

**Mark Bernstein, MD, FASER**

Past President, American Society of Emergency Radiology  
Professor of Radiology, Boston University School of Medicine  
Trauma & Emergency Radiology  
Boston Medical Center

# ***Mass Casualty Incidents***

Introduction for Imagers



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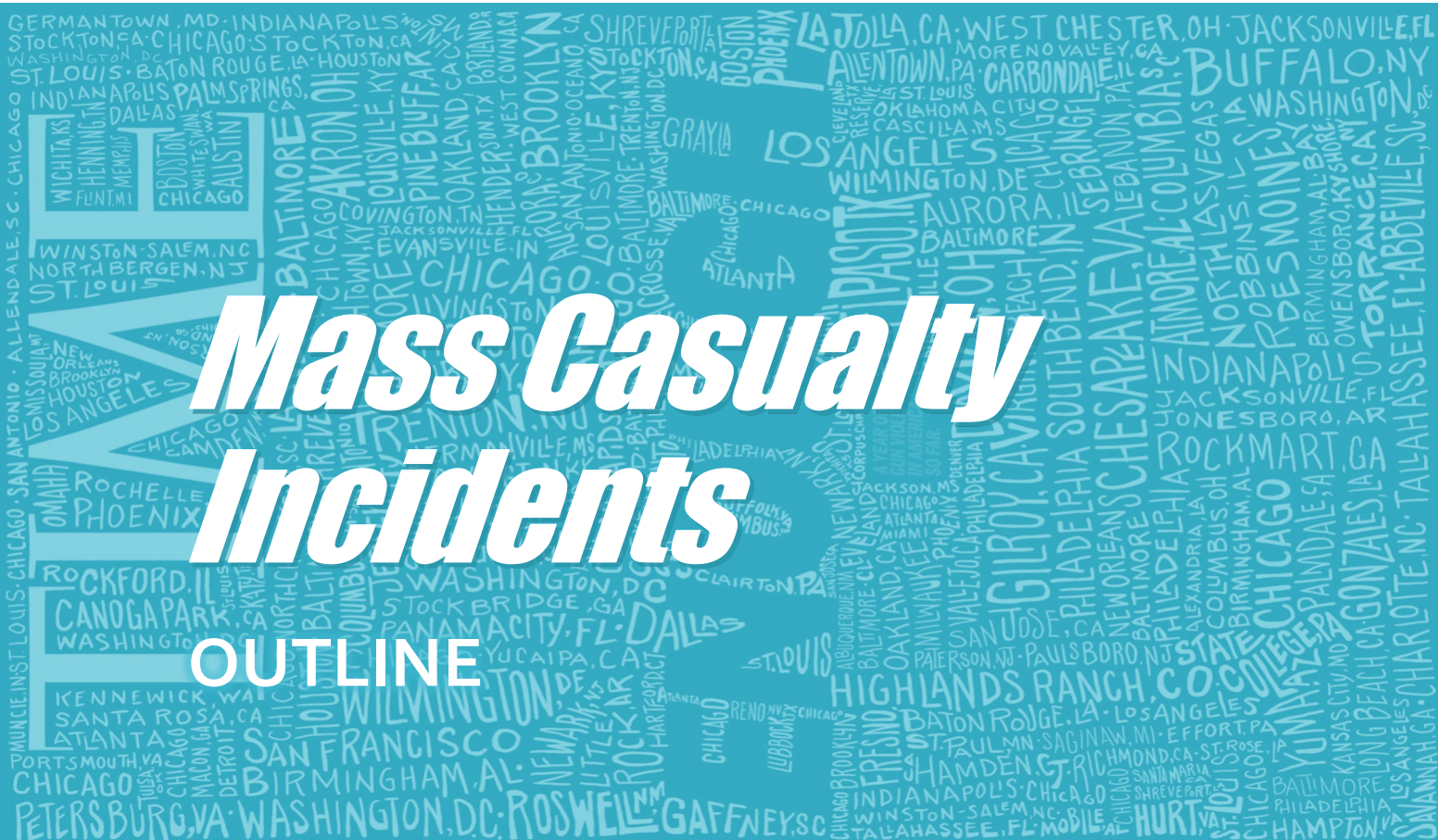
# ***Mass Casualty Incidents***

Introduction for Imagers



## **Special Thanks to:**

Ferco Berger, MD, FASER  
Colonel Eric Roberge, MD  
Ken Linnau, MD, FASER  
Ron Bilow, MD, FASER  
John Fildes, MD, FACS



# *Mass Casualty Incidents*

## OUTLINE

- 
- Introduction
  - MCI Response
  - Triage
  - Disaster Management
  - Role of Radiology
  - Lessons from LV

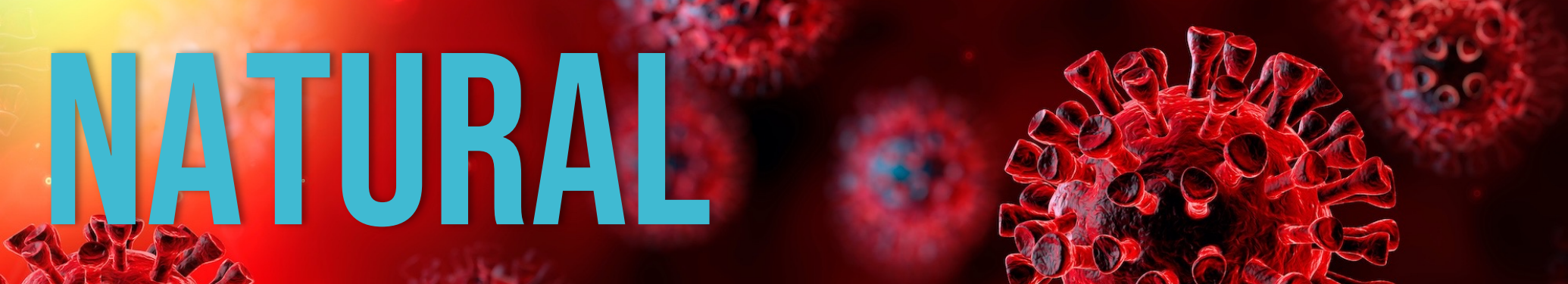
**INTENTIONAL**



**ACCIDENTAL**



**NATURAL**





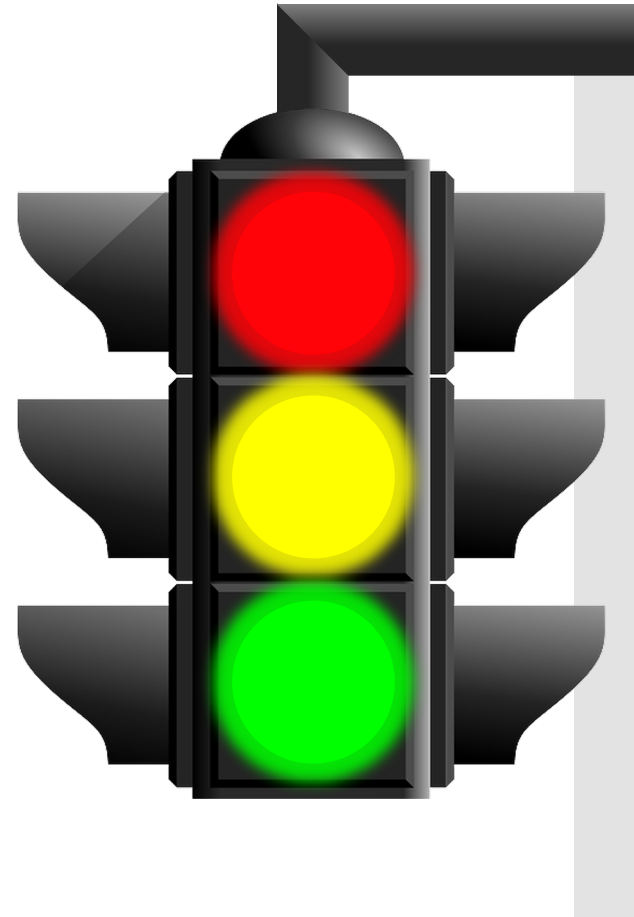
# *Introduction*



**Need for Healthcare to BE PREPARED**

# *Introduction*

- **Assumption...**
  - Healthcare delivery as per established standards
- **Reality...**
  - With each subsequent major event realized resources overwhelmed
- **Need for (updated) Disaster Management Plan**



# MULTIPLE CASUALTIES *vs* MASS CASUALTIES

- What is an MCI?
- What's different?
- What's similar?



