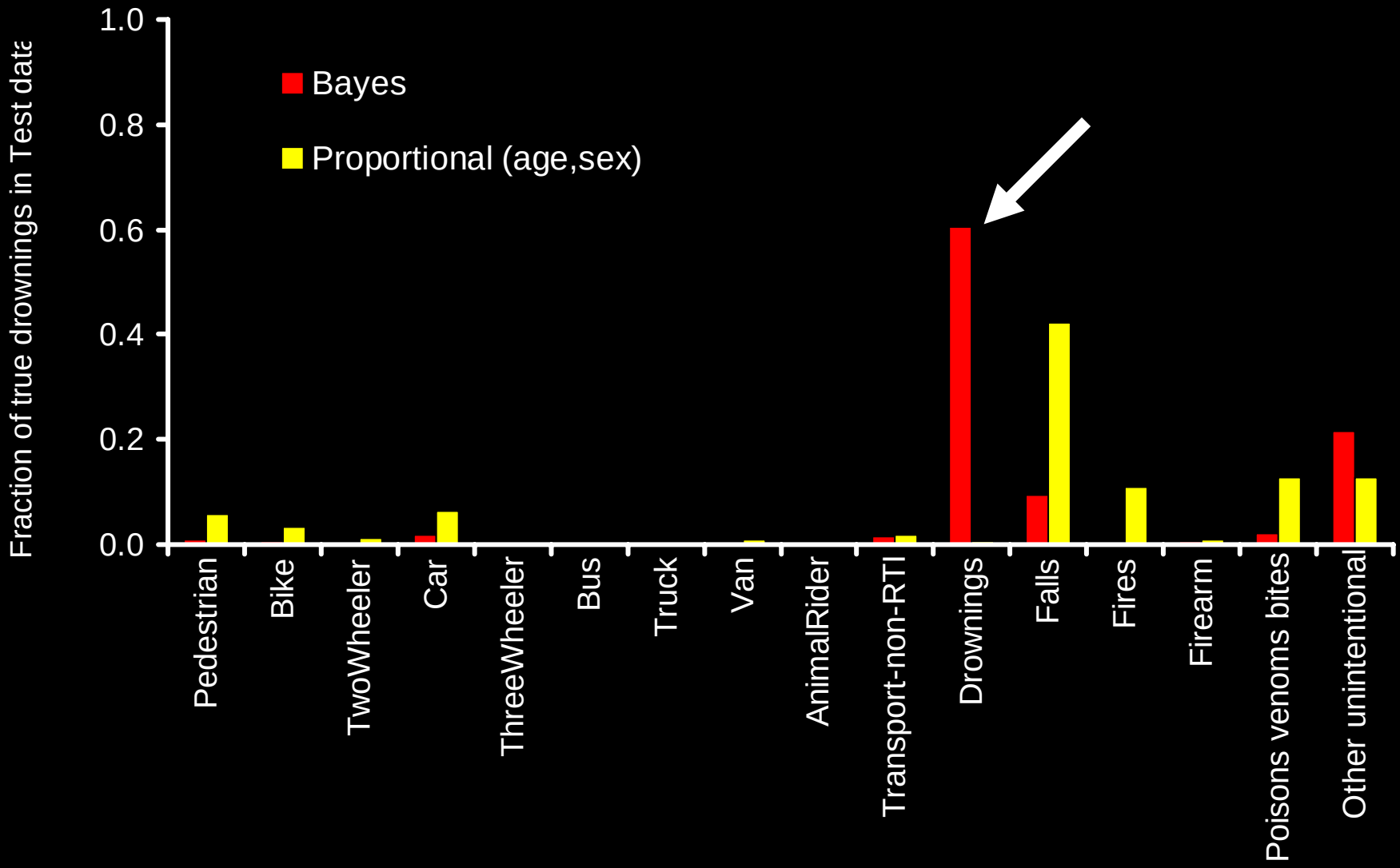
Implementing with Hospital Data

- Mexico MOH hospital dataset (injury cases)
  - Contains both injuries and external causes
  - Divide into two equal parts:
    1. Training dataset (~ 50,000 cases)
    2. Test dataset (remaining ~ 50,000 cases)
  - Use Training dataset to derive prior probabilities
    - Computed as a function of age and sex of victim
  - Predict external causes in Test dataset
  - Compare prediction with known answer

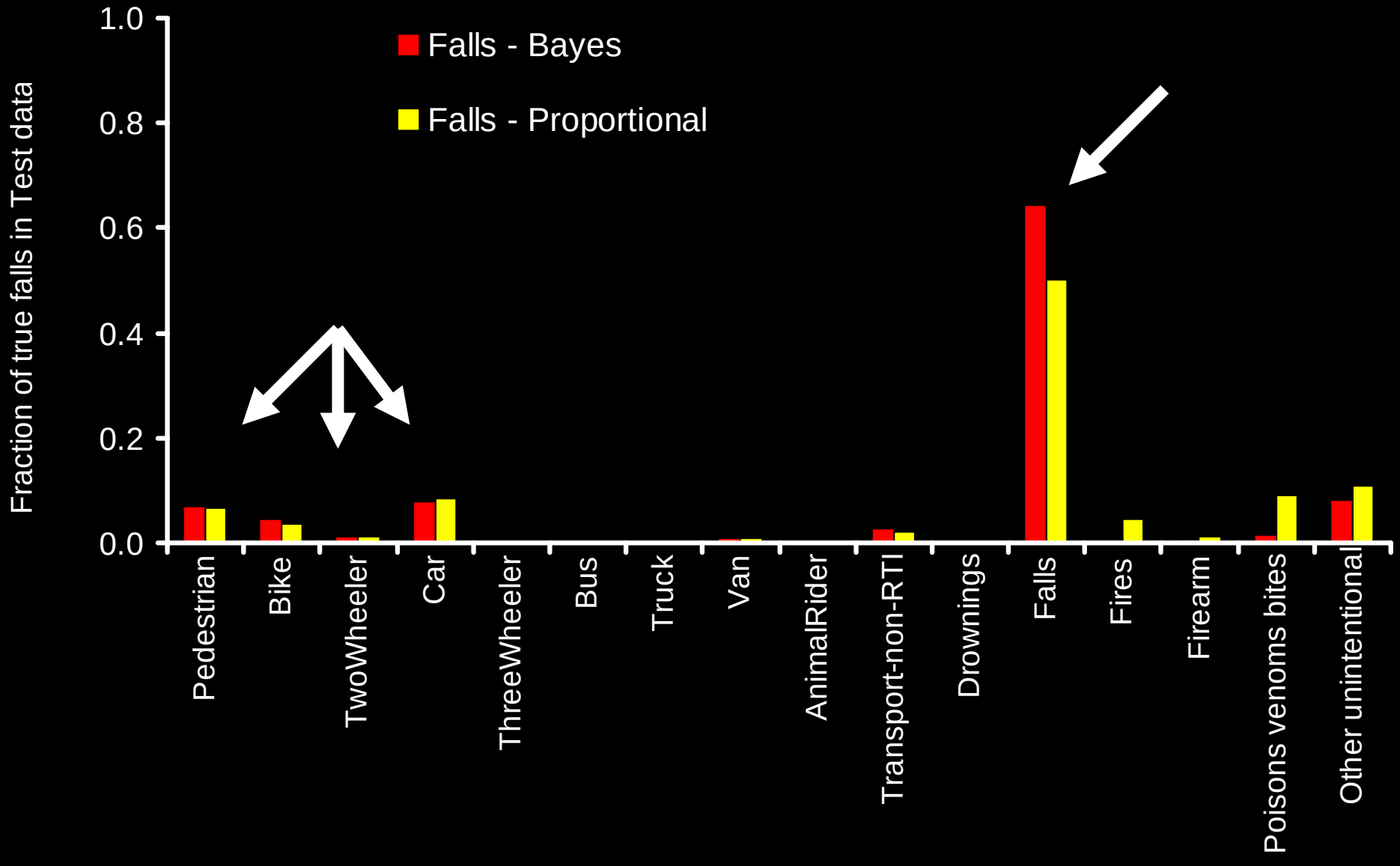
Validation Results: fraction of poisonings assigned correctly



