

# **“A-E-M-S” Medical Mass Casualty Incident Algorithm**

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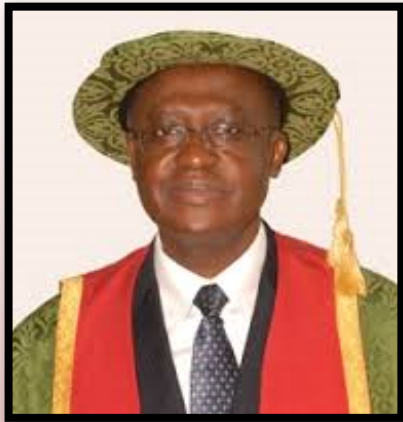
*BY: DR. ROXANE RICHTER  
2016-2017 FULBRIGHT - FOGARTY  
(NIH) POSTDOCTORAL GLOBAL HEALTH  
FELLOW, SUB-SAHARAN AFRICA*

*MAY 18, 2017 - U.S. EMBASSY, ACCRA, GHANA*



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**Challenge:**  
**High Number of Road Traffic Accident**  
**(RTAs) with Acute Injuries & Fatalities in**  
**Mass Casualty Incidents (MCIs) in Kumasi**





# Ghana's "Accident Death Rate" Global Rank: HIGH

2014 - **24.6** Rated as "High" in the WORLD<sup>1</sup>

Ranked 38<sup>th</sup> out of 172 nations<sup>2</sup>

Iran (highest at 43.54) – to Maldives (lowest at 1.05)

2015 – **26.2** WHO<sup>3</sup>

90% RTA global fatalities in low- and middle-income countries, even though these countries have 54% of world's vehicles

RTAs cost approx. 3% of nation's GDP



1. Calculations Are Age-Adjusted Death Rates Per 100,000 Population

2. World Health Rankings. Road Traffic Accidents from WHO 2014. [www.worldlifeexpectancy.com/cause-of-death/road-traffic-accidents/by-country](http://www.worldlifeexpectancy.com/cause-of-death/road-traffic-accidents/by-country). Accessed May 13, 2017.

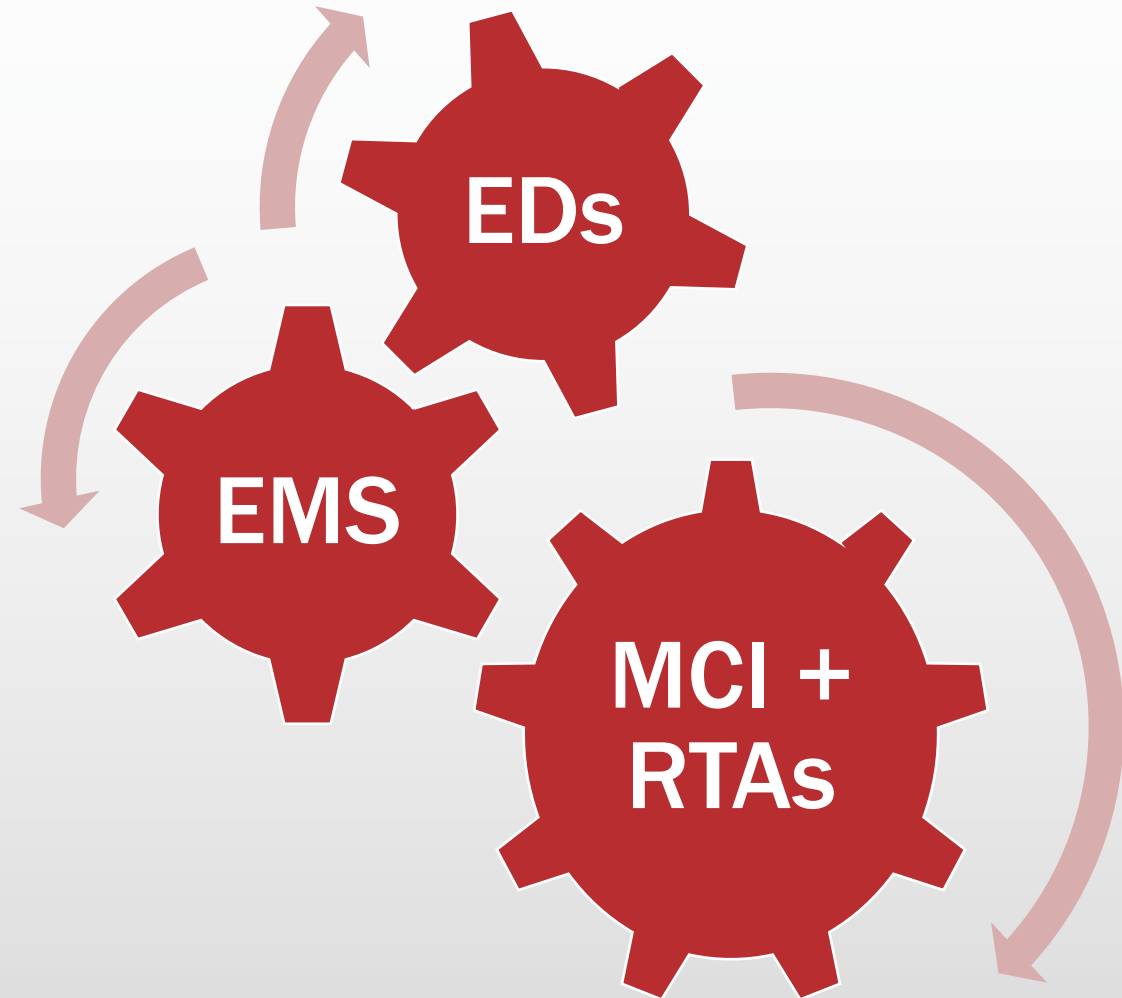
2. WHO. Global status report on road safety 2015. World Health Organization. Switzerland: Geneva. 2015.



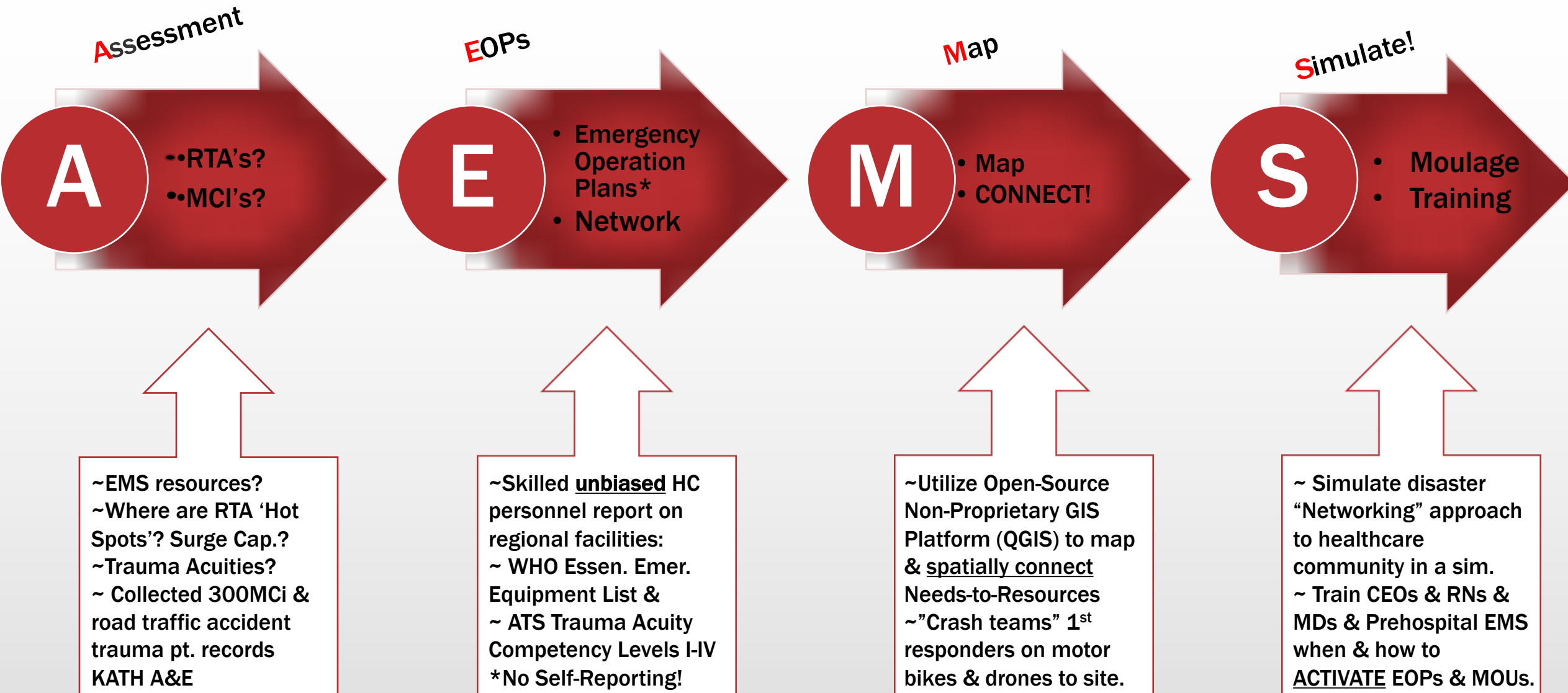


**How to Assess & More Effectively Network  
(*Spatially Connect*)  
Road Traffic Accident  
MCI/Disaster  
'Hotspots' —**

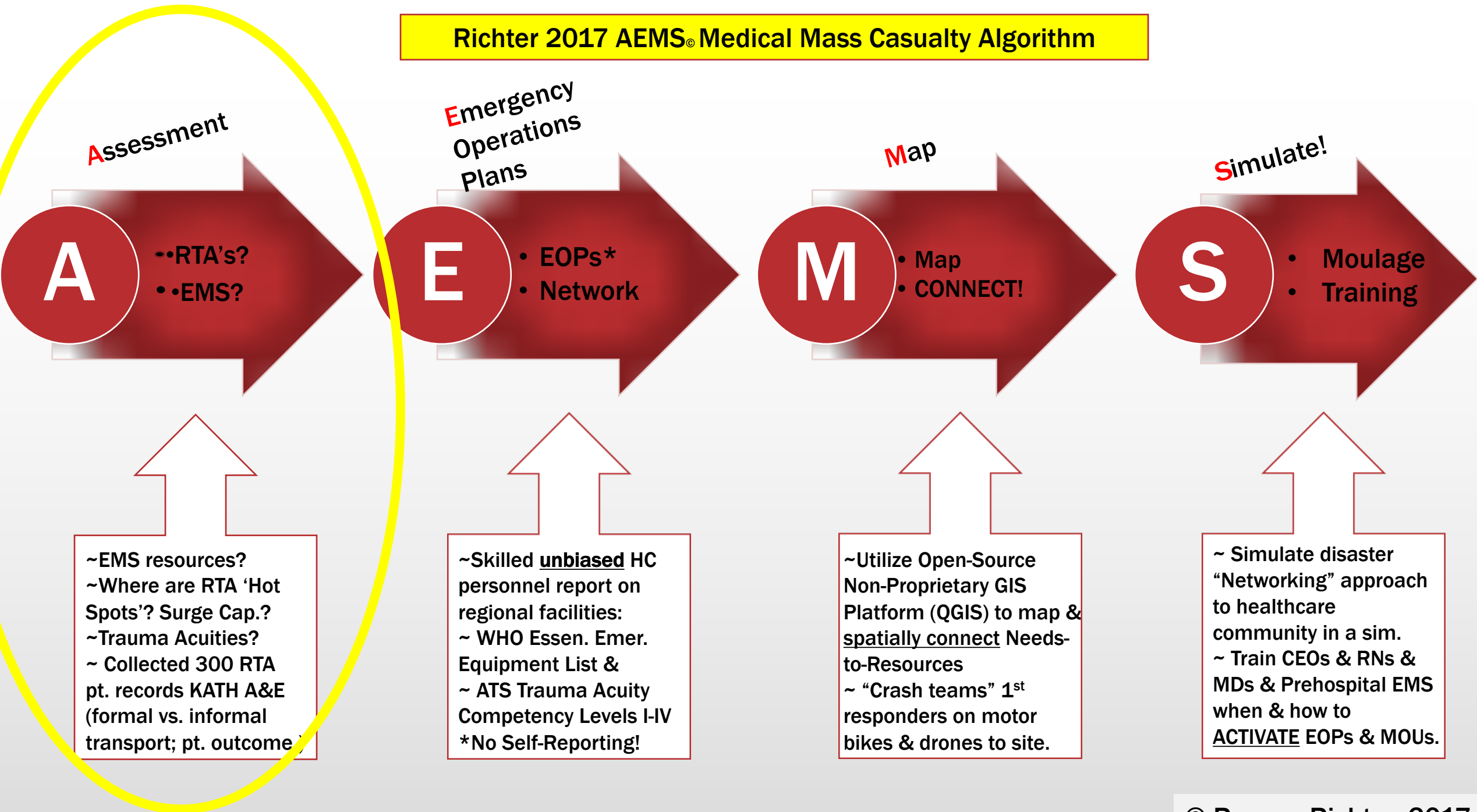
**to Existing Prehospital  
EMS Capacities & ED  
Trauma Acuity  
Competencies?**