## ***MCI Definition***

“ an event which generates more patients at one time than locally available resources can manage *using routine procedures.* ”

**NO THRESHOLD**

- World Health Organization (WHO), 2007



# ***MCI Definition***

and requires **exceptional emergency arrangements** and additional or **extraordinary assistance**.

- *World Health Organization (WHO), 2007*

# *Multiple* *vs* *Mass* *Casualty*



- Resources:
  - Staff
  - Equipment
  - Time
  - Space



- Requirements:
  - Surgical, ICU, ER teams
  - OR's
  - Blood
  - Ventilators

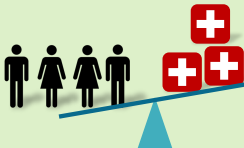
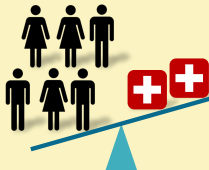
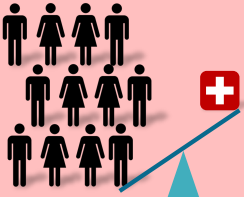
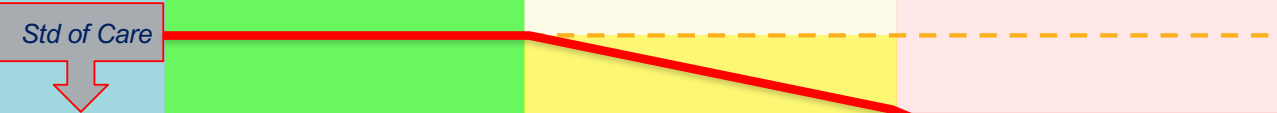
## **MULTIPLE** Casualty

- Available resources not overwhelmed

## **MASS** Casualty

- The number of casualties overwhelms available resources
  - *Change delivery of care*

# MCI

Surge Magnitude	Normal 	Multiple Casualty 	Mass Casualty 
increase capacity	1.2x	2x	3x
Response	conventional	contingency	crisis/MCI
Std of Care			
Response Strategies	Conserve Substitute	Conserve Substitute Adapt Reuse	Conserve Substitute Adapt Reuse Reallocate

The logo for Mass Casualty Incident (MCI) is displayed in a white, italicized, sans-serif font against a teal background.

- **Definition:**
  - The number & needs of casualties overwhelms available resources
- **Consequence:**
  - Divert from routine Standard of Care
- **Paradigm Shift:**
  - Individual Health → *Population Health*
    - *from:* best care for *each patient*
    - *to:* best care for the *greatest number* of patients

*MCI  
Paradigm  
Shift*

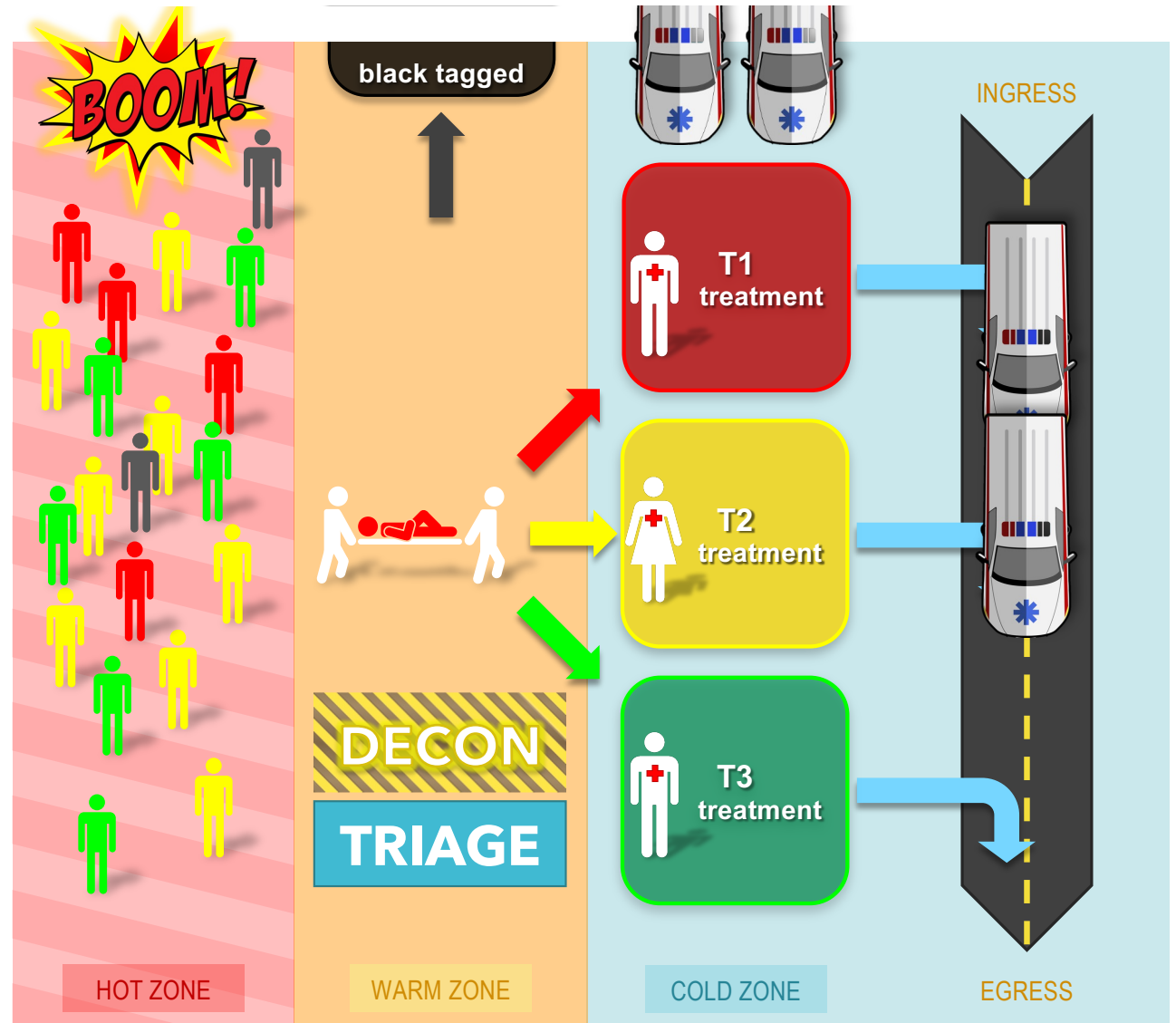
THE *for the*  
**GREATEST**  
GOOD NUMBER OF  
PEOPLE

A blue-tinted photograph of a protest. A crowd of people is gathered, many holding signs. Visible signs include "BLACK LIVES MATTER", "LOVE", "FU", and "LATE". In the foreground, a person is seen from behind, wearing a white t-shirt. To the right, the rear of a dark-colored Toyota Tundra truck is visible, with the text "TOYOTA TUNDRA" on the tailgate. The overall scene is busy and chaotic.