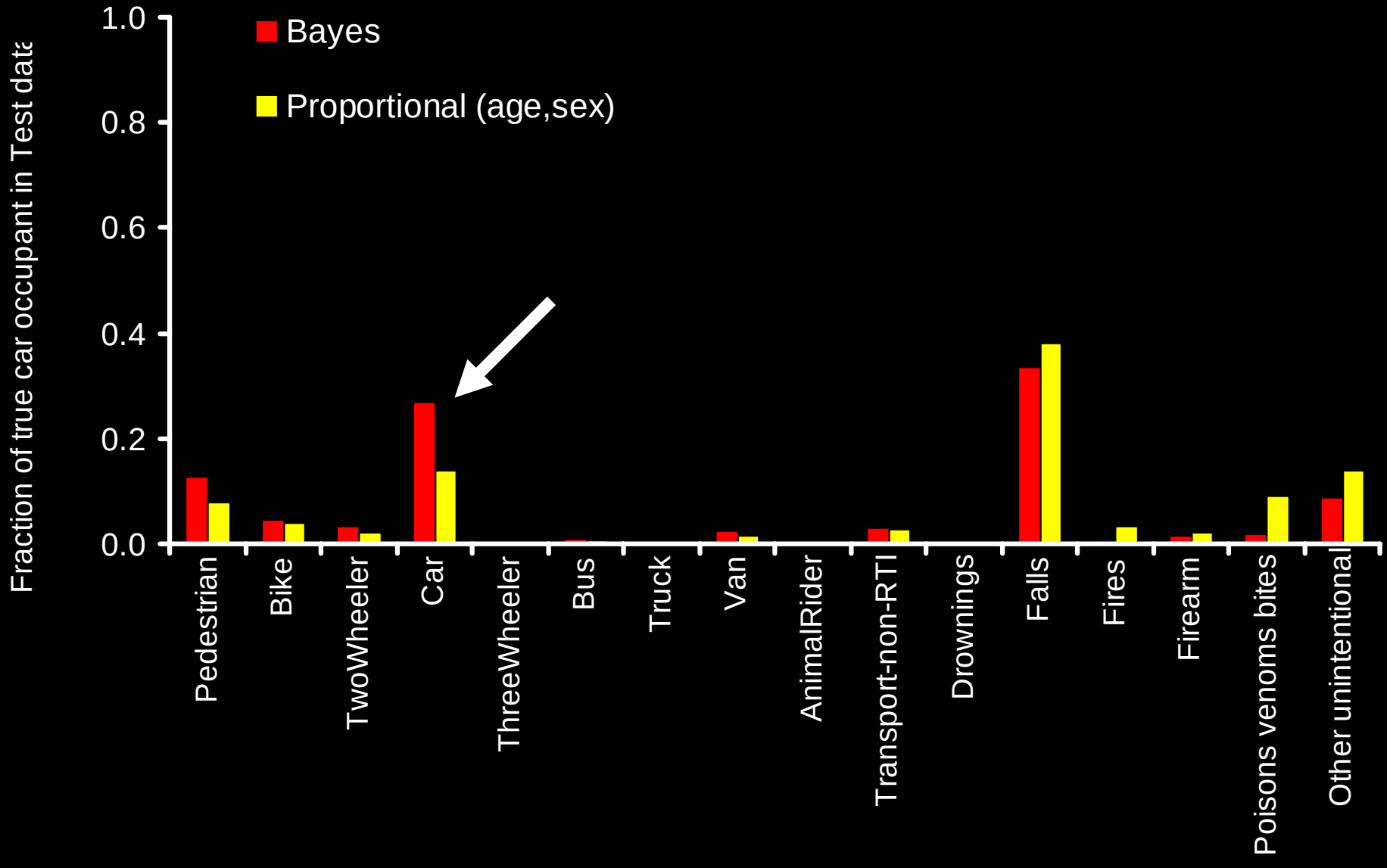
Validation Results: fraction of drownings assigned correctly



Validation Results: fraction of falls assigned correctly



Validation Results: fraction of car occup. assigned correctly



Rankings by frequency of occurrence

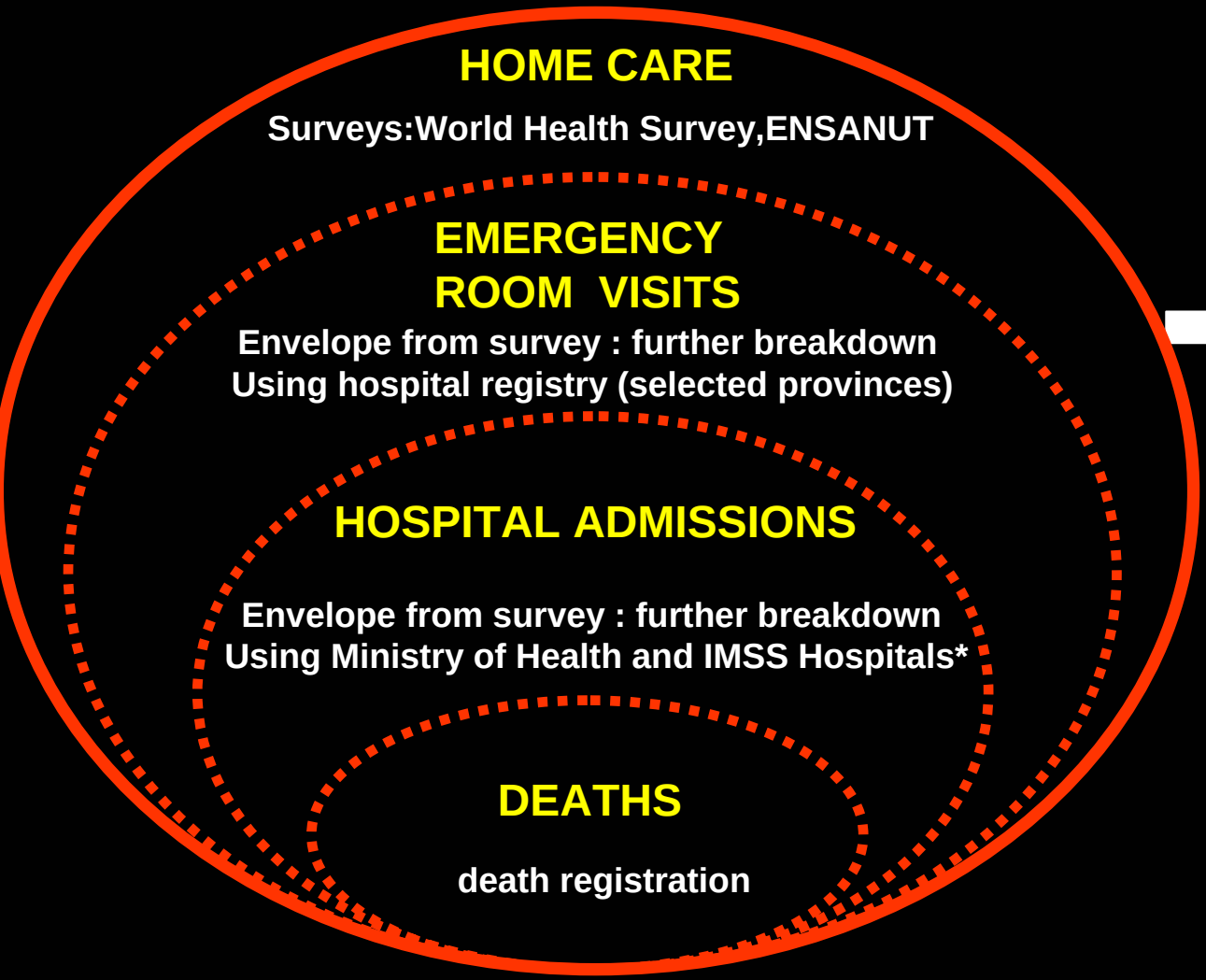
ICD code	Nature of Injuries	Falls	RTI-Pedestrian	RTI-Car
S069	Intracranial injury, unspecified	1	1	2
S828	Fractures of other parts of lower leg	2	6	11
S822	Fracture of shaft of tibia	3	2	5
S729	Fracture of femur, part unspecified	4	5	4
S720	Fracture of Neck of femur	5	13	17
S527	Multiple fractures of forearm	6	>50	20
S424	Fracture of lower end of humerus	7	>50	41
S423	Fracture of shaft of humerus	8	7	8
S528	Fracture of other parts of forearm	9	32	31
S525	Fracture of lower end of radius	10	50	43