# Richter 2017 "AEMS© "Assess - EOPs - Map - Simulate" Medical Mass Casualty Incident Algorithm



# Richter 2017 AEMS® Medical Mass Casualty Algorithm

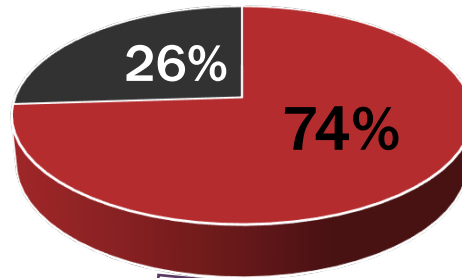




**RICHTER:**  
300 Road Traffic  
Accident (RTA)  
Patient Records  
@ KATH A&E  
Feb.-May 2017

Avg. RTA  
Patient Age = 39

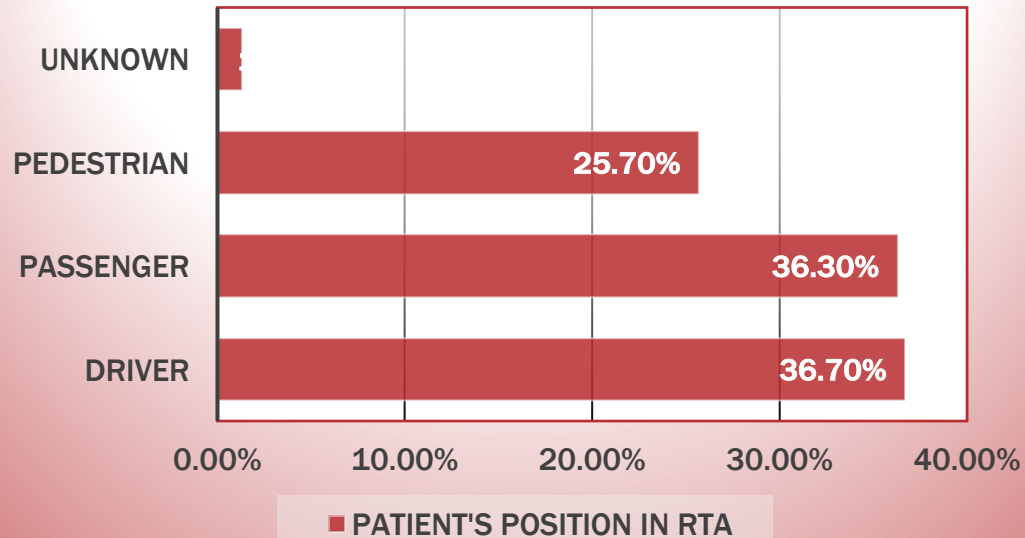
### PATIENT GENDER



100% Male Drivers

■ MALE ■ FEMALE

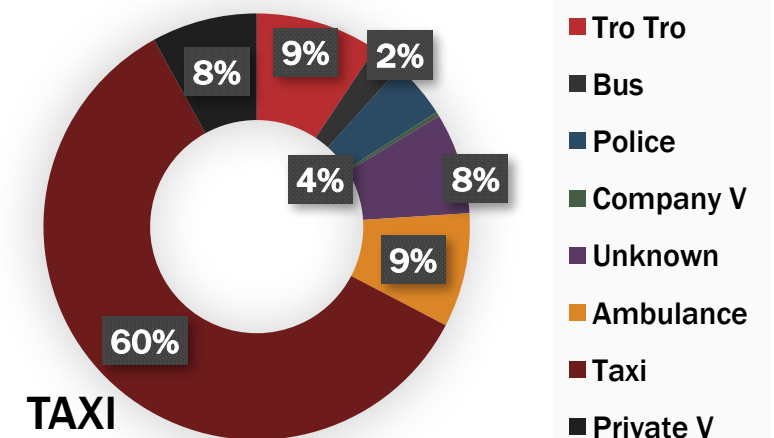
### PATIENT'S POSITION IN RTA



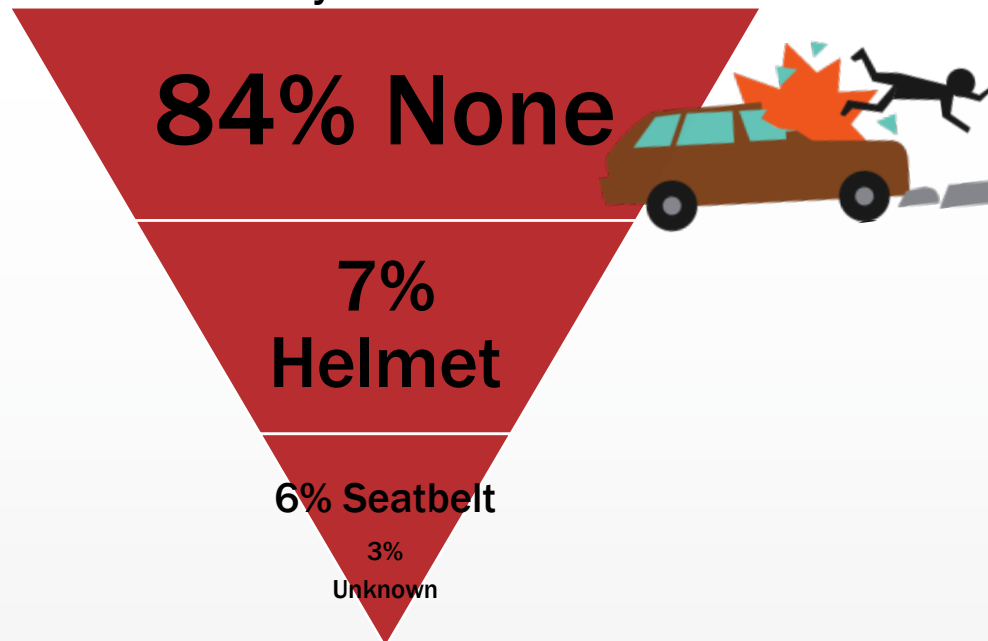
**Avg. Transport Time:**  
33 min.  
99 min.



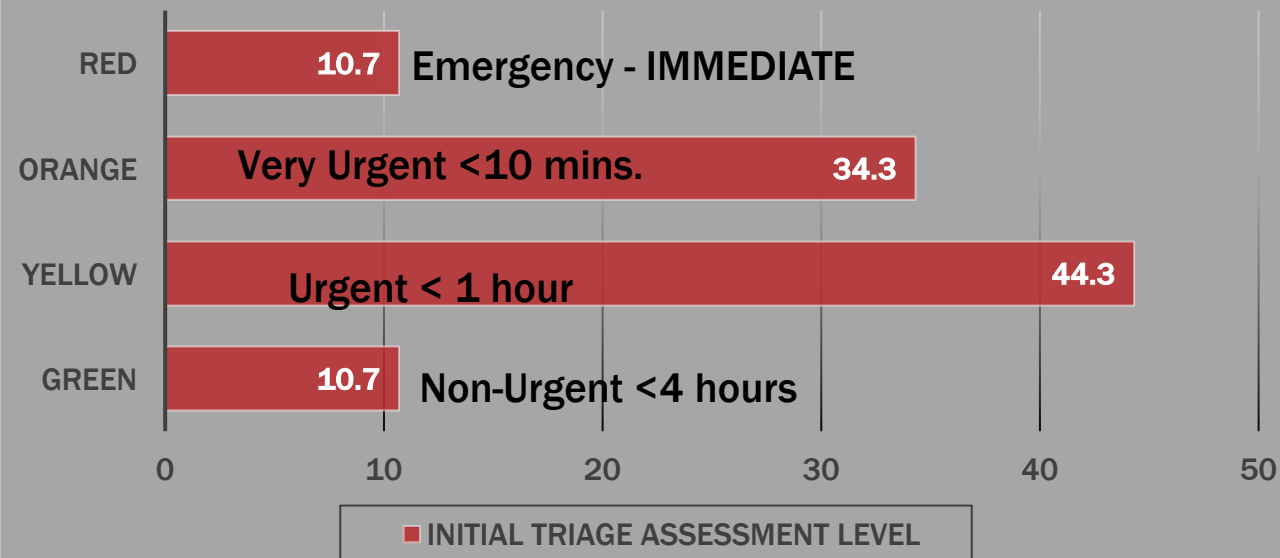
### PATIENT TRANSPORT TO ED



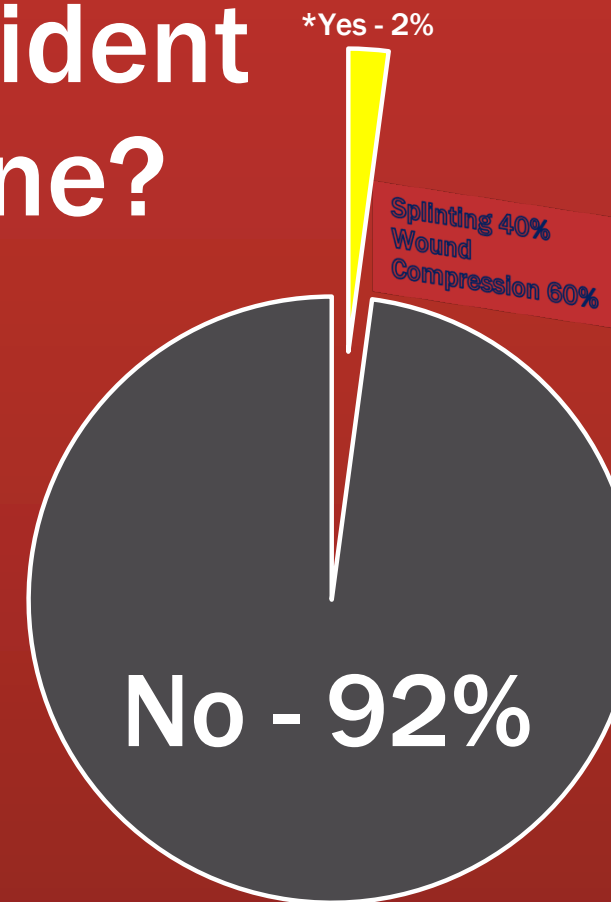
## Safety Gear Used?