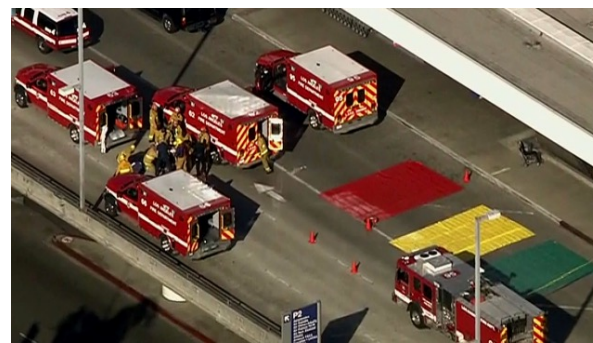
# *Mass Casualty Incidents*

RESPONSE

# MCI Response



# *Field Triage*





# MCI Triage



# *MCI Triage*

0



Unlikely to survive

T1



Immediate attention  
needed to survive

T2

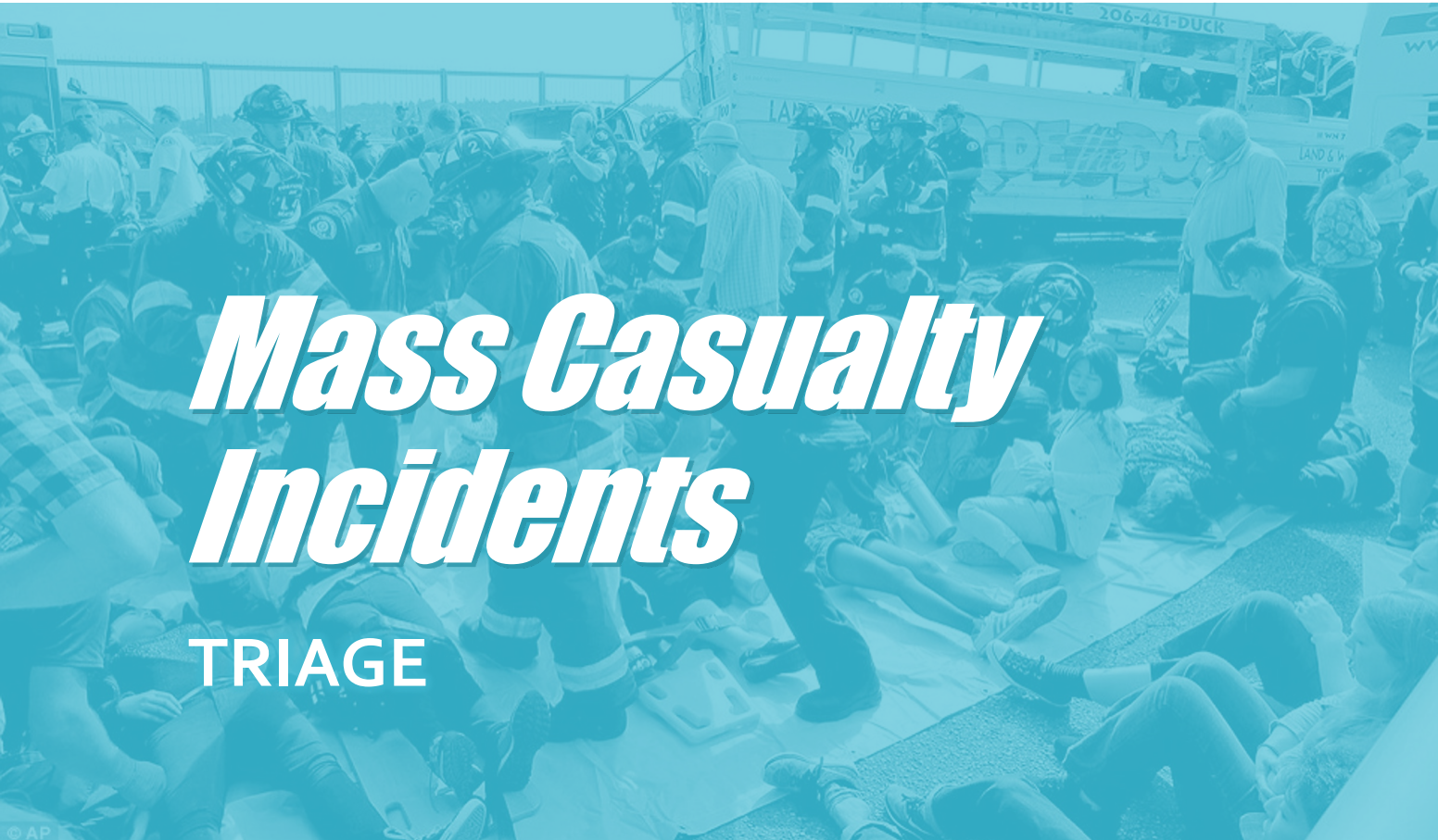


Not red, not green  
Able to wait

T3



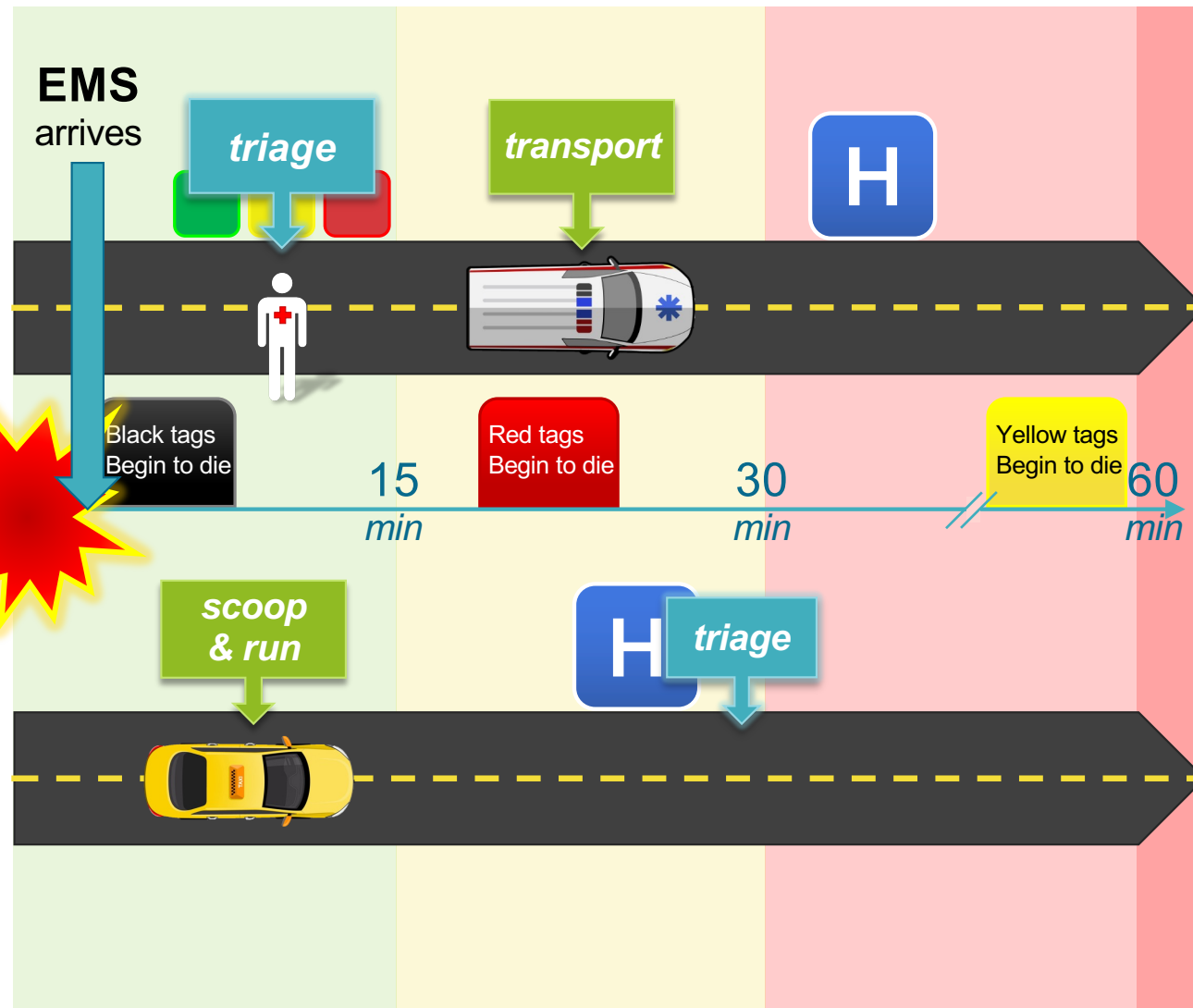
"walking wounded"