Conclusions about Bayesian Inference

- Bayesian inference allows a rapid estimate of the distribution of external causes in large hospital datasets
- Performance
  - Works well for causes with clearly defined injuries
  - Not so well when underlying injuries are similar

- We need to make the best use of existing data sources rather than wait for quality to improve

Mexico – building a national snapshot



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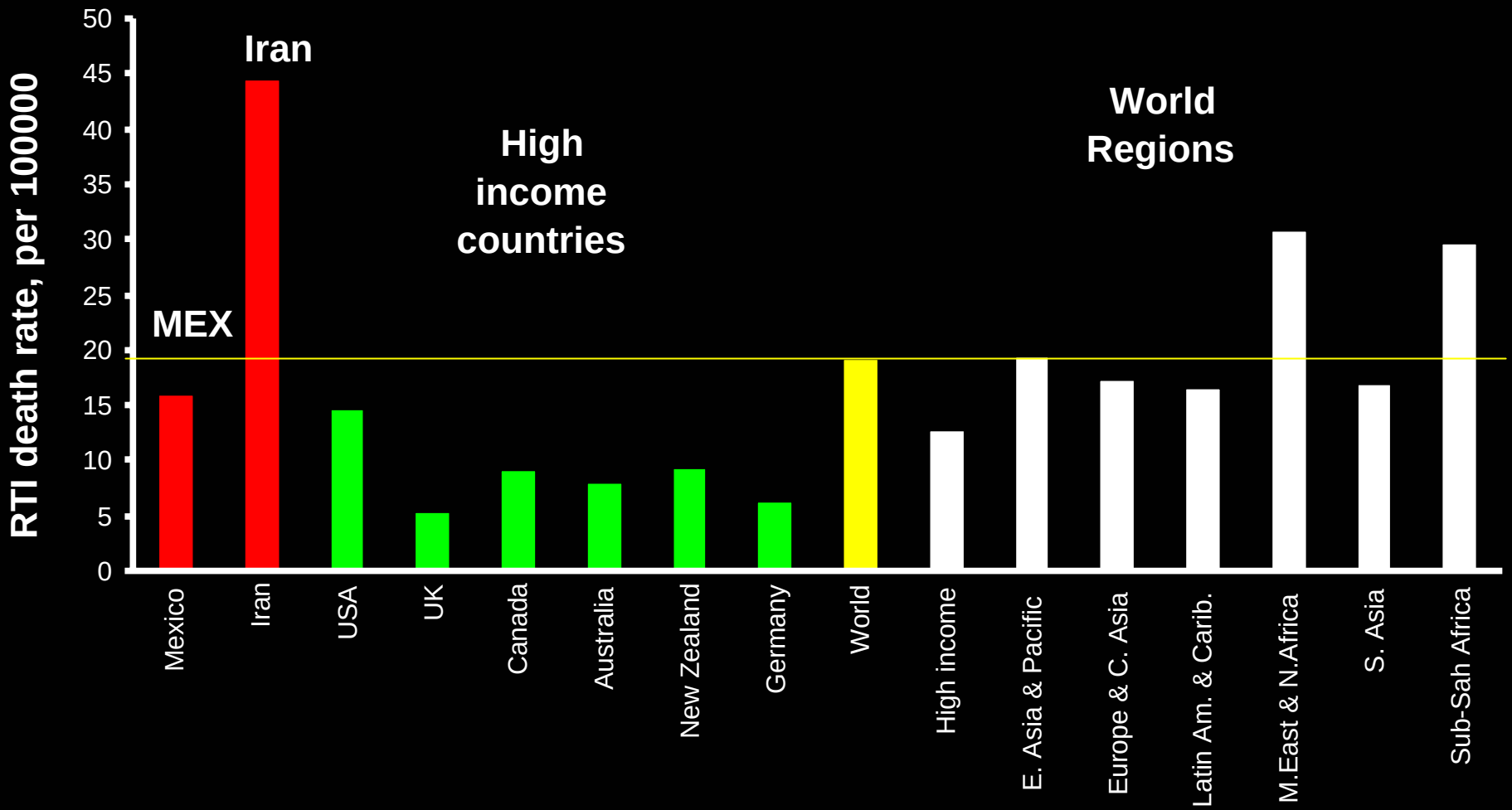
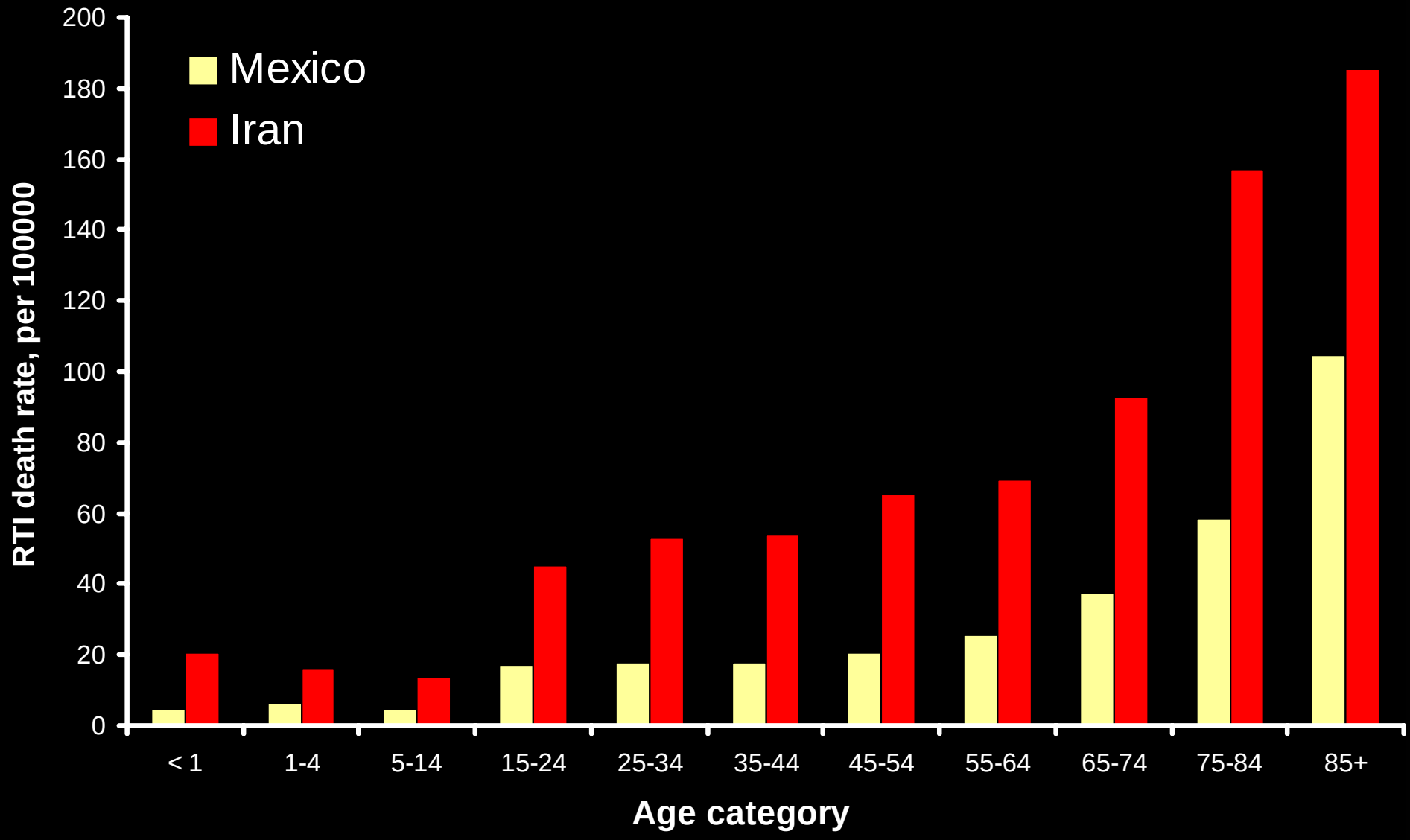
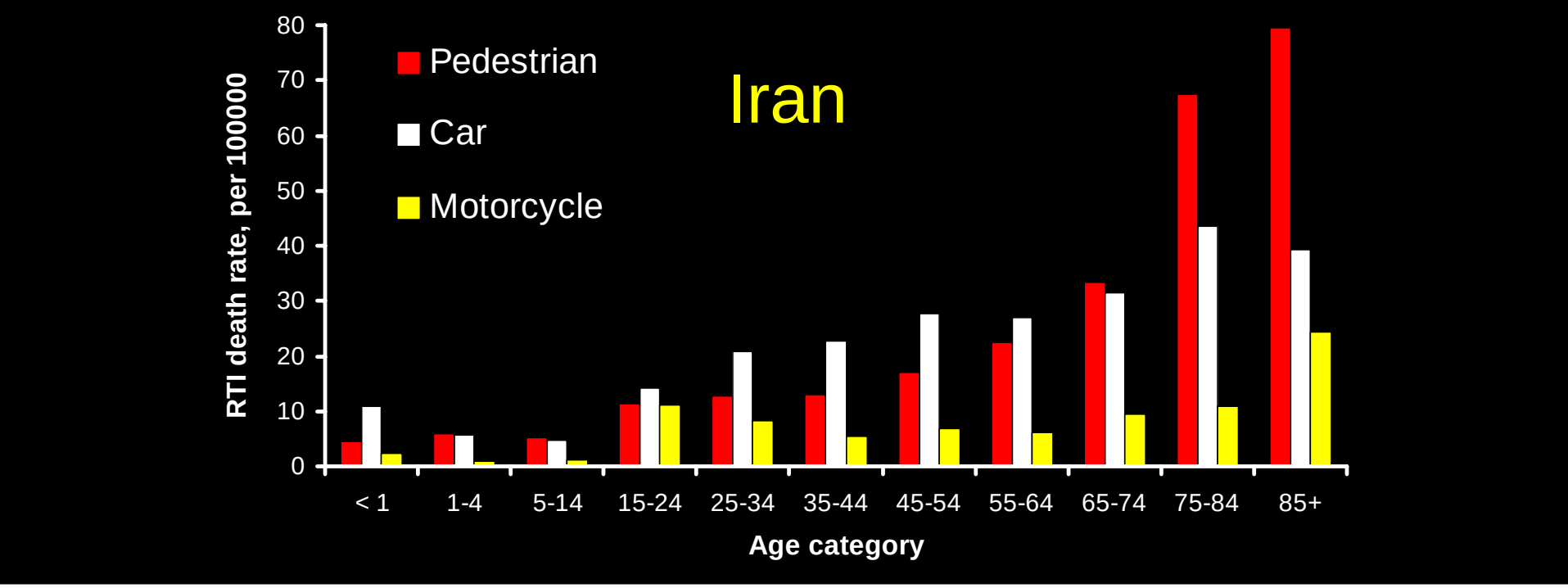
** IMSS does not report external causes*