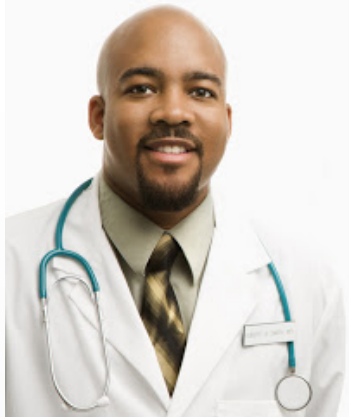
## INITIAL TRIAGE ASSESSMENT LEVEL



## 1st Aid Provided at Accident Scene?



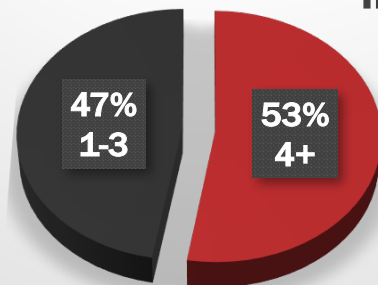
\*20% each: bystander/fellow passenger /1<sup>st</sup> Aid provider/physician



Avg. Time ...  
To Dr.  
Exam in  
KATH  
ED...

**53 mins.**

Equal # of Mass  
Casualties (4+)  
To Non-MCI's (1-3)  
In KATH  
RTA's



**< 24 hrs.**

**55%**

**< 48**

**23%**

**<72**

**13%**

**<168**

**4%**

**168 + hrs.**

**5%**

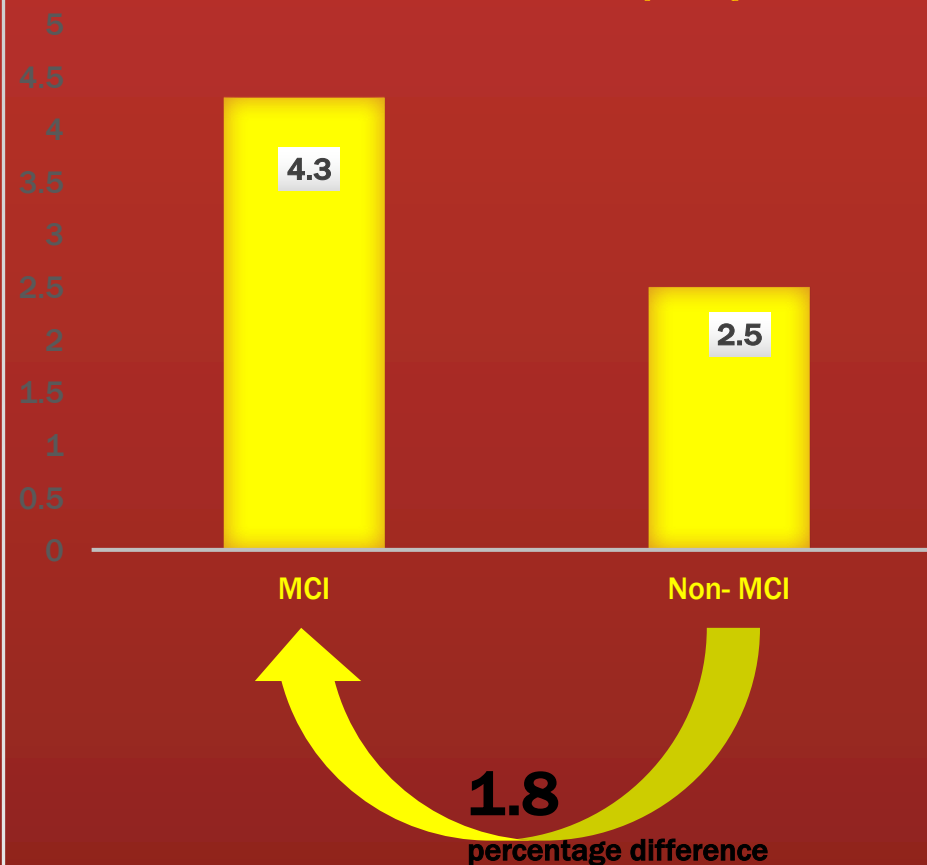
Length of Patient Stay in KATH ED

## FATALITIES: MASS CASUALTIES vs. Non-MCI's

**AVG. FATALITIES= 3.3%**

**NON-MCI (<4)= 2.5%**

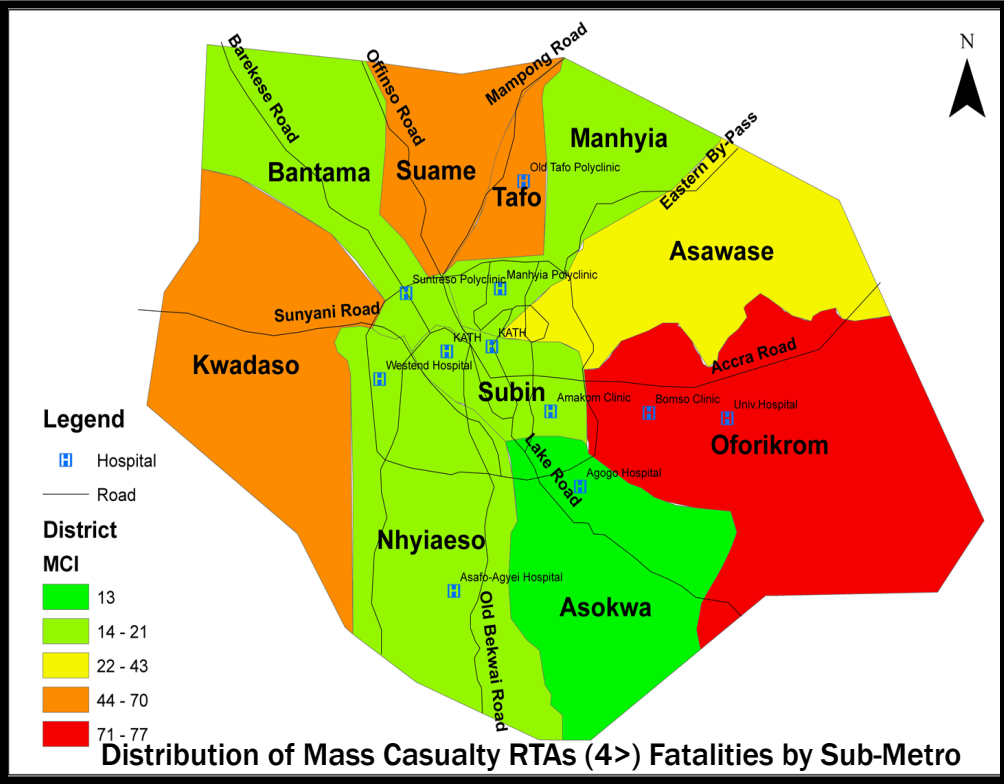
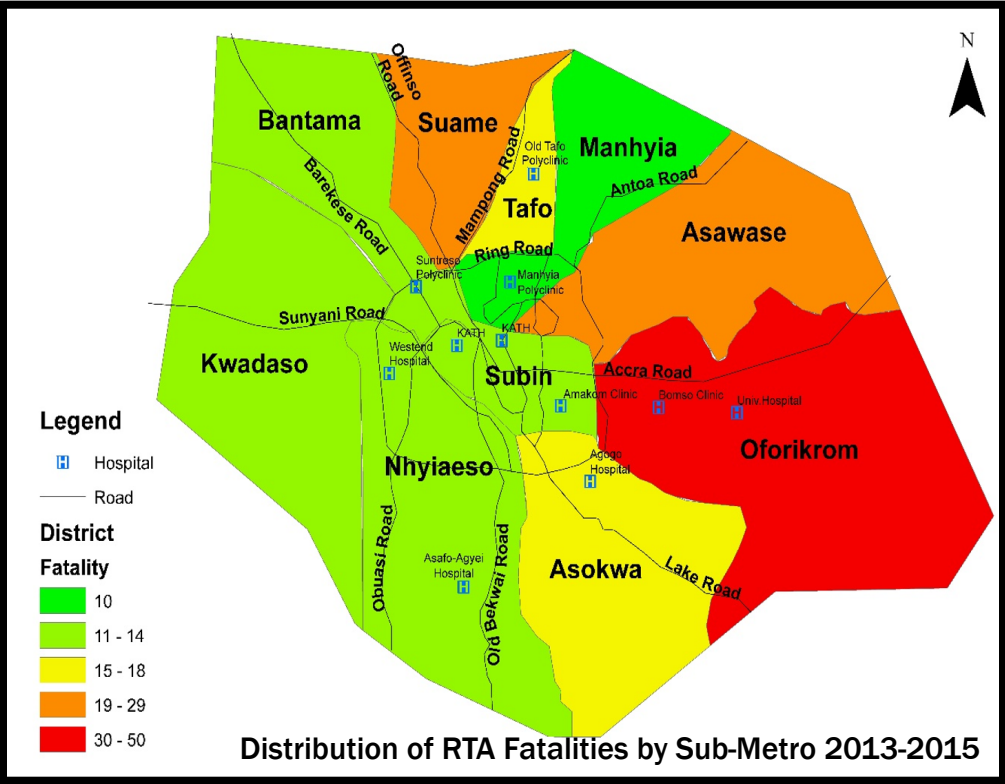
**MCI (4+)= 4.3%**