# *Mass Casualty Incidents*

TRIAGE

# MCI Response & Triage

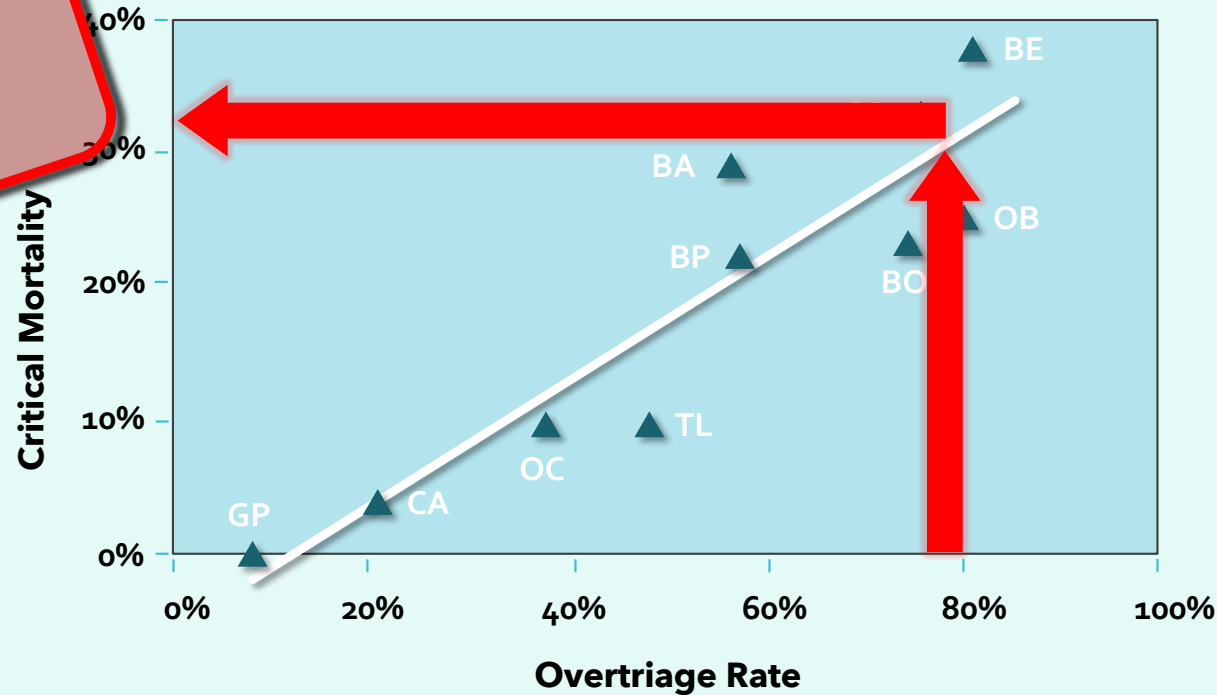


# *MCI Triage*

- **Field Triage:**
  - Only moderately accurate
- **Over Triage:**
  - T1 red **not** critical, *should* be T2 yellow or T3 green
  - **Blocks critical resources**
    - ER, OR, ICU, blood
  - → *results in high overall mortality*
    - Linear correlation of over-triage rate and mortality

**OVERTRIAGE  
KILLS!**

**MCI  
Triage**



Overtriage rate to critical mortality rate, in 10 terrorist bombing incidents from 1969 to 1995. Linear correlation coefficient ( $r = 0.92$ ). GP, Guildford pubs; CA, Craigavon; OC, Oklahoma City; TL, Tower of London; BP, Birmingham pubs; BO, Bologna; BA, Buenos Aires; OB, Old Bailey; CC, Cu Chi; BE, Beirut.

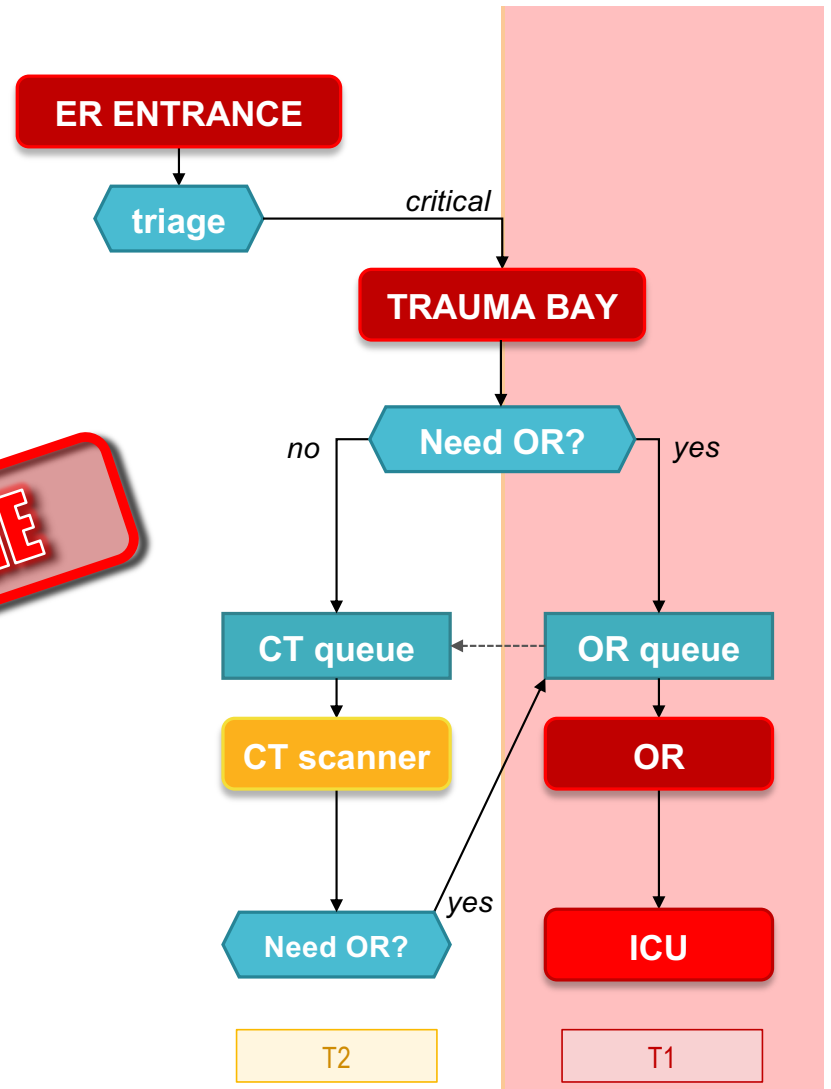
# MCI Triage



- **Triage ≠ one-time Pt assessment.**
  - Triage is **assignment of resources**
  - Based on Pt assessment & available resources
  - These 2 variables *may change over time*:
    - Once stable Pts may quickly decompensate
    - CT may identify critical injury in stable Pt
    - Critical Pts may stabilize (e.g. after tourniquet)
- **Re-assess patients & resources**

