Evaluating Hospital-Based Emergency Room (ER) Triage System in Mass Casualty Events in Taiwan

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Key Research Questions

This study assesses the misclassification of patients in hospitals in Taiwan over a period of nine years during mass casualty incidents (MCIs) triage.

Methods

We identify 1,097 MCIs spanning nine types of disasters, which result in 39,468 emergency room (ER)-admitted injuries. We assess patients' emergency severity and resource utilization using the ER's 5-level triage system, which assigns triage levels 1 and 2 to severe cases, discharging non-severe cases on the same day. We focus on hospitalization and outcome tracking.

Results

We found misclassification rates of 63.6% across 9 disaster categories, with higher misclassification rates in earthquakes (60.9%) and tropical cyclones (69.7%) compared to traffic accidents (45.7%) and fire/explosions (52.1%). MCI scale and emergency medical personnel misclassifying non-serious patients as triage levels 1 and 2 correlated. Misclassification rates were higher for large-scale fire and explosion incidents with more than 41 people, which could be attributed to the surge of patients overwhelming emergency rooms. Misclassification rates for earthquakes and tropical cyclones appeared dependent on incident characteristics such as location, magnitude, and impact period.
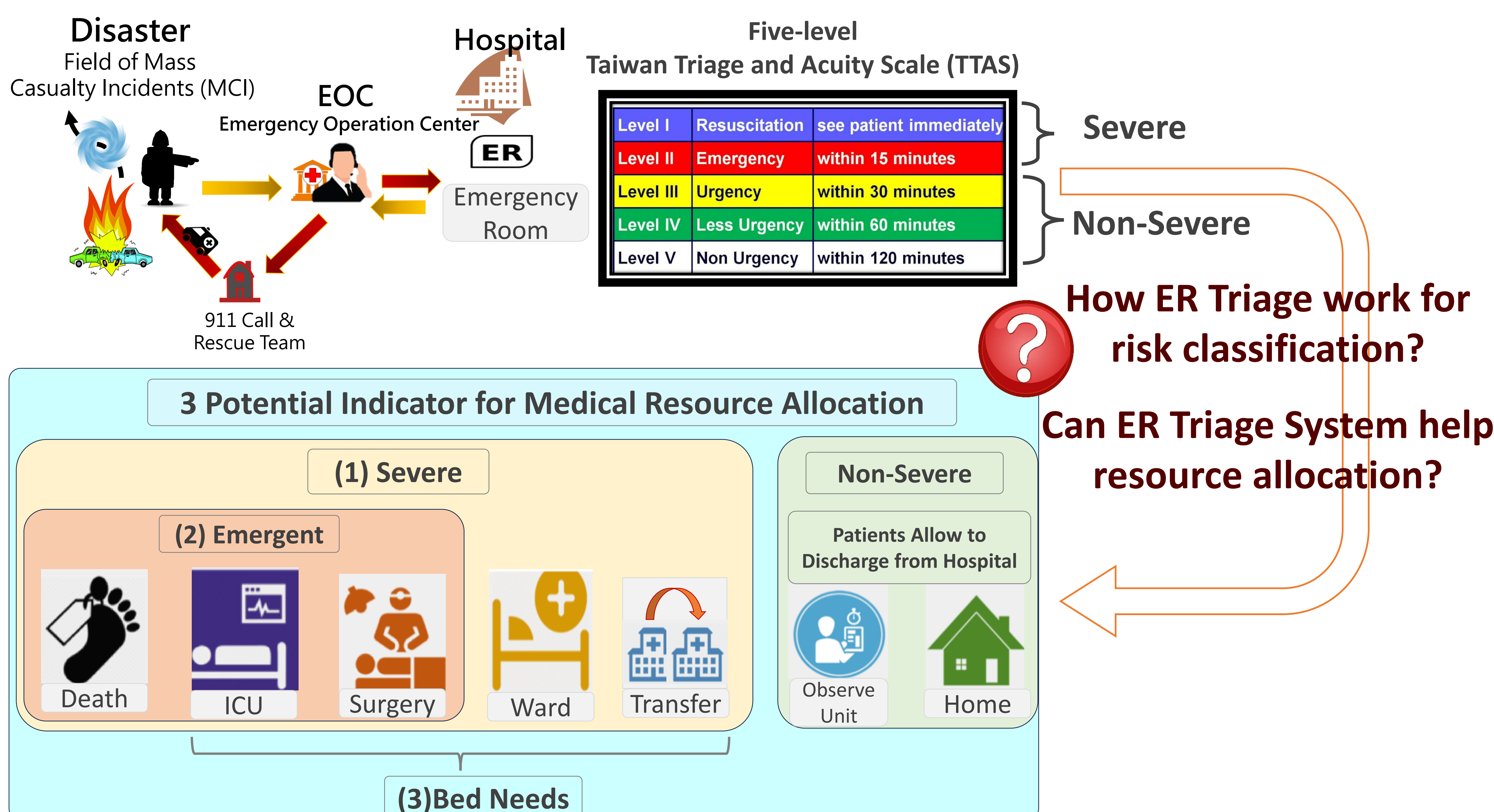
Disaster
Field of Mass Casualty Incidents (MCI)

EOC
Emergency Operation Center

Hospital
ER
Emergency Room

911 Call & Rescue Team

Five-level Taiwan Triage and Acuity Scale (TTAS)

Level I	Resuscitation	see patient immediately
Level II	Emergency	within 15 minutes
Level III	Urgency	within 30 minutes
Level IV	Less Urgency	within 60 minutes
Level V	Non Urgency	within 120 minutes

Severe
Non-Severe

How ER Triage work for risk classification?