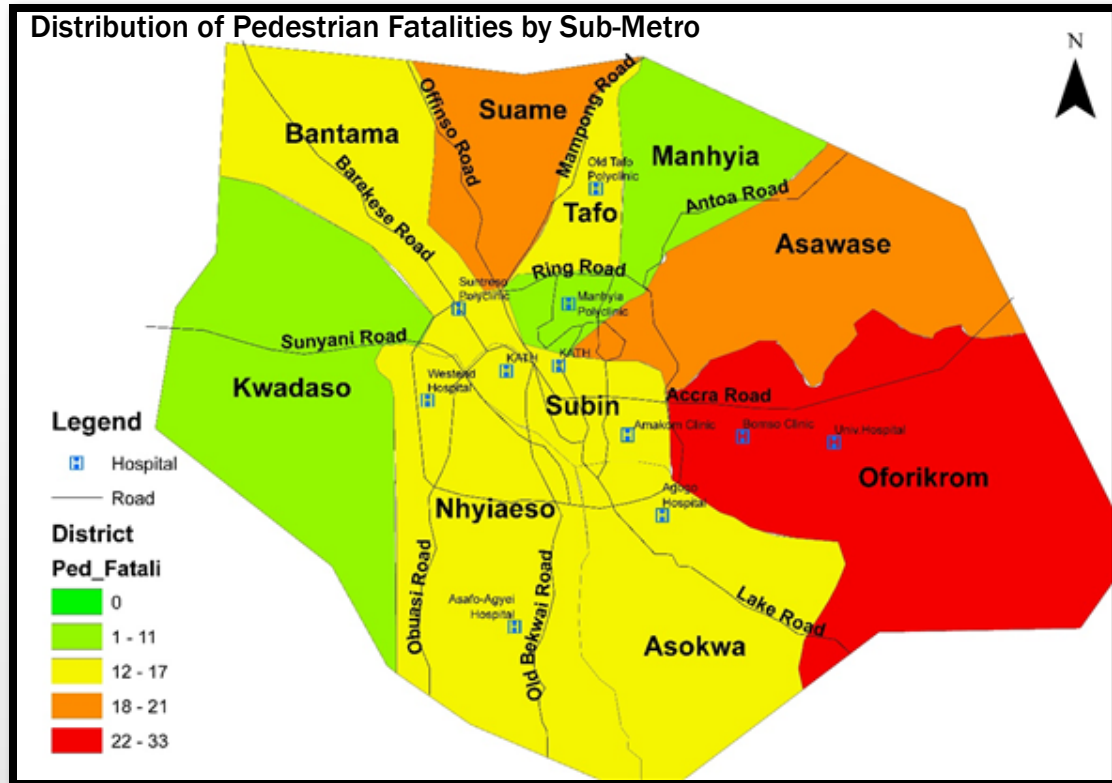


# Kumasi MCIs & RTA Fatalities 2013-2015

Kumasi RTAs (total) 1,560 ~ Approx. 14 % Resulted in 1> Fatality



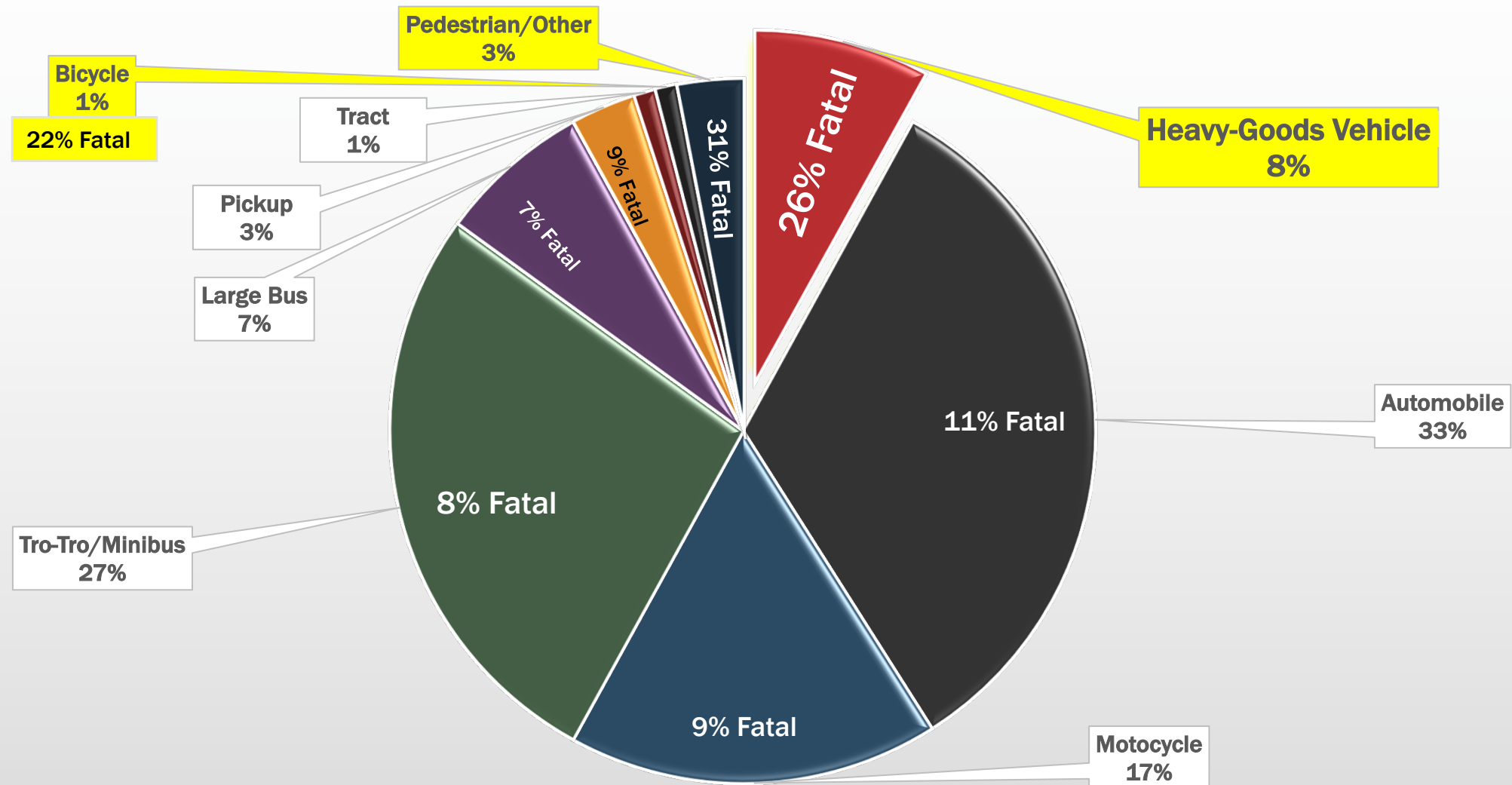
# “Most Fatal” RTA & MCI & Pedestrian ‘Hot Spot’ – Oforikrom @ Anloga Junction



Anloga Junction deemed a “hazardous zone” “asthma and other respiratory conditions” - smoke emissions from vehicles climbing & descending hill of busy intersection & “constant smoke emanating from a charcoal production enclave”<sup>1</sup>

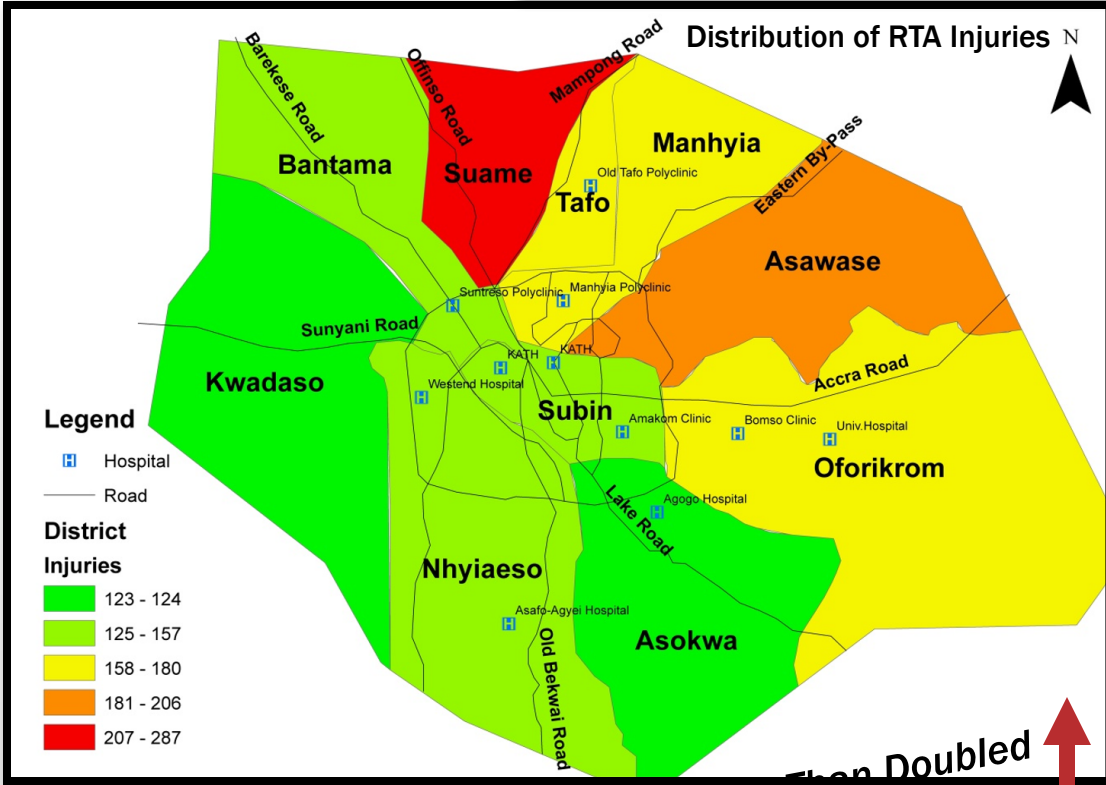
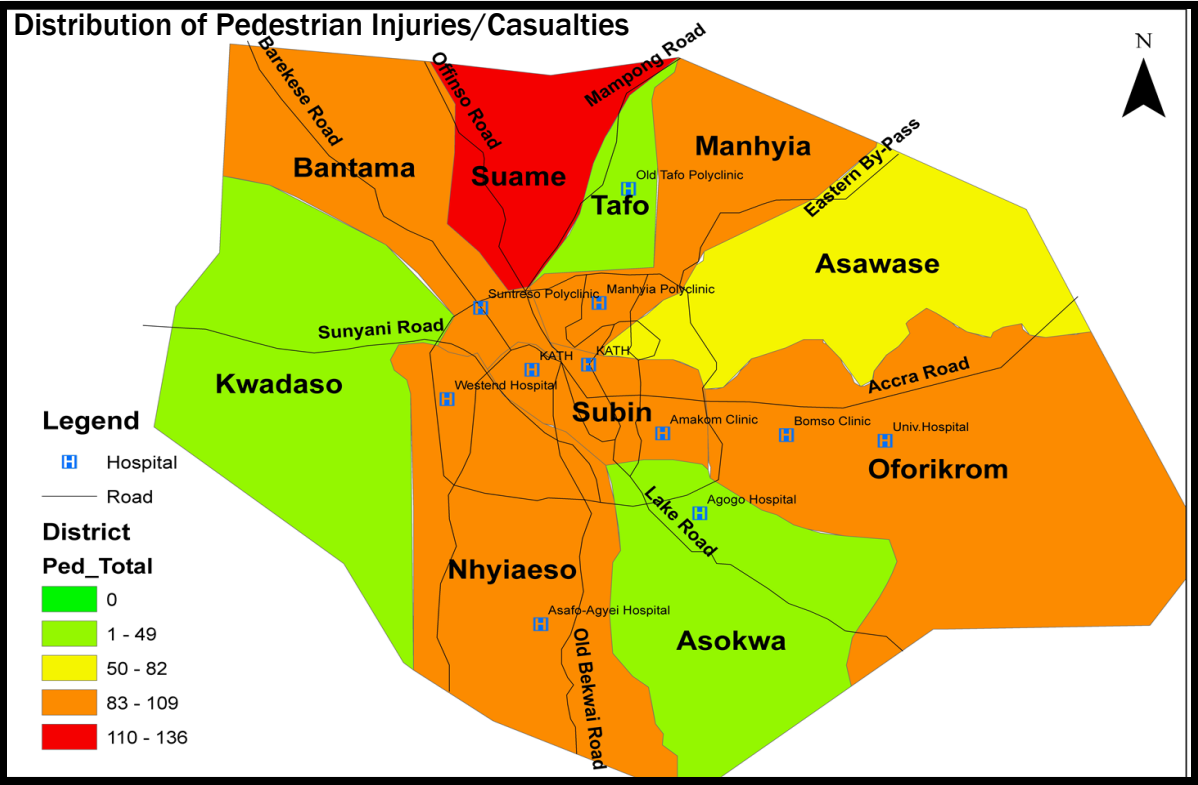
1. “Anloga junction dangerous place to live – Doctor” Health News. Ghanaweb, May 17, 2016. <http://www.ghanaweb.com/GhanaHomePage/health/A-R-Anloga-junction-dangerous-place-to-live-Doctor-439320>. Accessed May 13, 2107.