# MCI Process Map

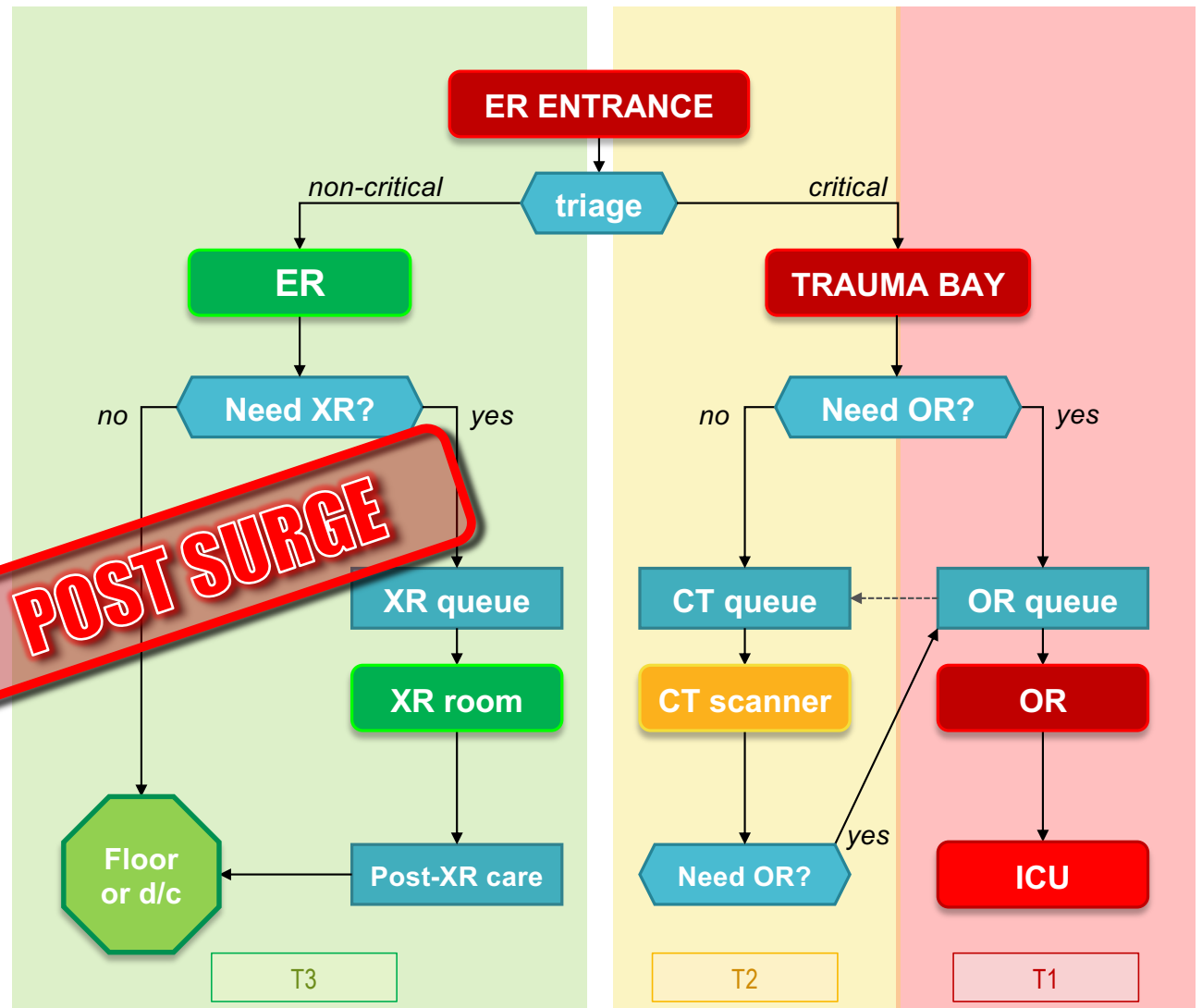
**POST SURGE**





# MCI Process Map

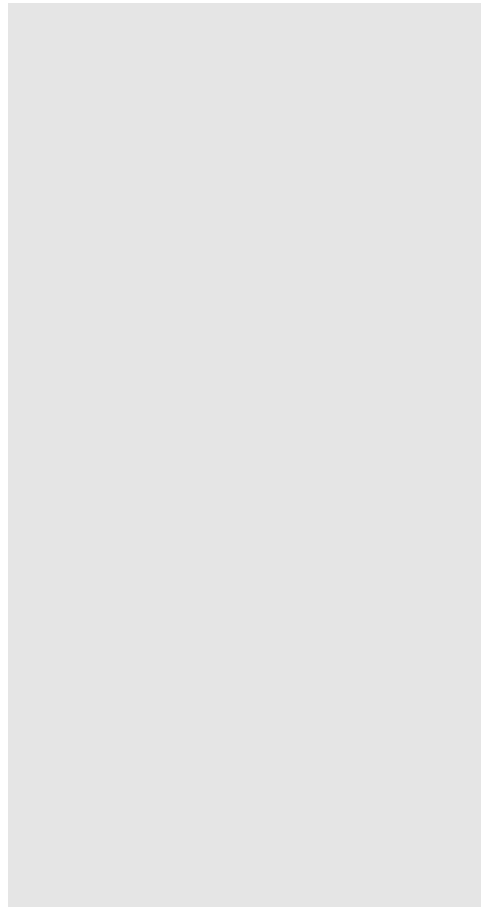
**POST SURGE**





# ***Mass Casualty Incidents***

**DISASTER MANAGEMENT PLAN**



# Disaster Management

## Disaster is declared

- Regional Disaster Command Center Activated
- Hospital **DMP** Activated
- Radiology **DMP** Activated
- Preparation for Surge begins

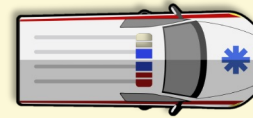
15  
min



30  
min

## Get information

- Nature of disaster
- Anticipated number of Pts
- Assess personnel needs
  - Call in rads, techs, clerks
- Huddle:
  - pre-designated meeting area
  - **Assign roles**
- Clear scanners
  - Activate MCI protocols



1  
hr

Peak influx of patients

2-4  
hr

Surge  
equilibrium  
reached

A blue rectangular graphic with the text 'MCI Disaster Management' in white, bold, italicized font. The background features faint, light blue icons of 'X' marks and circles with arrows pointing in various directions.

## *MCI Disaster Management*

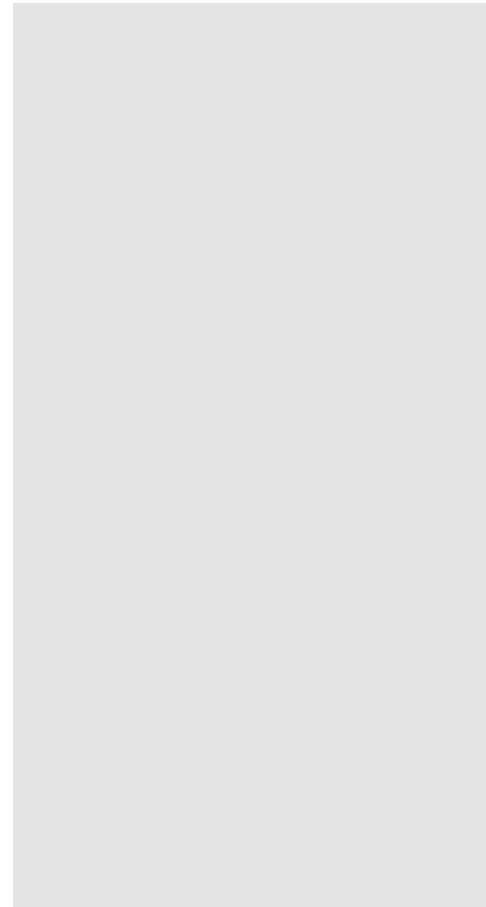
- **Disaster Management Plan (DMP)**
  - Mass Casualty Incidences are rare, unpredictable
  - Delivery of care in MCI differs from routine
  - **Plan** needs to be developed *before* disaster occurs
  - **Plan** needs to be **practiced**
  - *Radiology has critical role for in-hospital triage*

Bolster F. et al., Emerg Radiol (2017); 24: 47-53, PMID 27623691  
Berger-FH et al., Br J Radiol (2016); 89: 20150984