Can ER Triage System help resource allocation?

3 Potential Indicator for Medical Resource Allocation

(1) Severe

(2) Emergent

Death | ICU | Surgery | Ward | Transfer

(3)Bed Needs

Non-Severe

Patients Allow to Discharge from Hospital

Observe Unit | Home

Figure 1. Mis-classification rate of severe condtions in mass casualty incidents (percentage of non-severe affected people within ER triage level 1 and 2)

Overall (*Ref)	63.6%
Earthquakes/Landslides	60.9%
Tropical Cyclones	69.7%
Food Poisoning	81.1%
Traffic Accident	45.7%
Fire/Explosion	52.1%

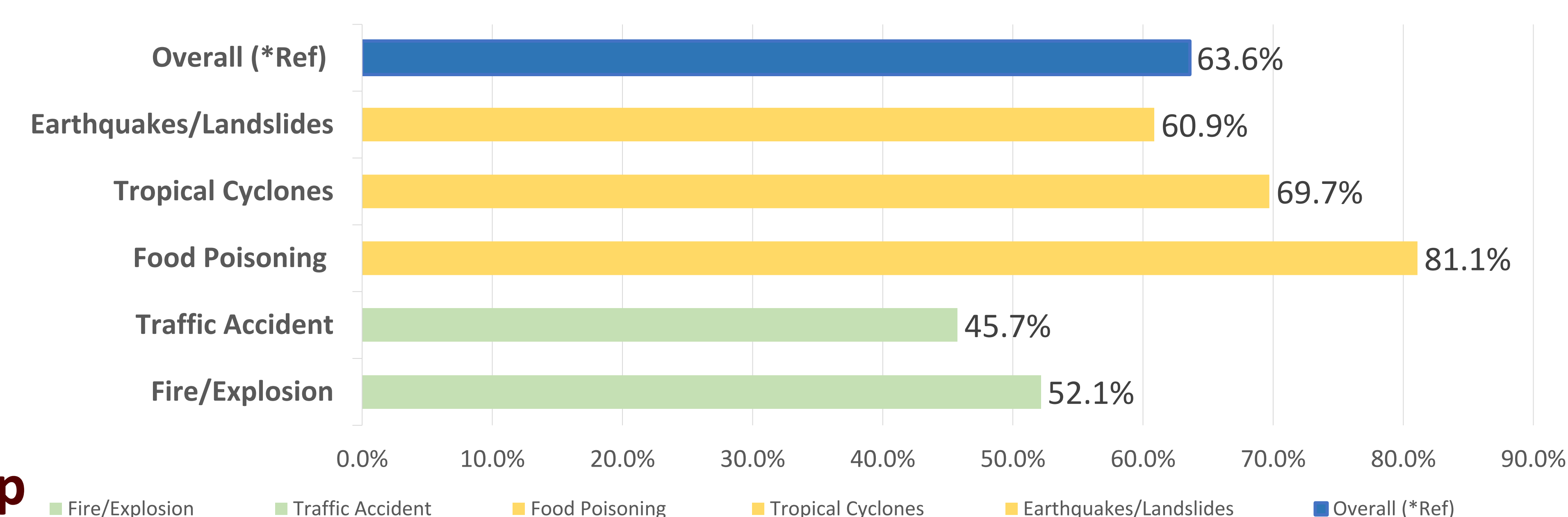Fire/Explosion   Traffic Accident   Food Poisoning   Tropical Cyclones   Earthquakes/Landslides   Overall (*Ref)

Figure 2. Mis-classification rate of severe condtions in mass casualty incidents in Taiwan (percentage of non-severe affected people within ER triage level 1 and 2)