# Kumasi RTAs – Percentage of Total RTAs By Vehicle Type & Death Rate (2013-2015)



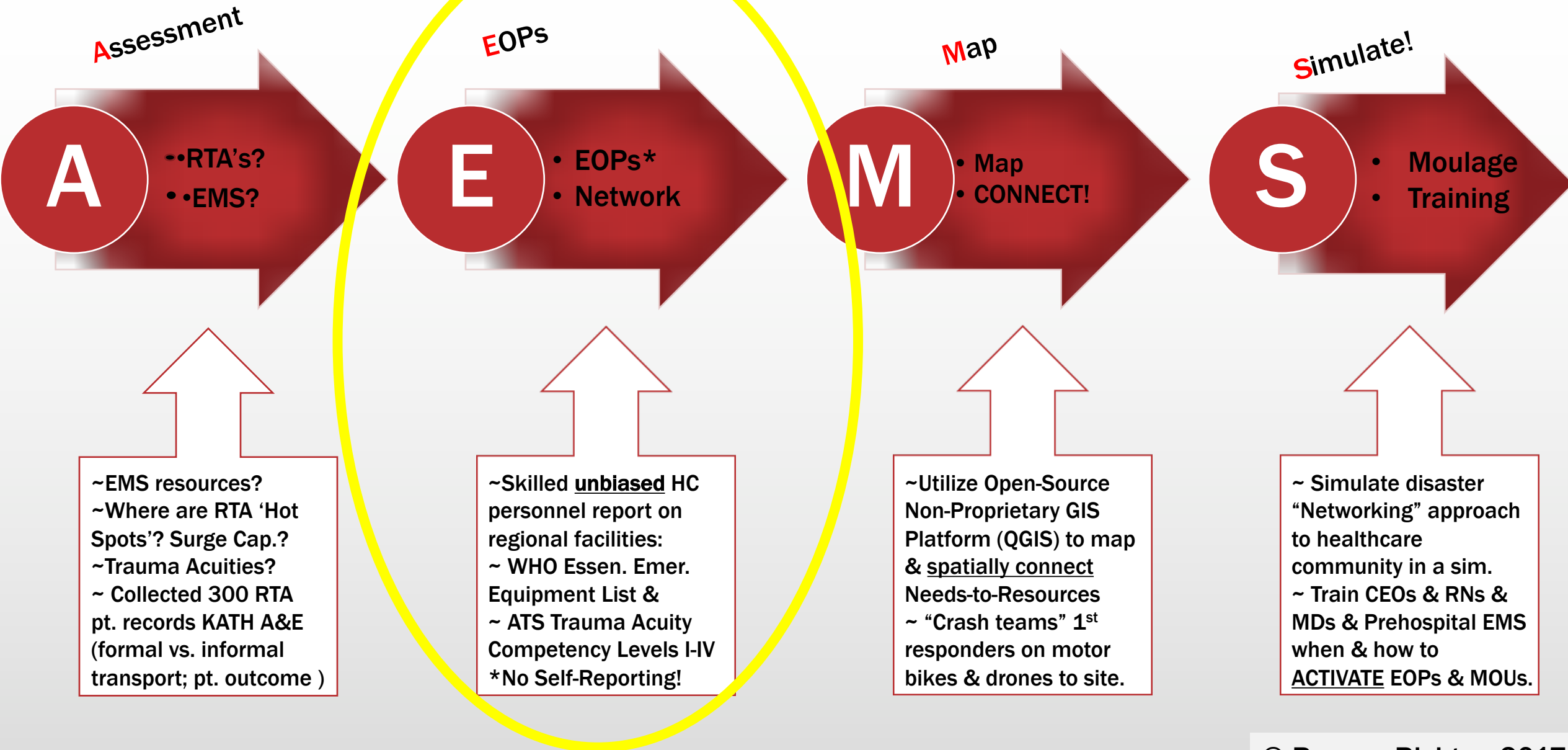


# “Most Dangerous” for RTAs & Pedestrians

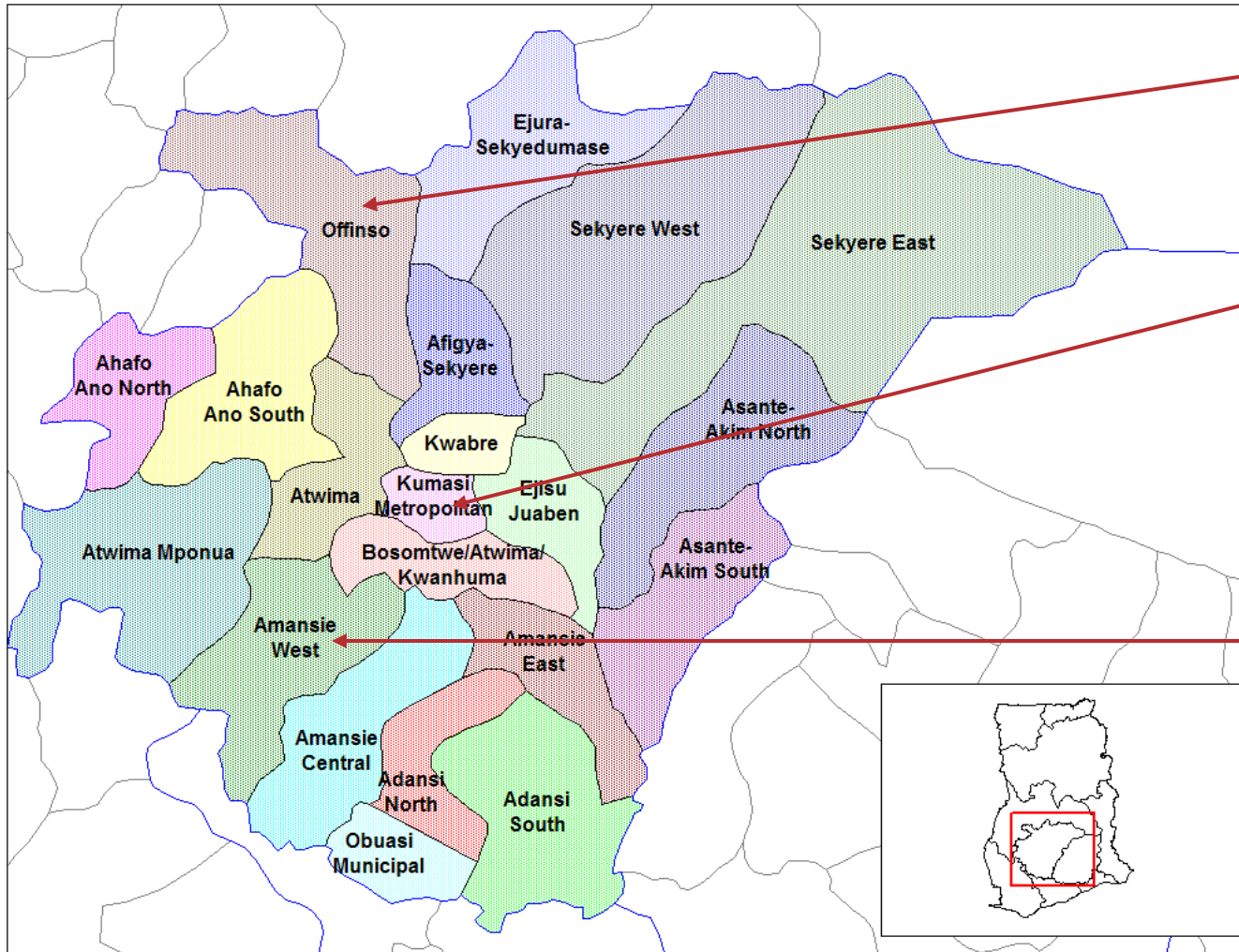


RTA Casualties/Injuries/Fatalities More Than Doubled  
2014-2015 @ Suame Roundabout/Circle

# Richter 2017 AEMS® Medical Mass Casualty Algorithm



# Ashanti Regions (27) with 8 (EOP Assessed) Hospitals



- St. Patrick's Hospital

- TAFO Government Hospital
- Suntreso Government Hospital
- Manhyia District Hospital
- Komfo Anokye Teaching Hospital
- KNUST Hospital
- Asokwa Children's Hospital

- St. Martin's Catholic Hospital



# EOP “Foundational Assessment” Tool #1: WHO Emergency Equipment List



## WHO Generic Essential Emergency Equipment List

This checklist of essential emergency equipment for resuscitation describes minimum requirements for emergency and essential surgical care at the first referral health facility

Capital Outlays	Quantity	Date checked
Resuscitator bag valve and mask (adult)		
Resuscitator bag valve and mask (paediatric)		
Oxygen source (cylinder or concentrator)		
Mask and Tubings to connect to oxygen supply		
Light source to ensure visibility (lamp and flash light)		
Stethoscope		
Suction pump (manual or electric)		
Blood pressure measuring equipment		
Thermometer		
Scalpel # 3 handle with #10,11,15 blade		
Scalpel # 4 handle with # 22 blade		
Scissors straight 12 cm		
Scissors blunt 14 cm		
Oropharyngeal airway (adult size)		
Oropharyngeal airway (paediatric size)		
Forcep Kocher no teeth 12-14 cm		
Forcep, artery		
Kidney dish stainless steel appx. 26x14 cm		
Tourniquet		
Needle holder		
Towel cloth		
Waste disposal container with plastic bag		
Sterilizer		
Nail brush, scrubbing surgeon's		
Vaginal speculum		
Bucket, plastic		
Drum for compresses with lateral clips		
Examination table		
Wash basin		
<b>Renewable Items</b>		

E

O

P



**Equipment:** (Capacity) # of Beds; # of Operating Theatres; # of working Resuscitation, Diagnostic & Surgical Resources (x-ray/ultrasound/CT scanner/blood lab etc.), etc.

**Staffing:** # of personnel (and working hours) of Labs, Radiology, Anesthesia, Accident & Emergency, etc.

**Pediatric vs. Adult:** infant-/child-specific supplies & staff expertise

**Capabilities (Skill):** Head Injury (neurology & neurosurgery); Skeletal Injuries (orthopedist & orthopedic surgeon); Traumatologist, etc.

# EOP “Foundational Assessment” Tool #2 : Trauma Acuity Level Evaluation, Designation & Verification (Pediatric / Adult Facility)

Source: American Trauma Society. Trauma Levels Explained. <http://www.amtrauma.org/?page=TraumaLevels>. Accessed May 15, 2017.

**Level I = comprehensive regional resource that is tertiary care facility central to trauma system; provides total care for every aspect of injury – from prevention through rehabilitation.**

- 24-hour in-house coverage by general surgeons, and prompt availability of care in specialties such as orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, internal medicine, plastic surgery, oral and maxillofacial, pediatric and critical care
- Referral resource for nearby regions; leadership in prevention/education to communities
- Continuing education of the trauma team; operates organized teaching and research effort to help direct new innovations in trauma care
- Program for substance abuse screening and patient intervention
- Meets minimum requirement for annual volume of severely injured patients; comprehensive quality assessment program

**Level II Trauma Center is able to initiate definitive care for all injured patients.**

- 24-hour immediate coverage by general surgeons, orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology & critical care
- Tertiary care needs such as cardiac surgery, hemodialysis and microvascular surgery may be referred to a Level I Trauma Center.
- Provides trauma prevention and continuing education programs for staff.
- Incorporates a comprehensive quality assessment program.