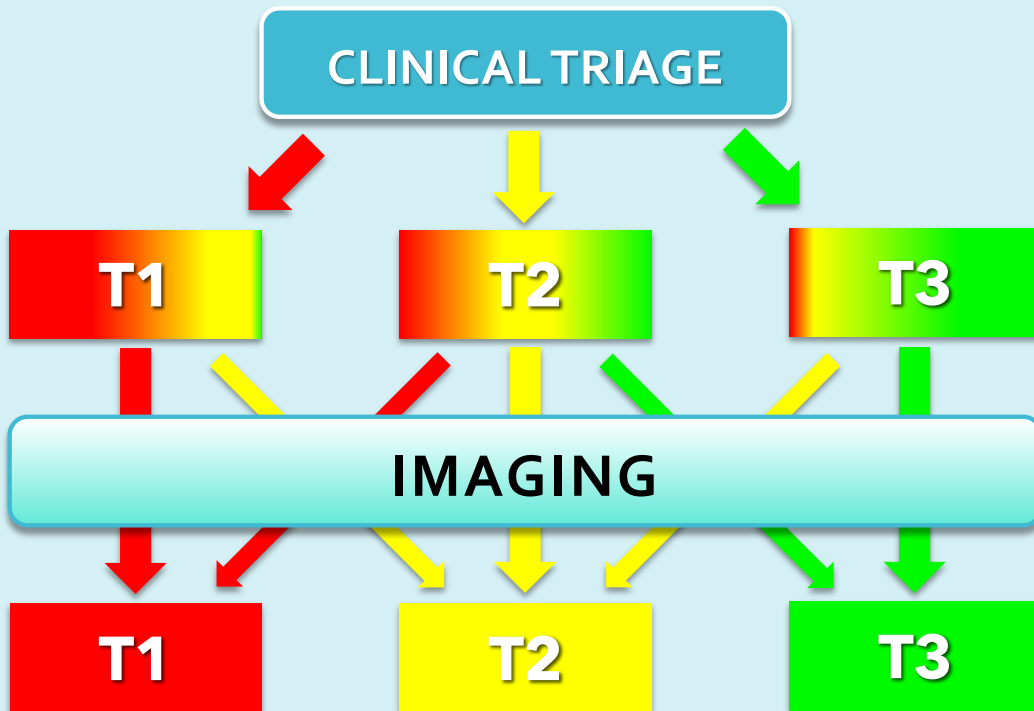


# ***Mass Casualty Incidents***

**ROLE OF RADIOLOGY**



# *MCI Imaging Role*



- ✓ Correct *Over* triage
- ✓ Correct *Under* triage

# *MCI Imaging Role*

- **Imaging:**
  - increases triage accuracy
  - changes management
- **Role of CT:**
  - In-hospital re-triage relies on CT
  - 72-93% of patients (analysis of recent MCIs)



# Radiology Value

Pt Name:	DoB:	FAST	pos / neg / equivocal
Pt MRN:	Date: M / F	Trauma type:	blunt / penetrating

X-RAYS	
<input type="checkbox"/> CXR done	negative <input type="checkbox"/>
PTX	R L <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Effusion	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Tension?	Y / N
Flail Chest	R / L / none
<input type="checkbox"/> ETT	OK / _____
<input type="checkbox"/> enteric	OK / _____
<input type="checkbox"/> chest tube	<input type="checkbox"/> R / <input type="checkbox"/> L _____
<input type="checkbox"/> other	
<input type="checkbox"/> Pelvic XR done	negative <input type="checkbox"/>
pelvic fracture	Y / N stable / unstable

HEAD	
<input type="checkbox"/> done	negative <input type="checkbox"/>
Hemorrhage	R L SDH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
EDH	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
SAH	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
parenchymal	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Herniation?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / N
Fractures	
calvarial	R / L / none
skull base	R / L / none
facial	R / L / none

CHEST	
<input type="checkbox"/> done	negative <input type="checkbox"/>
PTX	R L <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Effusion	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Tension?	Y / N
Aortic Injury	Y / N
Fractures	Y / N
site(s)	

SPINE	
<input type="checkbox"/> done	negative <input type="checkbox"/>
Done	Fractures
<input type="checkbox"/> C-spine	Y / N
<input type="checkbox"/> T-spine	Y / N
<input type="checkbox"/> L-spine	Y / N
	stable / unstable
Levels	

ABDOMEN & PELVIS	
<input type="checkbox"/> done	negative <input type="checkbox"/>
Visceral Injury	
Liver	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / N
Spleen	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> / N
Kidney	R / L / N
Other	Y / N
site(s)	
Free Air	Y / N
Free Fluid	Y / N
Bleeding	
Arterial bleed	Y / N
PSA	Y / N
	liver / spleen / pelvis / other
Pelvic Fracture	Y / N
	stable / unstable

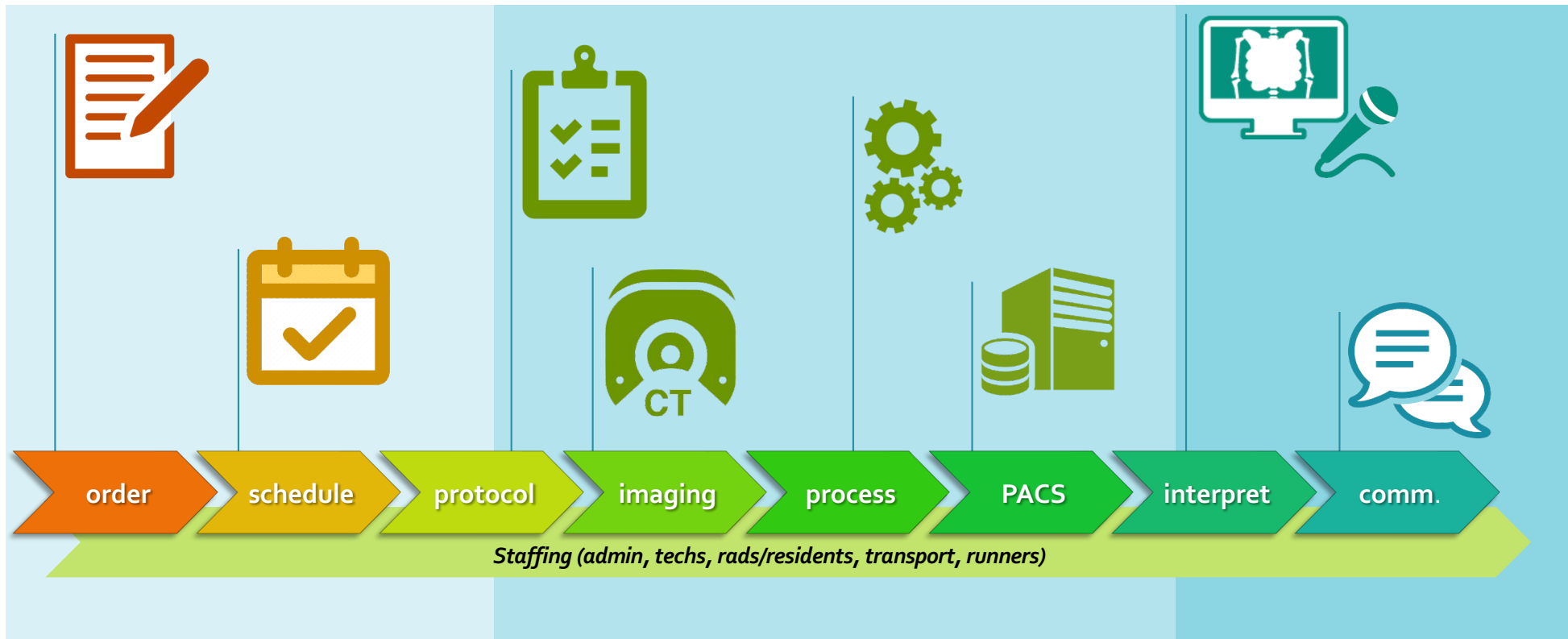
time on CT scout	CT scanner	ER / 1 / 2 / 3
Notes/Additional Findings:		