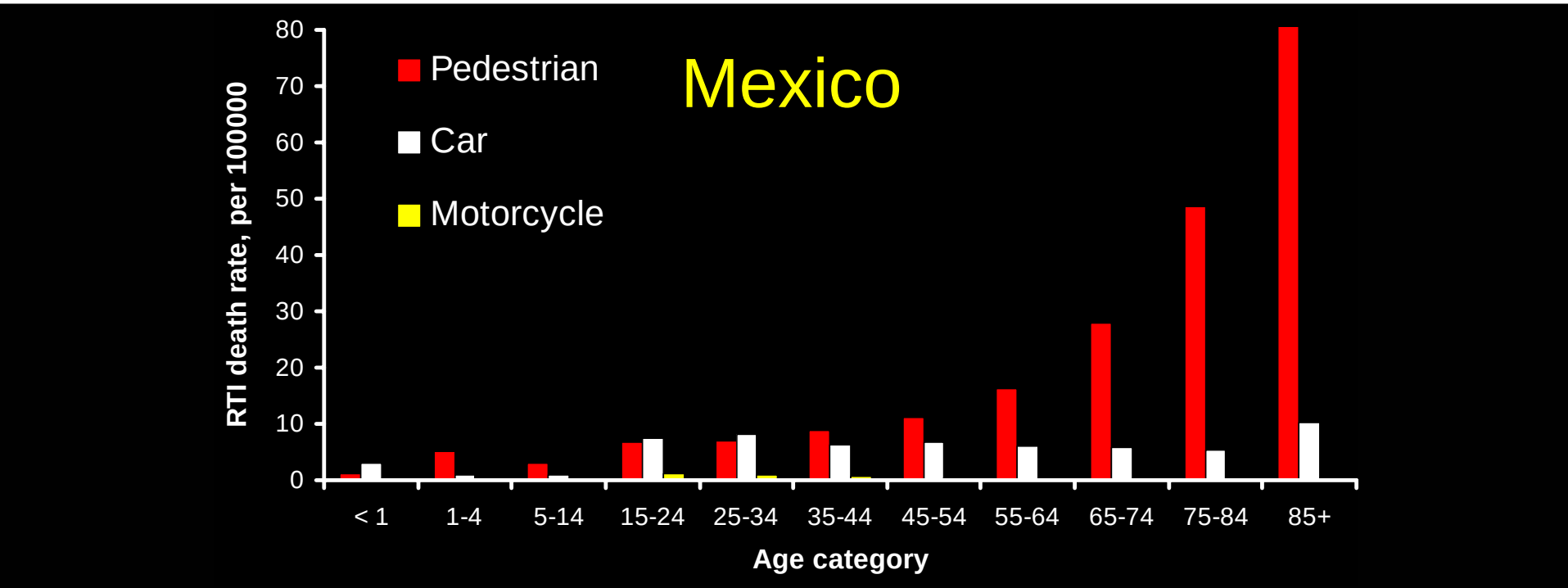
Mexico RTI death rates



Iran and Mexico: RTI death rates by age




Iran
Pedestrian
Car
Motorcycle
RTI death rate, per 100000
0
10
20
30
40
50
60
70
80
< 1
1-4
5-14
15-24
25-34
35-44
45-54
55-64
65-74
75-84
85+
Age category