**Level III = provides prompt assessment, resuscitation, surgery, intensive care & stabilization of injured patients & emergency operations.**

- 24-hour immediate coverage by emergency medicine physicians & prompt availability of general surgeons and anesthesiologists
- Comprehensive quality assessment program
- Has developed patient transfer agreements for Level I or II Trauma Centers
- Provides back-up care for rural and community hospitals
- Continued education of nursing or trauma team
- Involved with prevention efforts & active outreach program

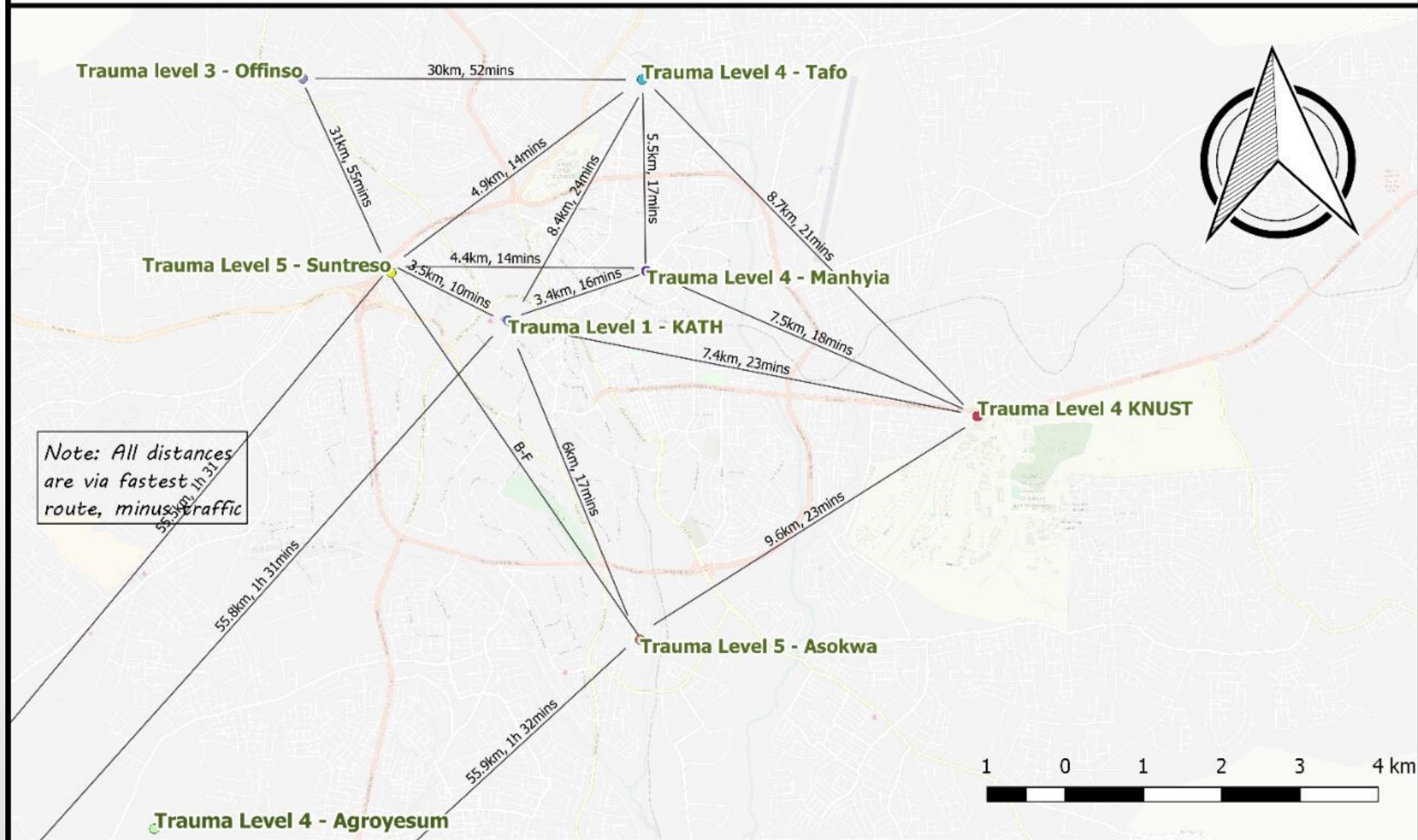
**Level IV = provides ATLS prior to transfer of patients to higher-level trauma center; provides evaluation, stabilization & diagnostic capabilities for injured patients.**

- Basic emergency dept. with ATLS protocols and 24-hour laboratory coverage; trauma nurse(s) & physicians available upon patient arrival
- May provide surgery and critical-care services if available.
- Has developed patient transfer agreements for Level I or II Trauma Centers
- Comprehensive quality assessment program
- Involved with prevention efforts & active outreach program

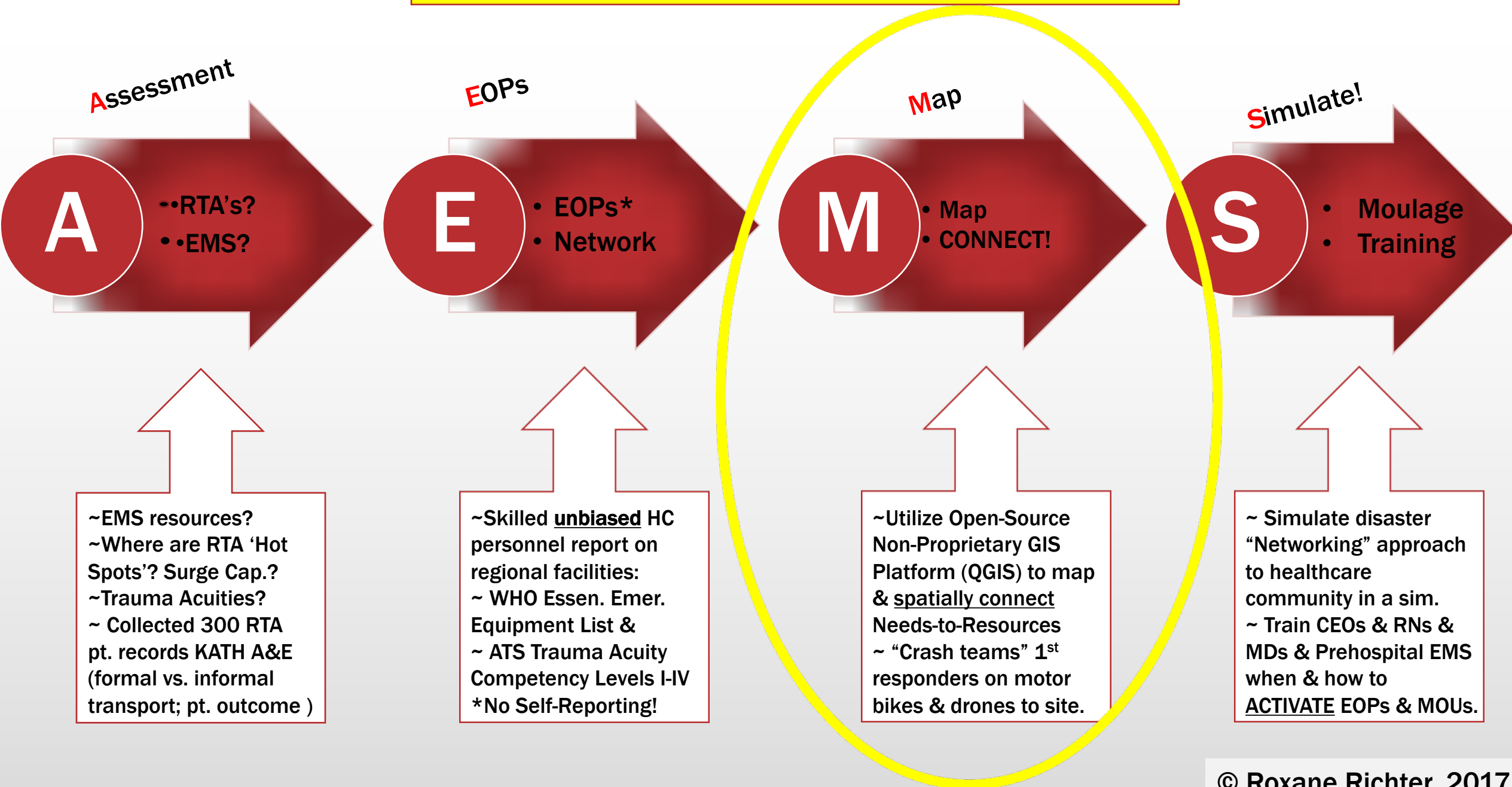
**Level V = initial evaluation, stabilization & diagnostic capabilities; prepares patients for transfer to higher levels of care.**

- Basic emergency department facilities to implement ATLS protocols
- Trauma nurse(s) and physicians available upon patient arrival
- Has developed patient transfer agreements for Level I through III Trauma Centers
- After-hours activation protocols - if facility is not open 24-hours a day
- May provide surgery and critical-care services (if/when available)

# TRAUMA ACUITY LEVELS OF KUMASI AREA HOSPITALS WITH DISTANCES BETWEEN THEM



# Richter 2017 AEMS® Medical Mass Casualty Algorithm







**Drones sent out to accident sites will “virtually augment” on-scene injury assessment & triage by (remotely accessing) highly skilled ER physician(s):**

1. Transmit photographs/videos of high-acuity patient injuries;
2. Show “mechanism of injury (MOI)”- injury patterns differ for side motor vehicle collision, vehicle ejection, or rollover vs. frontal impact collision;
3. Allows a “kinetic energy forces assessment” -  $(KE) = 1/2 MV^2$  so the speed at which an object strikes a person (rather than the object’s mass) determines the severity of that person’s injuries;
4. To get real-time road access & traffic recognition patterns for EMS/fire/police rescue/response vehicles out to site.



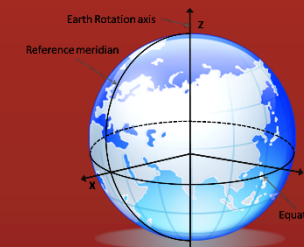
***“Crash Team” to utilize (2)  
DJI Phantom 4 Pro Quadcopters:***  
 Flight time: 30 mins.  
 Control range: 7 kms.  
 Speed: 72 KM/H  
 Video resolution: 4K 60fps  
 Sensor range: 30 m

GIS = A computer-based system for the manipulation & analysis of geospatial information in which there is an automated link between a data object and their spatial location.