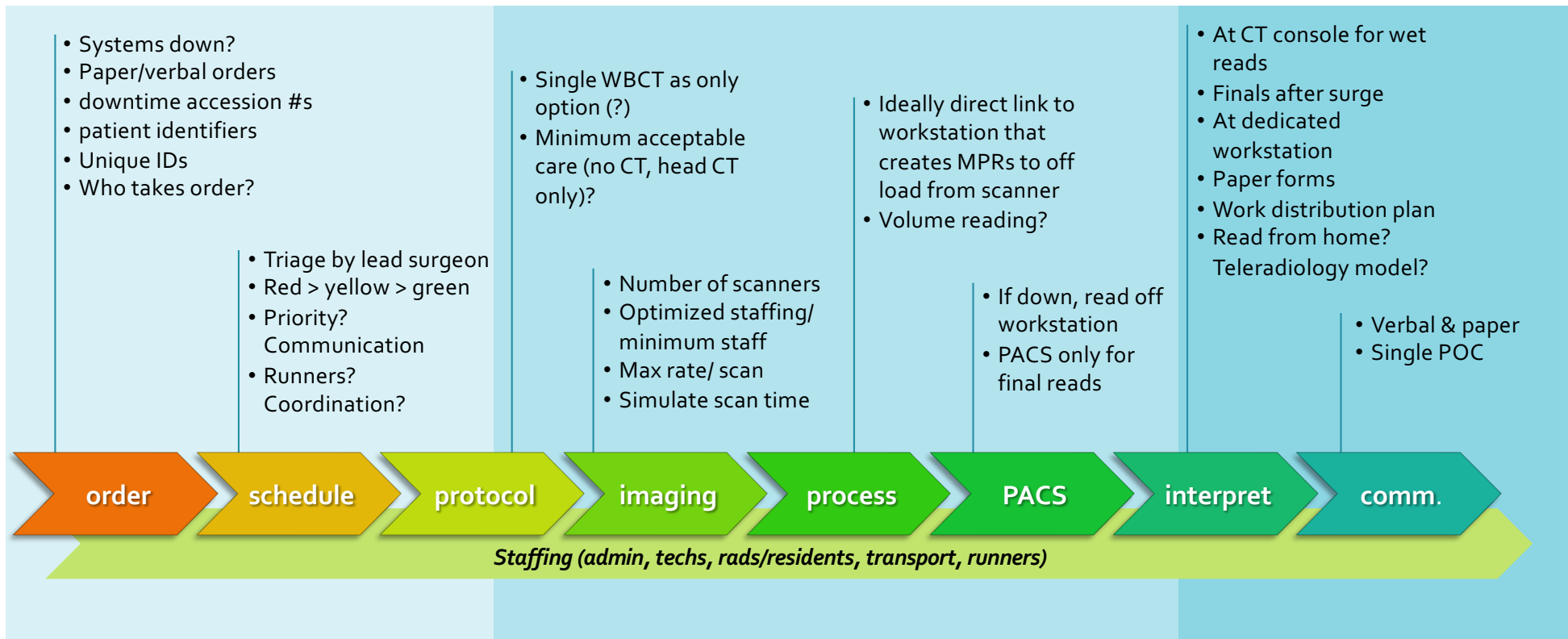
Radiologist	_____
Provider	_____



# Radiology Process Map



# Radiology Process Map



# Ordering & Scheduling

order

schedule

Patient		Exam	
read R	ED	NEURO	CT HEAD WITHOUT IV CONTRAST HEADTRAUMA
view ▼	ED	NEURO	LAMBDA ONE HUNDRED... CT HEAD WITHOUT IV CONTRAST HEADTRAUMA
read R	ED		LAMBDA ONE HUNDRED AND SEVENTY-FOUR, LAMBDA (M) 30y
view ▼	ED		[ click to view patient jacket ]
read R	ED		CP

# Ordering & Scheduling

order

schedule

		Patient	Exam	
read	R	LAMBDA ONE HUNDRED...	NEURO	CT HEAD WITHOUT IV CONTRAST
view	▼	ED		HEADTRAUMA
view	▼	LAMBDA ONE HUNDRED...	NEURO	CT HEAD WITHOUT IV CONTRAST
		ED		HEADTRAUMA
read	R	LAMBDA ONE HUNDRED...	NEURO	CT HEAD WITHOUT IV CONTRAST
view	▼	ED		HEADTRAUMA
read	R	DELTA ONE HUNDRED...	NEURO	CT HEAD WITHOUT IV CONTRAST
view	▼	ED		HEADTRAUMA

# Ordering & Scheduling

order

schedule

## What's in a hurricane's name?

Atlantic tropical storm name lists, 2016-2021

2016	2017	2018	2019	2020	2021
Alex	Arlene	Alberto	Andrea	Arthur	Ana
Bonnie	Bret	Beryl	Barry	Bertha	Bill
Colin	Cindy	Chris	Chantal	Cristobal	Claudette
Danielle	Don	Debby	Dorian	Dolly	Danny
Earl	Emily	Ernesto	Erin	Edouard	Elsa
Fiona	Franklin	Florence	Fernand	Fay	Fred
Gaston	Gert	Gordon	Gabrielle	Gonzalo	Grace
Hermine	Harvey	Helene	Humberto	Hanna	Henri
Ian	Irma	Isaac	Imelda	Isaias	Ida
Julia	Jose	Joyce	Jerry	Josephine	Julian
Karl	Katia	Kirk	Karen	Kyle	Kate
Lisa	Lee	Leslie	Lorenzo	Laura	Larry
Matthew	Maria	Michael	Melissa	Marco	Mindy
Nicole	Nate	Nadine	Nestor	Nana	Nicholas
Otto	Ophelia	Oscar	Olga	Omar	Odette
Paula	Philippe	Patty	Pablo	Paulette	Peter
Richard	Rina	Rafael	Rebekah	Rene	Rose
Shary	Sean	Sara	Sebastien	Sally	Sam
Tobias	Tammy	Tony	Tanya	Teddy	Teresa
Virginie	Vince	Valerie	Van	Vicky	Victor
Walter	Whitney	William	Wendy	Wilfred	Wanda

Source: National Oceanic and Atmospheric Administration

### First Names

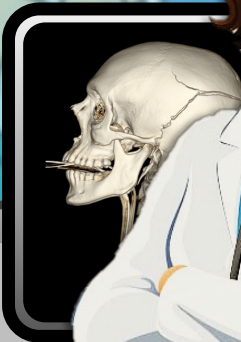
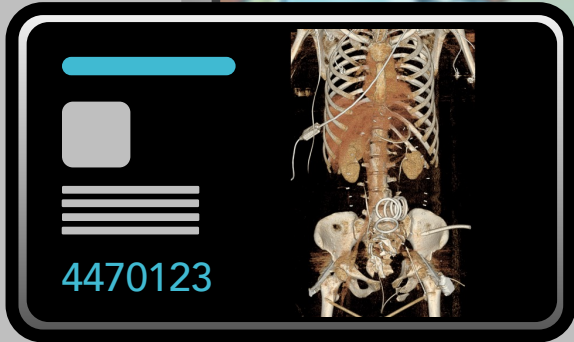
- Hurricanes
- Countries
- Capital cities
- States
- Beers of the world
- Colors


### Last Names

- Trauma,
- MCI,
- Disaster,

CT ER

READING ROOM





***MCI***  
***Imaging***

- **Concepts:**

- Disaster policies should **build off daily practices**
- Protocols should allow for **situational flexibility**
- Understand overall response **principles**
  - Apply tactics that fit the incident