Mexico
Pedestrian
Car
Motorcycle
RTI death rate, per 100000
0
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60
70
80
< 1
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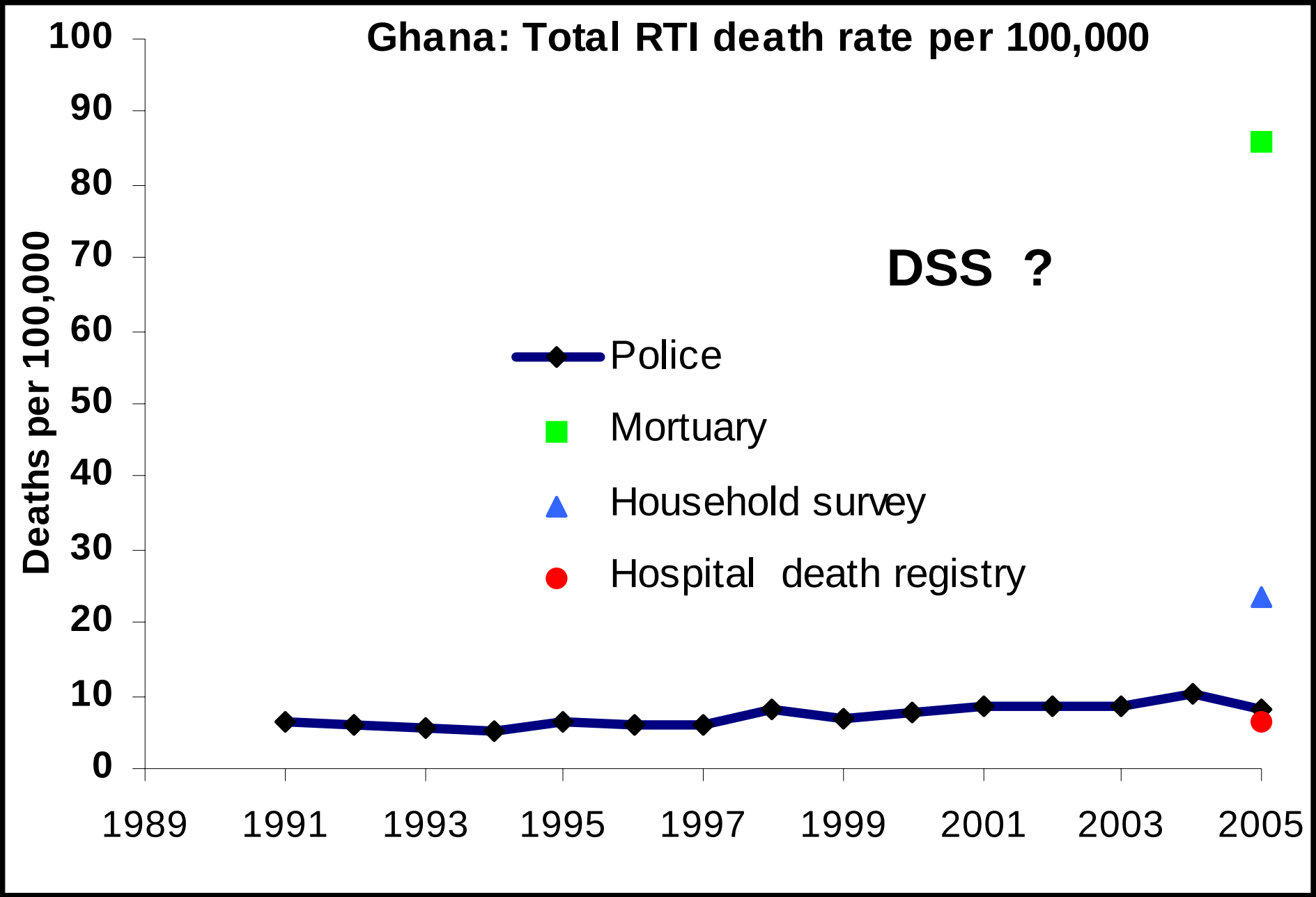
5-14
15-24
25-34
35-44
45-54
55-64
65-74
75-84
85+
Age category

Country assessment of road traffic injuries in Ghana

Data Sources Inventory

- World Health Survey
- Household RTI Survey (Kumasi and Brong-Ahafo)
- Hospital based death registration data
- Police and road traffic injury surveillance data
- Mortuary data
- Hospital based morbidity study
- DSS INDEPTH Sites -verbal autopsy of cause of death

Ghana death rate



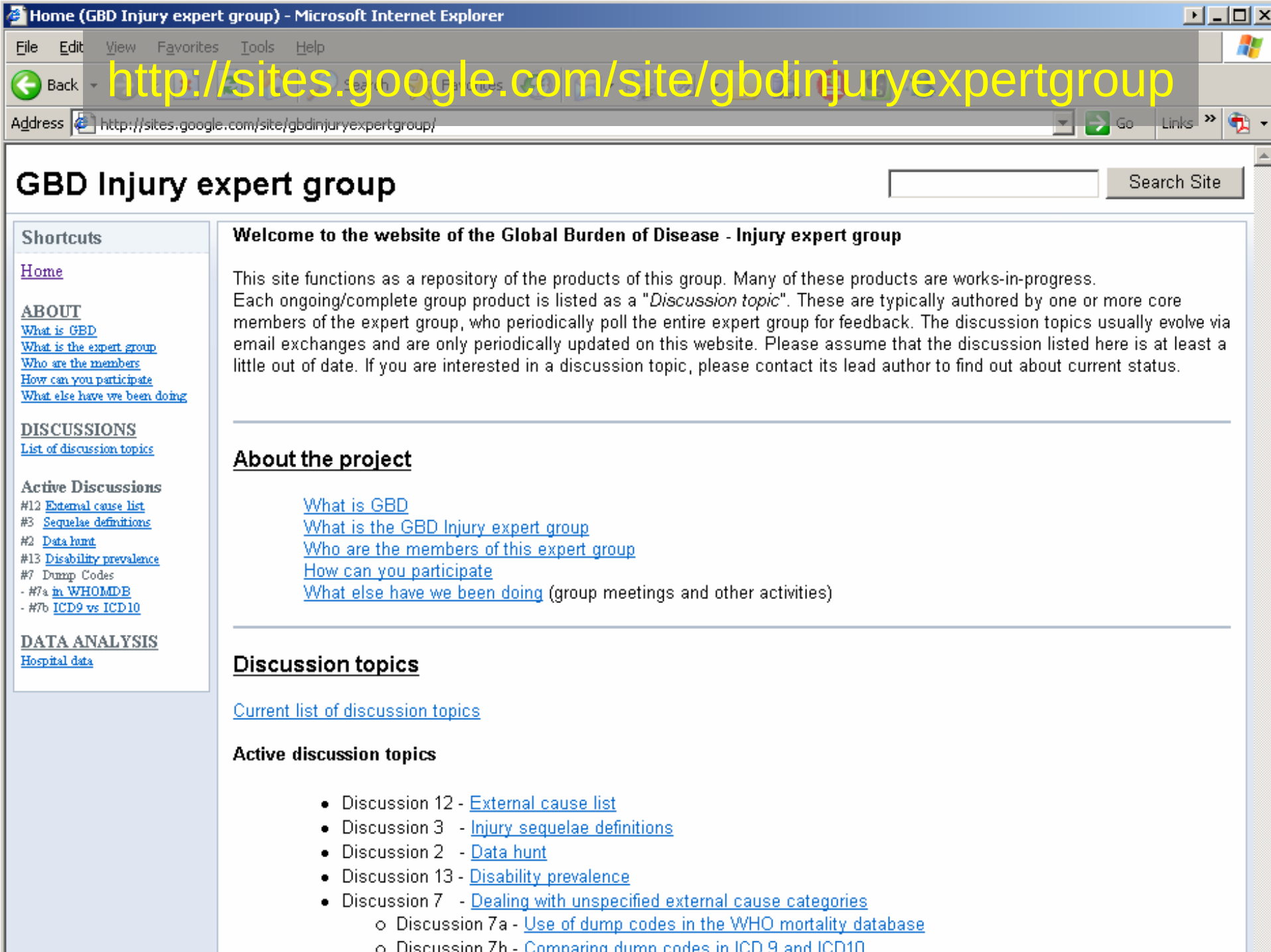
Summary: Estimating road traffic injuries in developing countries

Key Ideas:

- Make the most of existing sources of information

- Boldly make estimates in the face of poor quality data

Estimating the Global Burden of Injuries



GBD Injury expert group

Search Site

Shortcuts

Home

ABOUT
What is GBD
What is the expert group
Who are the members
How can you participate
What else have we been doing

DISCUSSIONS
List of discussion topics

Active Discussions
#12 External cause list
#3 Sequelae definitions
#2 Data hunt
#13 Disability prevalence
#7 Dump Codes
- #7a in WHOMDB
- #7b ICD9 vs ICD10

DATA ANALYSIS
Hospital data

Welcome to the website of the Global Burden of Disease - Injury expert group

This site functions as a repository of the products of this group. Many of these products are works-in-progress.
Each ongoing/complete group product is listed as a "*Discussion topic*". These are typically authored by one or more core members of the expert group, who periodically poll the entire expert group for feedback. The discussion topics usually evolve via email exchanges and are only periodically updated on this website. Please assume that the discussion listed here is at least a little out of date. If you are interested in a discussion topic, please contact its lead author to find out about current status.