GIS = A set of components for:  
 Storing  
 Mapping  
 Analyzing...  
*Spatial Data.*



Information System



Geographic Position



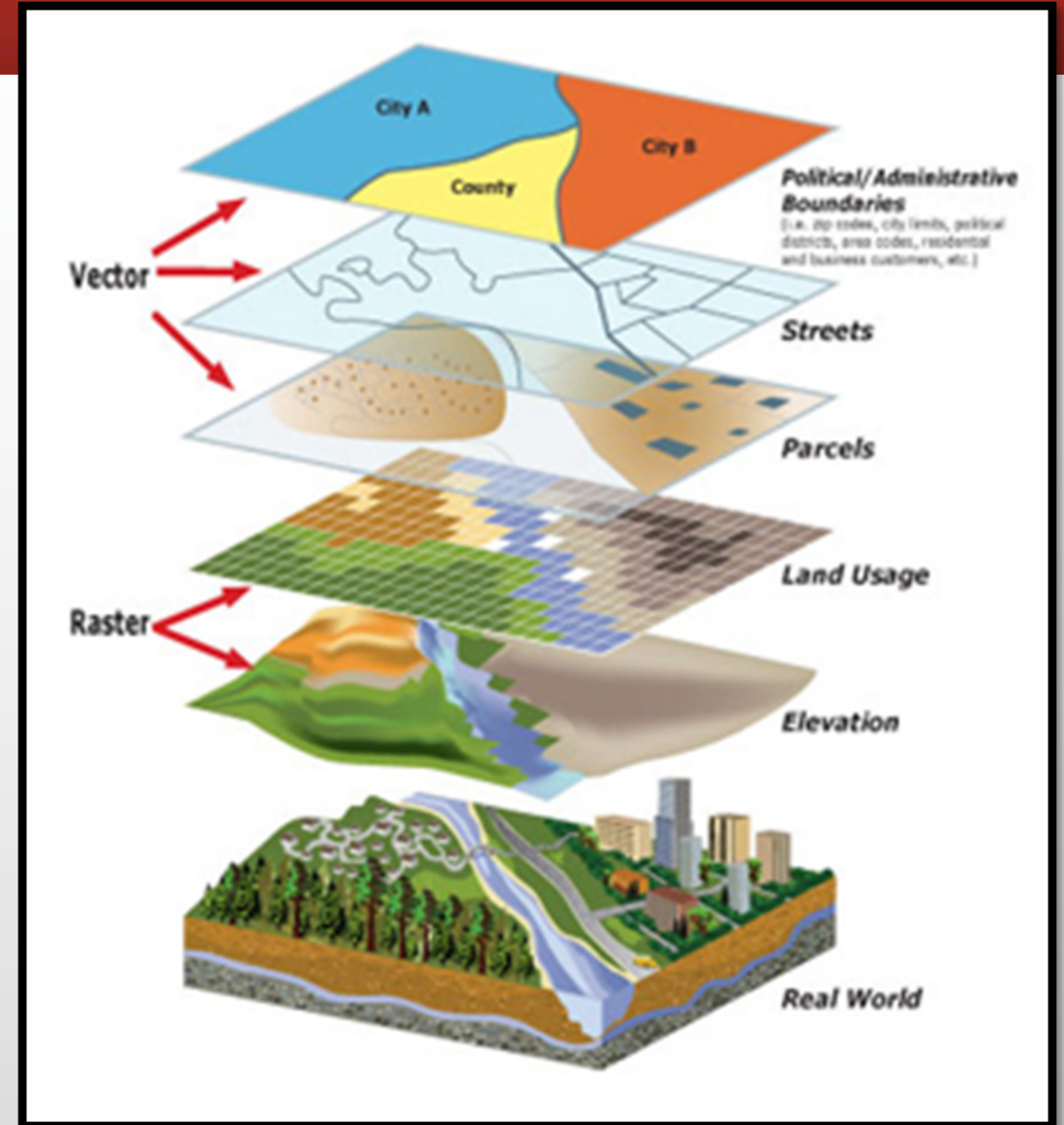
GIS

# Why GIS is the Right Tool for “MEDICAL GEOGRAPHY”

## Map Epidemics & Public Health

History: Dr. John Snow - Mapping 1854 Cholera Outbreak, London:

- First, identified **WHERE** people lived who were infected;
- Clustered **PATTERN** suggested a particular water pump as the source; and
- Made **MAPS** to show the location of cholera cases in relation to water sources.



# GIS Spatially Answers “Where Do We Need More Resources?”

## Via GIS Mapping, We Can:

- ☐ Identify & Map High-Risk RTA Sites, Junctions
- ☐ Identify & Map Natural/Man-Made (EOP Assessed) Hazards (Mine, Factory)
- ☐ Identify & Map I-IV Trauma Acuity Level Care Hospital Distribution
- ☐ Identify & Map Surge Capacity (Bed/Staff/OR)
- ☐ Identify & Map Current Prehospital Staff Locations
- ☐ Identify & Map Existing Ambulance Stations



## In Order to:

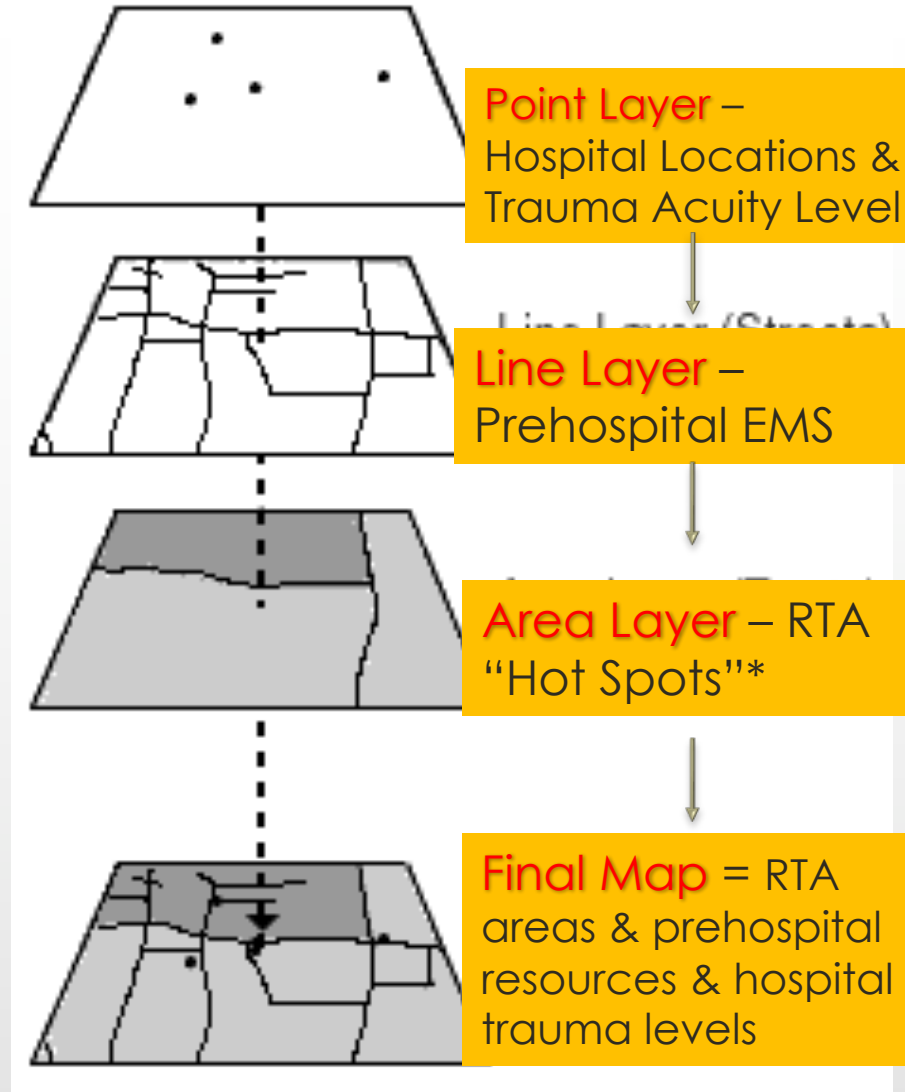
- Optimize Current Location(s) of Existing Ambulance Staffing, Stations
  - Augment Prehospital EMS Training Near High-Acuity Sites
  - Mitigate Future Disasters/MCI Impact(s)
  - Optimize Distribution of Current (High-Low Acuity) Trauma Care Facilities
  - Minimize/Prevent Surge to KATH/Other
- Match & Direct Low-Acuity RTA/EMS Transports to Low-Acuity Facilities; High-Acuity Trauma to High-Acuity Care
- Augment (higher) Trauma Acuity Level Hospital Care Near High-Risk RTA Areas
- Assist Proactive Future Community Development Planning for Facilities & Healthcare Resource Allotment(s)

## RICHTER: QGIS free/open-source\*/cross-platform (lin/win/mac) desktop software

Points = Hospital I-V  
Trauma Acuity level Adult  
& Pediatric (trauma  
competencies) & show  
bed/patient/OR surge  
capacities

Lines = show locations of  
EMS staff & routes

Areas = use collected  
police data By Police  
Jurisdiction\*



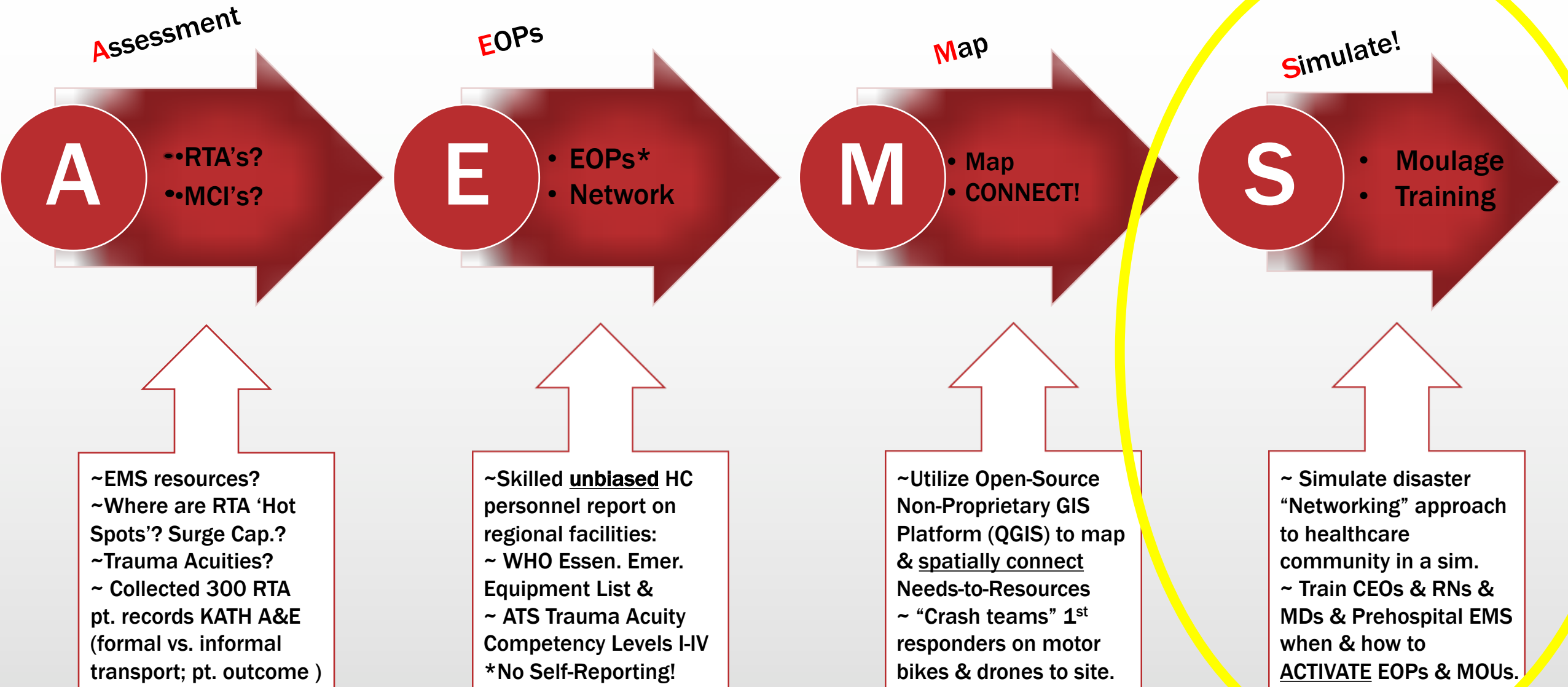
GIS  
&  
Spatial Analysis  
Methods  
are becoming  
part of  
the  
Health  
Researcher's  
“Methodological  
Arsenal”!



\*“Open-source software”= has “source code” that anyone can inspect, use, modify.

“Source code” = the code computer programmers use that forms how a piece of software—a “program” or “application”—works.