# *MCI Trauma Imaging*

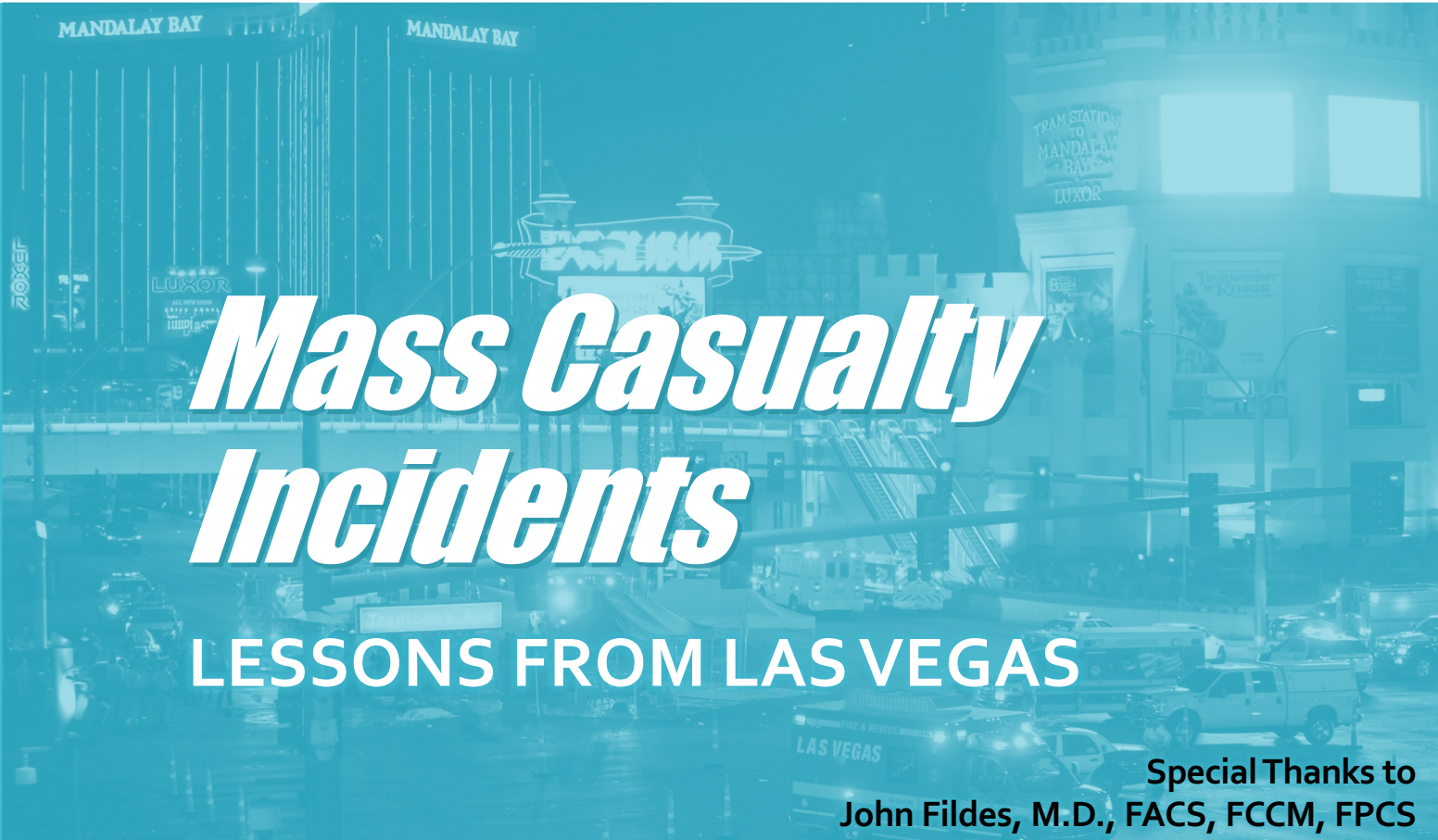


  
Formula 1

# *Routine Trauma Imaging*







# *Mass Casualty Incidents*

LESSONS FROM LAS VEGAS

Special Thanks to  
John Fildes, M.D., FACS, FCCM, FPCS

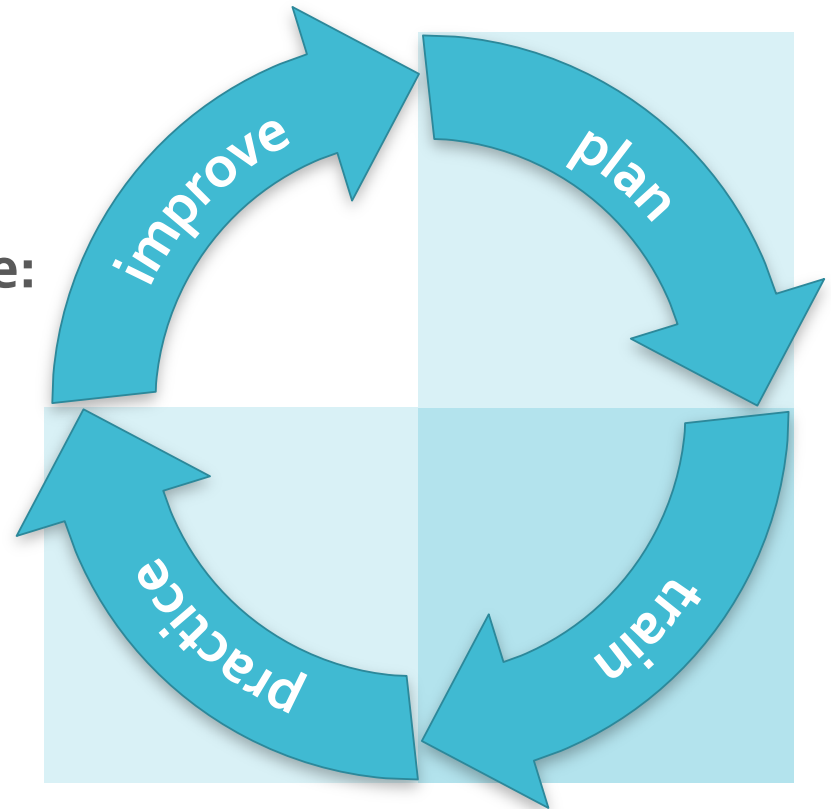
# ***MCI*** ***Response*** ***Strengths***

- The MOST IMPORTANT strengths associated with MCI response are:
  - **PREPARATION**
    - *Plan* your response
    - *Practice* your response
    - *Execute* your response
  - **COLLABORATION**

# ***MCI Disaster Planning***

The PLAN must be:

- Simple
- Flexible
- Modular
- Scalable



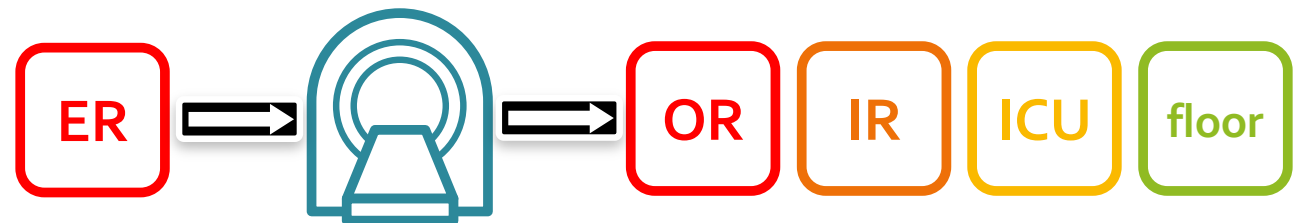
# LV Shooting

- **Lessons Learned**

- Create *upstream capacity* by increasing downstream patient movement along a *one-way path*



- *ie. Following CT, Pts should not be returning to ER*



# *LV Shooting*

- **Lessons Learned**

- Have a plan to call in additional staff at every level  
12/12
  - Will take days to return to normal
  - Post-surge imaging > imaging during surge ?
- Develop a **"DOE"** naming system
- Use abbreviated documentation
- And ***be prepared*** for the unpredictable...

# ***LV Shooting***

- **Lessons Learned**

- Realize that this *changes everyone permanently*
  - Start counselling early
  - Spread resilience to your colleagues, friends
- And know that *seeing the worst that man can do will bring out the best in mankind...*



**THANK YOU!**



**BOSTON MEDICAL CENTER**