About the project

What is GBD
What is the GBD Injury expert group
Who are the members of this expert group
How can you participate
What else have we been doing (group meetings and other activities)

Discussion topics

Current list of discussion topics

Active discussion topics

- Discussion 12 - External cause list
- Discussion 3 - Injury sequelae definitions
- Discussion 2 - Data hunt
- Discussion 13 - Disability prevalence
- Discussion 7 - Dealing with unspecified external cause categories
  - Discussion 7a - Use of dump codes in the WHO mortality database
  - Discussion 7b - Comparing dump codes in ICD 9 and ICD10

GBD-Injury Expert Group: Discussion Topics

Topic 1: Case definition

John Langley, Ronan Lyons, Limor Aharonson-Daniel, Tim Driscoll, Caroline Finch

Topic 3: Categories and definitions for GBD injury 'sequelae'

James Harrison, Wendy Watson, Maria Segui-Gomez, Jed Blore, Belinda Gabbe, Fred Rivara, Saeid Shahraz, Phil Edwards, Pablo Perel

Topic 4: Dimensions of functioning relevant to injury

Wendy Watson, Maria Segui-Gomez, Ronan Lyons, Sarah Derrett

Topic 5: Dealing with multiple injuries

Belinda Gabbe, Limor Aharonson-Daniel, Mohsen Naghavi, Theo Vos, Phil Edwards, Pablo Perel, Margaret Warner

Topic 6: Implications for measurement of injury burden of method chosen to generate weights

Ronan Lyons, Rebecca Spicer, Juanita Haagsma, Ed Van Beeck, Steven Macey

GBD-Injury Expert Group: Discussion Topics (contd)

Topic 7: Dealing with unspecified categories in case data sets
Kavi Bhalla, James Harrison, Lois Fingerhut, Margaret Warner, M. Naghavi

Topic 9: Recurrent injury
Caroline Finch, Ronan Lyons, Soufiane Boufous

Topic 10: Assumption that burden of a condition is independent of the mechanism that produced it
Maria Segui-Gomez, Belinda Gabbe, Limor Aharanson-Daniel

Topic 11: Mortality data
Lois Fingerhut, Kavi Bhalla, Mohsen Naghavi, Tim Driscoll

Topic 12: GBD External Cause List and Associated ICD Code Groups
James Harrison, Kavi Bhalla, Caroline Finch

GBD-Injury Expert Group: Discussion Topics (contd)

Topic 13: Disability prevalence
Wendy Watson, Sarah Derrett

Topic 15: Making optimal use of police reported statistics
David Bartels, Kavi Bhalla

Topic 16: Sports injuries - are we ignoring a significant public health opportunity
Caroline Finch

GBD INJURY EXPERT GROUP

Real World Data

High Income Countries
- ???

Low Income Countries
- Environmental scan
- Data Access

Theoretical Input

List of Discussion Papers

Case Definition
GBD "Sequelae"
Multiple Injuries
Empirical Disability wts
Handling unspecifieds
Recurrent injuries
…
…

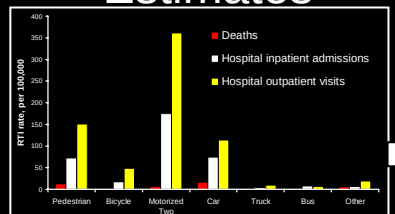
Data Analysis

Numbers

Theory

GBD ENGINE

Estimates



Sensible health priorities

GBD-Injury Data Sources

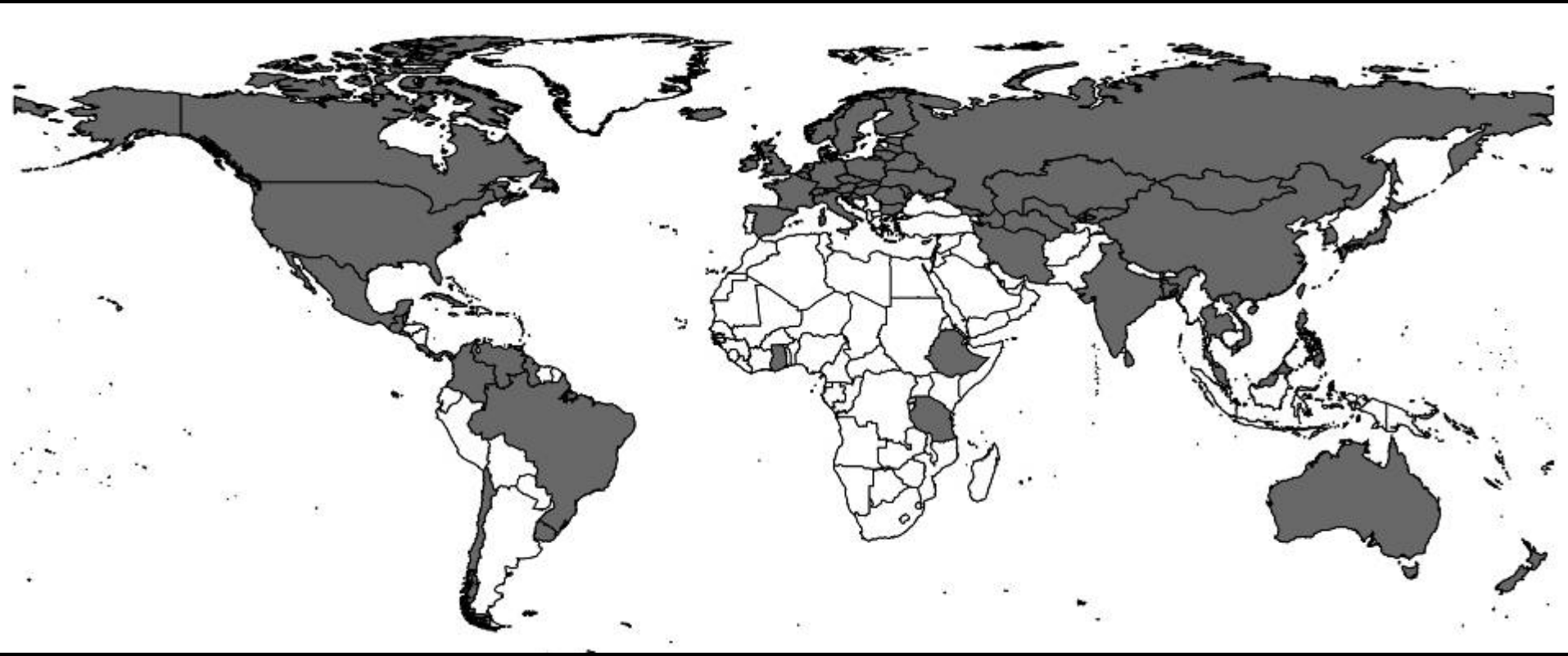
Environmental scan of availability of:

- Death registries
- Hospital registries and
- Health surveys (with injury questions)

This ongoing environmental scan is publicly available on our expert group website