# Richter 2017 AEMS® Medical Mass Casualty Algorithm





## News: “Health Officials Demonstrate Emergency Preparedness”



*“The exercise was to see how stakeholders could work together in such times ... not as in the past where various practitioners worked on their own...”*

*To foster relationships between emergency nurses, physicians, national ambulance service, and all stakeholders to contribute towards giving patients the best service, saving as many lives as possible, and to check on any unnecessary delays during such emergency situations.”*

~ KATH Emergency Medicine Specialist, Dr. Joseph Bonney

Daily Graphic Newspaper, 5 April, 2017

# NATO Categories

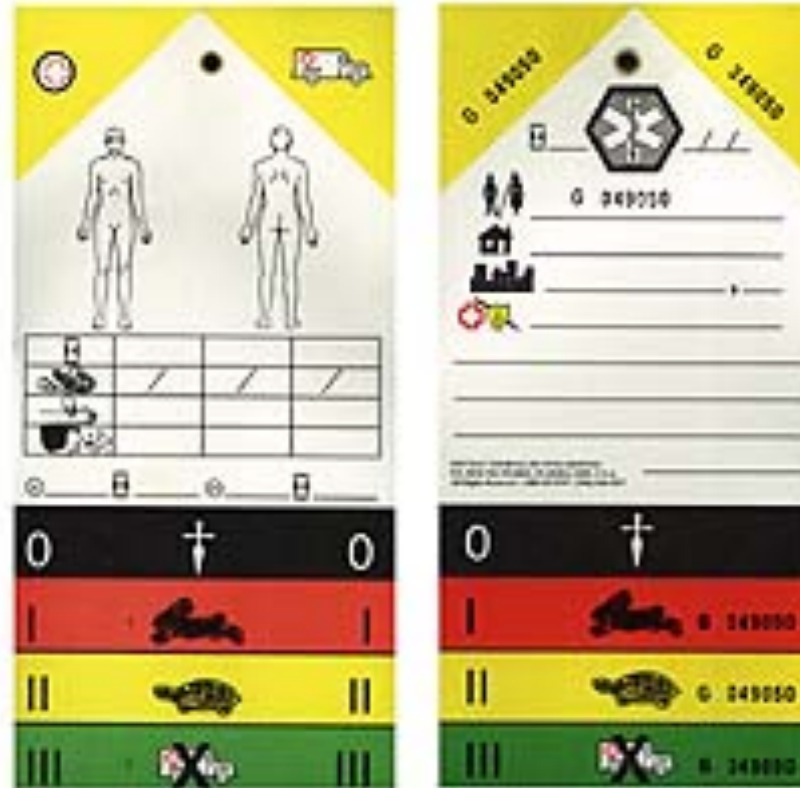


**Immediate:** Life-threatening injury; needs medical attention within the next hour

Airway obstruction, cardiorespiratory failure, significant external hemorrhage, shock, sucking chest wound, burns of face or neck

**Delayed:** Non-life-threatening injuries; needs medical attention, but treatment can be delayed a few hours

Open thoracic wound, penetrating abdominal wound, severe eye injury, avascular limb, fractures, significant burns other than face, neck, or perineum



**Minor:** need medical attention in the next few days ("the walking wounded")

Minor lacerations, contusions, sprains, superficial burns, partial-thickness burns of < 20% Body Surface Area (BSA)

**Deceased or Expectant:** Deceased ...OR injuries so severe that life-saving treatment cannot be provided with resources available

Head injury with GCS<8, burns >85% BSA, multisystem trauma, signs of impending death

# MCI Scene: Simple Triage And Rapid Treatment (START)



START Triage <b>Assess, Treat, (use bystanders)</b> When you have a color STOP - TAG - MOVE ON			
MINOR	-- Move Walking Wounded		
	DECEASED	-- No RESPIRATIONS after head tilt	
		-- Breathing but UNCONSCIOUS	
		-- Respirations - over 30	
		-- Perfusion Capillary refill > 2 or NO RADIAL PULSE Control bleeding	
		-- Mental Status Unable to follow simple commands	
IMMEDIATE	DECEASED	-- Otherwise	
		REMEMBER: Respirations - 30 Perfusion - 2 Mental Status - Can Do	

## RPM-30-2-Can DO

START Respirations: Is the patient's respiratory rate over or under 30?

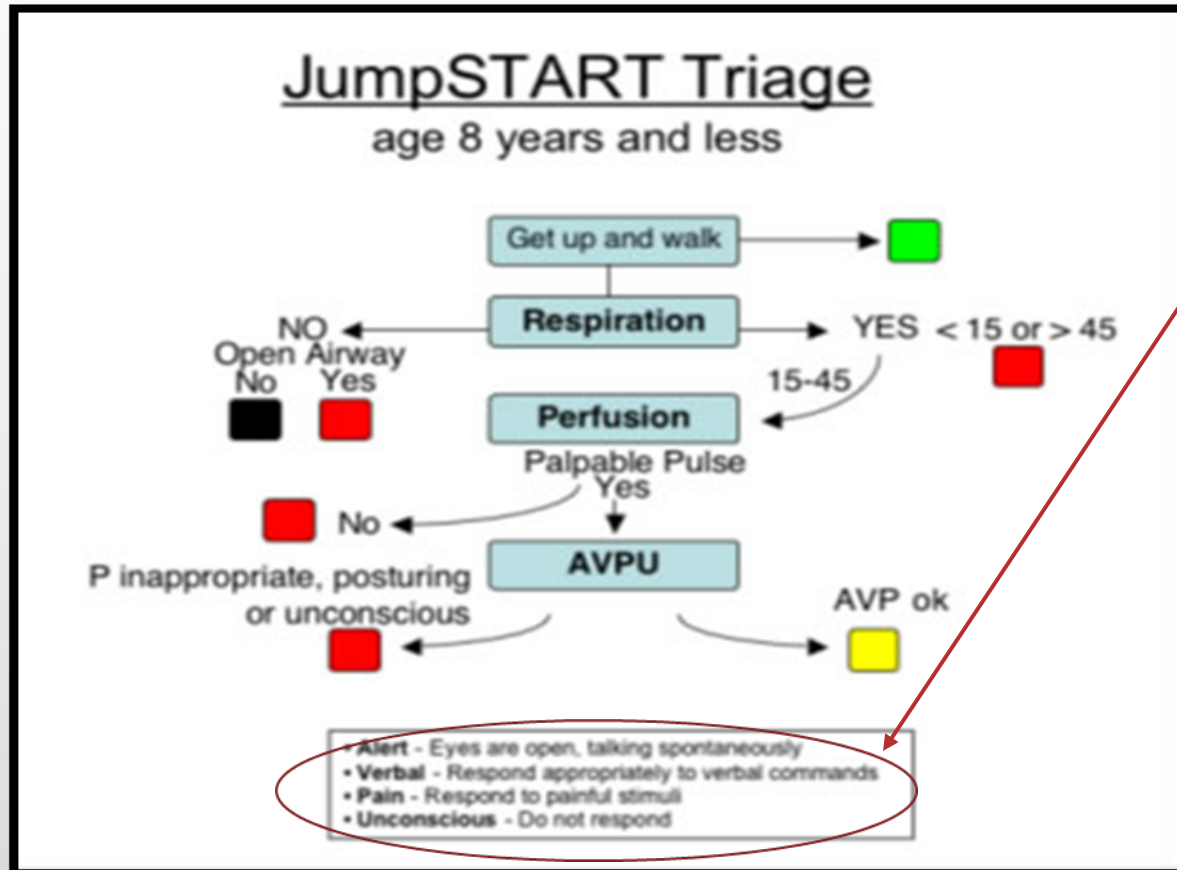
Perfusion: Is capillary refill over or under 2 seconds?

Mental status: Is the patient able to follow simple commands

# Pediatric (< Age 8) JumpSTART MCI Triage



JumpSTART



- significantly faster than SALT (Sort, Assess, Lifesaving Interventions, Treatment/Transport)<sub>6</sub>
- AVPU (simplified version of the Glasgow Coma Scale) mnemonic AVPU identifies levels of consciousness:
  - A – The patient is **awake and alert**. This does not necessarily mean that they are orientated to time and place or neurologically responding normally.
  - V – The patient is not fully awake, and will **only respond to verbal commands** or become roused after **verbal stimuli**.
  - P – The patient is difficult to rouse and will only respond to **painful stimuli**, such as nail bed pressure or trapezius pain.
  - U – The patient is completely **unconscious** and unable to be roused.

6. Jones N; White ML 2014; et al. "Randomized Trial Comparing JumpSTART versus SALT in a Pediatric Simulated Mass Casualty Event". Prehospital Emergency Care. 18 (3): 417–423.



- 100 cedi – Bottles of Water 100
- 300 cedi - 100 Lunches (meat pie, ground nuts & cookies & cocktail juice)
- 200 US \$ - Triage tape; tags; posters for START/JumpSTART
- 20 cedi - Plastic bags
- 400 cedi *Moulage* items - Glycerin, Red dishwashing soap, bowls, lots of clear plastic wrap, Alka Seltzer tablets, Baking Powder, 5 bottles Red food coloring, etc.)
- Disposable patient supplies (O2 tubing, gloves, ace wrap, kerlix bandage, splinting, – donated by KATH
- 350 cedis – Videographer/photographer – paid by KNUST
- 100 cedis – Ambulance petrol
- 100 cedis - Clipboards (8-12)
- 1,500 cedis - Moulage Polo Shirts (120)
- Additional: shirts & certificates for moulage “patients”; Kendrick extrication device; defibrillation trainer, reusable SAM splinting, etc.

Approximately: 3,670 GH cedis

# Moulage MCI Simulation Budget



# Why Nurse-Led Simulations & Triage?... Ratios!

## NURSE-LED TRIAGE

### **World Health Organization Recommendations:**

- nurse-to-population ratio = 1:1,000
- (2016) doctor-to-population ratio = 1:1,000
- doctor-to-patient ratio<sup>4</sup> = 1:600

### **Ghana Ratios:**

- approx. 3,000 MDs – 27 mil. Pop<sup>4</sup>  
(Upper East 1: 33,896; Upper West 1: 53,064)
  - doctor-to-population 1:10,452
  - nurse-to-population 1:1,251
- 



Thank You  
For  
Your  
Attention!



FOR MORE INFORMATION ON RICHTER'S PUBLISHED WORK, SEE:

**BOOKS:**

- Richter, R, Flowers, T., and Bongmba, E. *Witchcraft as a Social Diagnosis: Traditional Ghanaian Beliefs and Global Health*. Rowman & Littlefield, 2017.
- Richter, R. *Medical Outcasts: Gendered and Institutionalized Xenophobia in Undocumented Forced Migrants' Emergency Health Care*. Lexington Books, 2015.
- Richter, R. "Disparity in Disasters." In *Anthropology at the Front Lines of Gender-Based Violence*, (Eds.) Weis, J. and Haldane, H. Vanderbilt University Press, 2011.

**ARTICLES (abridged):**

- Gender-Aware Disaster Care: Issues and Interventions in Supplies, Services, Triage and Treatment. *International Journal of Mass Emergencies and Disasters* 28(2):207-225, August 2010.
- Gendered dimensions of disaster care: critical distinctions in female psychosocial needs, triage, pain assessment, and care. *American Journal of Disaster Medicine* 3(1):31-7, January 2008.
- Gender Matters: Female-specific relief efforts during disasters are key. *Journal of Emergency Medical Services* 32(5):58-63, June 2007.

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Fogarty Fellows: [fogartyfellows.org/fellow-richter-roxane/](http://fogartyfellows.org/fellow-richter-roxane/)

LinkedIn:  
[www.linkedin.com/in/roxane-richter-ph-d-e-m-t-99a02021?ppe=1](http://www.linkedin.com/in/roxane-richter-ph-d-e-m-t-99a02021?ppe=1)

World Missions Possible NGO (501c3 USA)  
<http://www.worldmissionspossible.org>