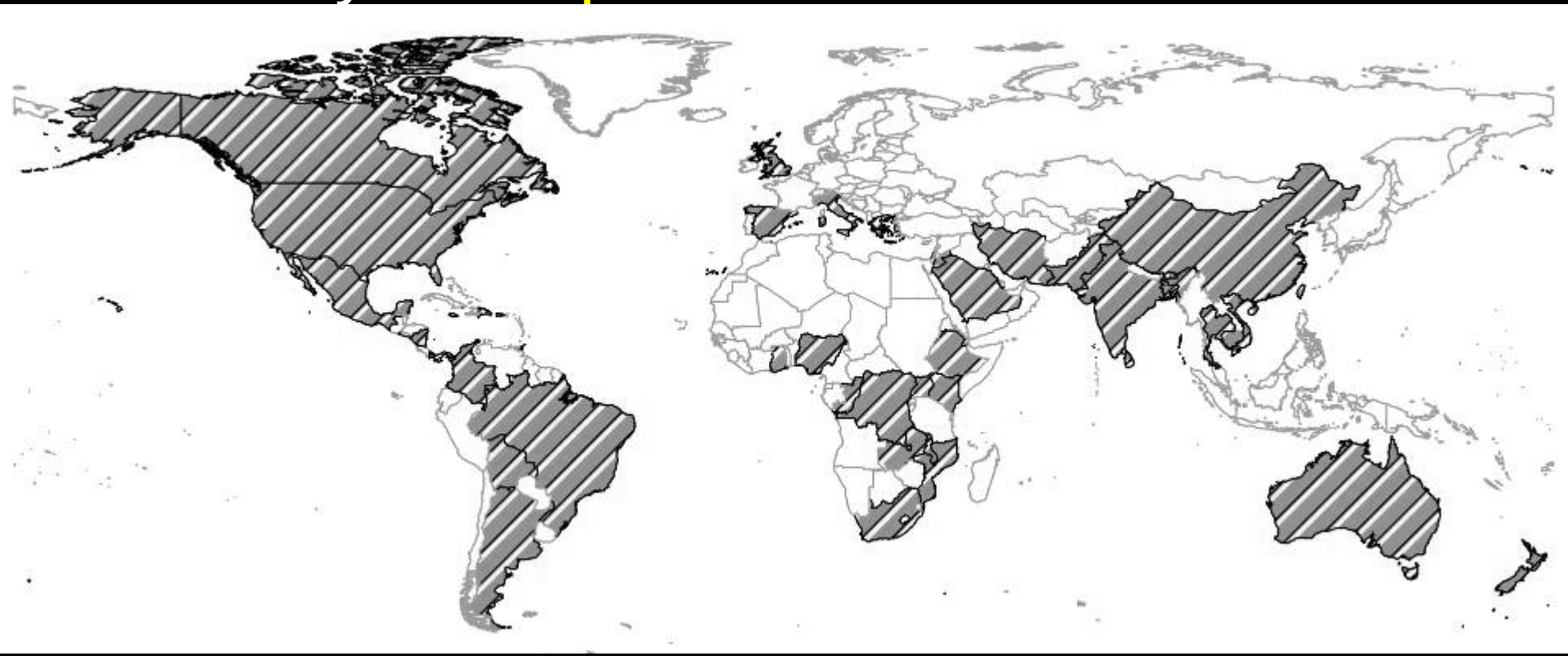
Environmental Scan

Availability of death registration data



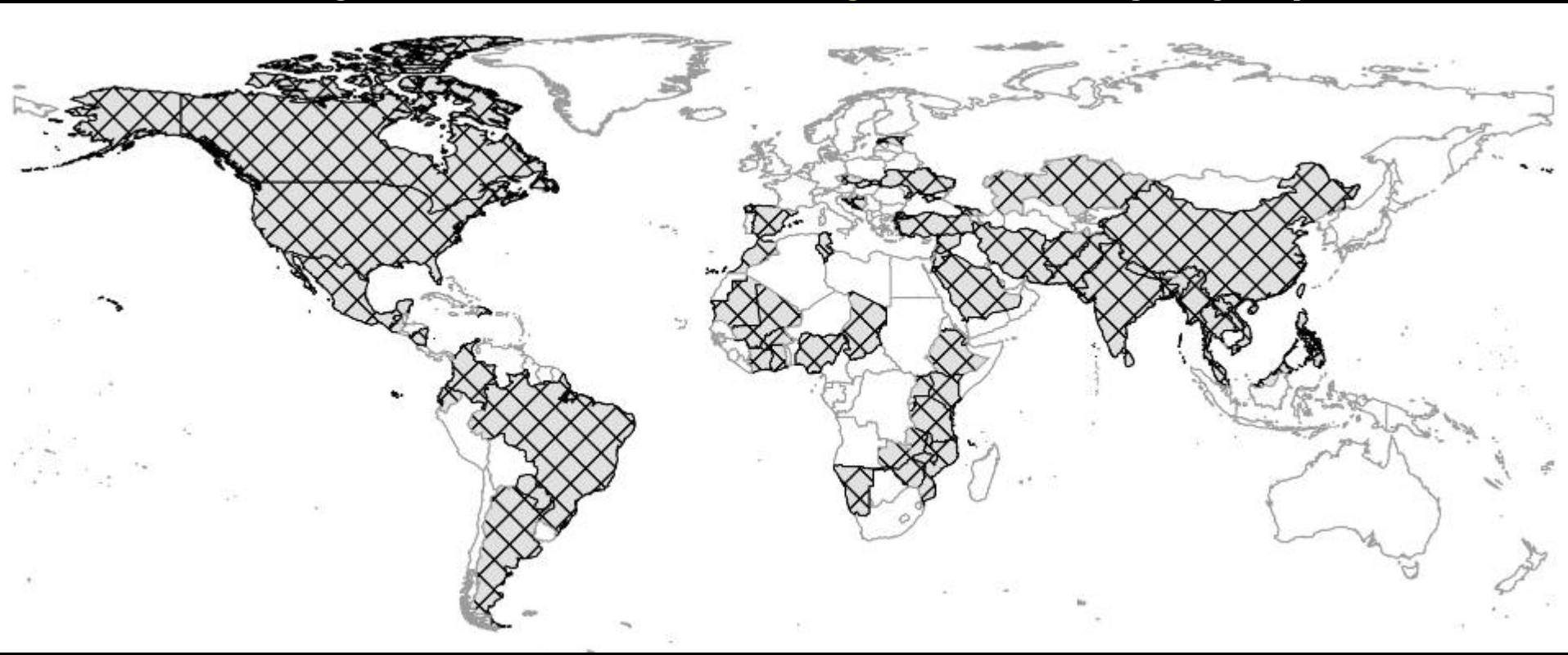
Environmental Scan

Availability of hospital data



Environmental Scan

Availability of health surveys with injury ques.



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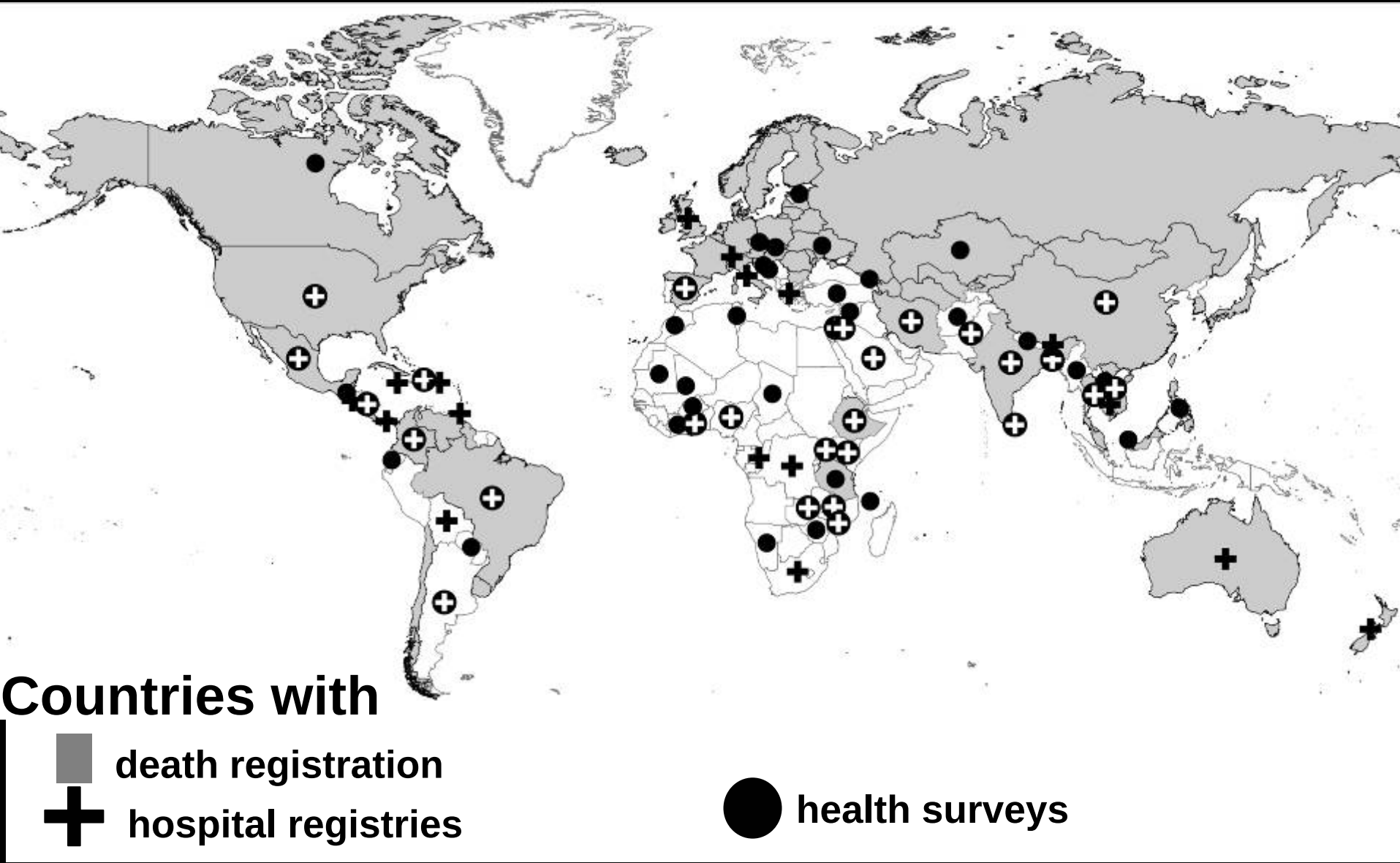

There is no data shortage. There is a shortage of analysts!

Summary: Estimating road traffic injuries in developing countries

Key Ideas:

- Make the most of existing sources of information

- Boldly make estimates in the face of poor quality data

Thanks!

Email: kavi_bhalla@harvard.edu

Website: http://www.globalhealth.harvard.edu
(click on *Research => Road Traffic Injuries*)

This work is supported by a grant from the World Bank Global Road Safety Facility

GBD-Injury Data Sources

Environmental scan of availability of:

- Death registries
- Hospital registries and
- Health surveys (with injury questions)

What Data Sources

1. Mortality
    1. Gold Standard: High Quality death registration data
    2. Alternate sources: police, mortuary, ?
2. Non-fatal Injuries:
    1. Health Surveys with injury questions
    2. Hospital and ER records

What Types of Data

1. Variables: Age, sex, external causes, nature of injuries
2. Degree of Aggregation:
    1. Unit record data (very nice but not essential)
    2. Tabulations in GBD injury and “sequelae” groups using our scripts (excellent)
    3. Detailed tabulations using other groupings (very good)
    4. Report or paper with summary tabulations (ok – better than nothing)

Maximizing Data Access (from low income countries)

1. Conduct Environmental Scan
    1. Scan published literature (ongoing)
    2. Google searches (ongoing)
    3. Ask expert group (ongoing)
2. Requesting Data Access
    1. Personal contacts
    2. Call for contributions in journal (ongoing)
    3. Circulate requests via World Bank, WHO field offices (not yet done)

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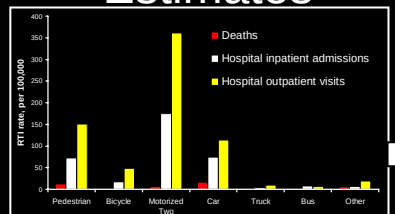
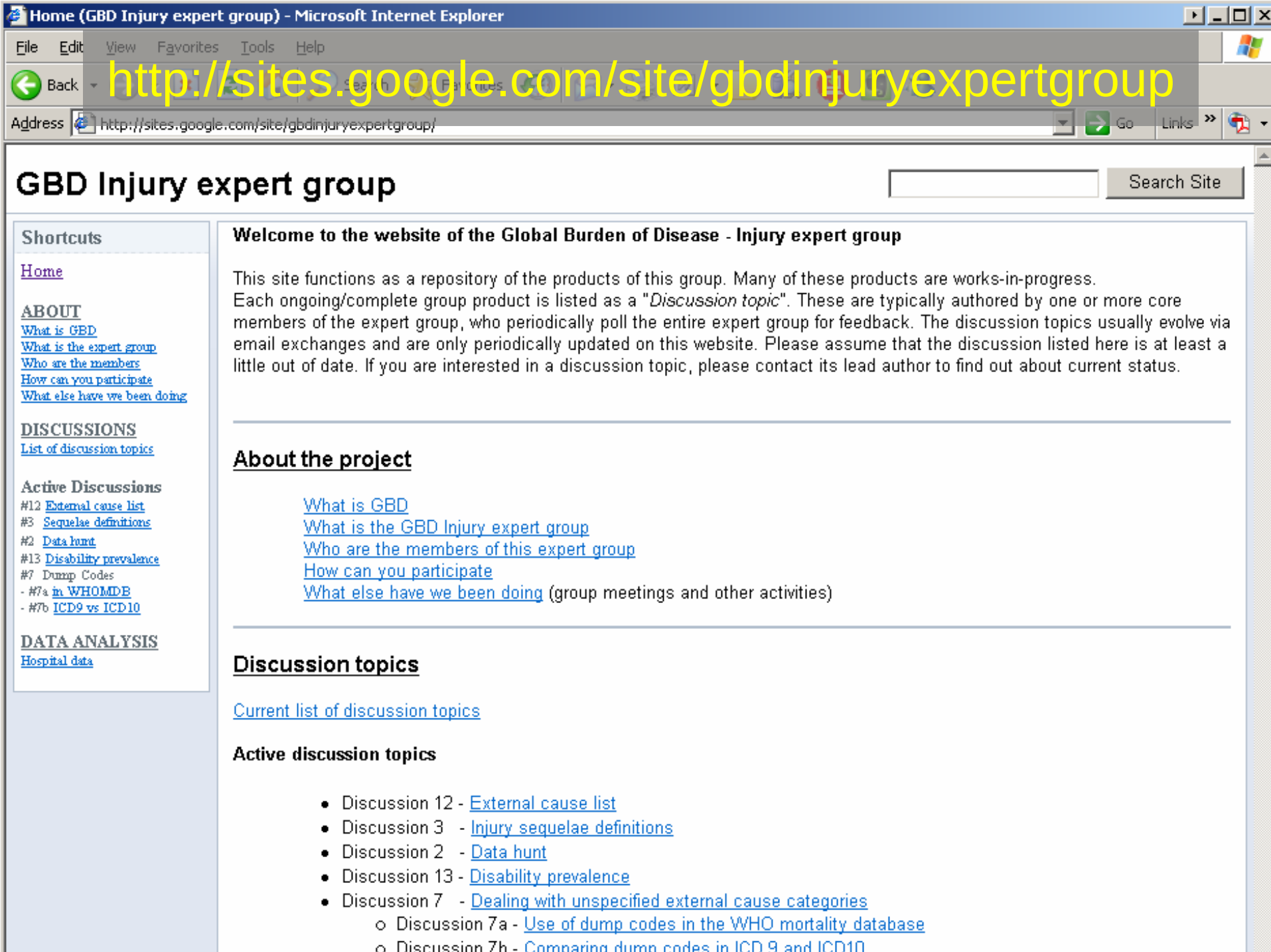


Sensible health priorities



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DATA ANALYSIS
Hospital data

Welcome to the website of the Global Burden of Disease - Injury expert group

This site functions as a repository of the products of this group. Many of these products are works-in-progress.
Each ongoing/complete group product is listed as a "*Discussion topic*". These are typically authored by one or more core members of the expert group, who periodically poll the entire expert group for feedback. The discussion topics usually evolve via email exchanges and are only periodically updated on this website. Please assume that the discussion listed here is at least a little out of date. If you are interested in a discussion topic, please contact its lead author to find out about current status.

About the project

What is GBD
What is the GBD Injury expert group
Who are the members of this expert group
How can you participate
What else have we been doing (group meetings and other activities)

Discussion topics

Current list of discussion topics

Active discussion topics

- Discussion 12 - External cause list
- Discussion 3 - Injury sequelae definitions
- Discussion 2 - Data hunt
- Discussion 13 - Disability prevalence
- Discussion 7 - Dealing with unspecified external cause categories
  - Discussion 7a - Use of dump codes in the WHO mortality database
  - Discussion 7b - Comparing dump codes in ICD 9 and ICD10

Making optimal use of available data to fill in the information gaps