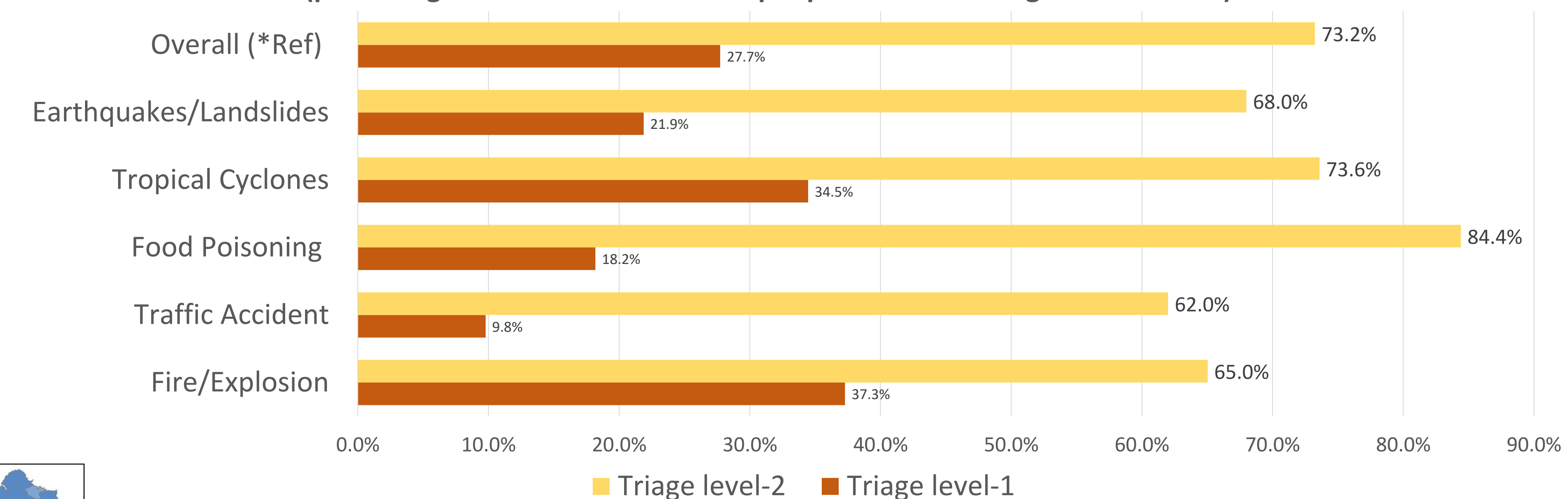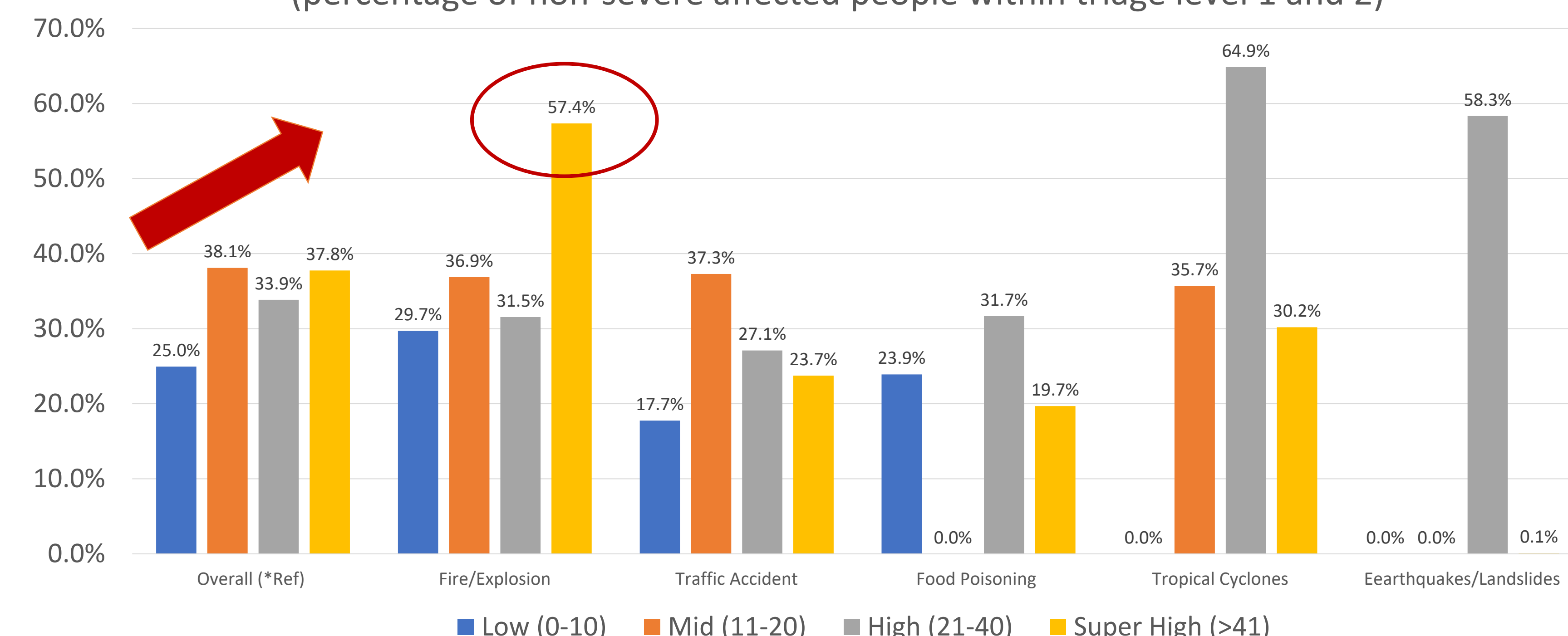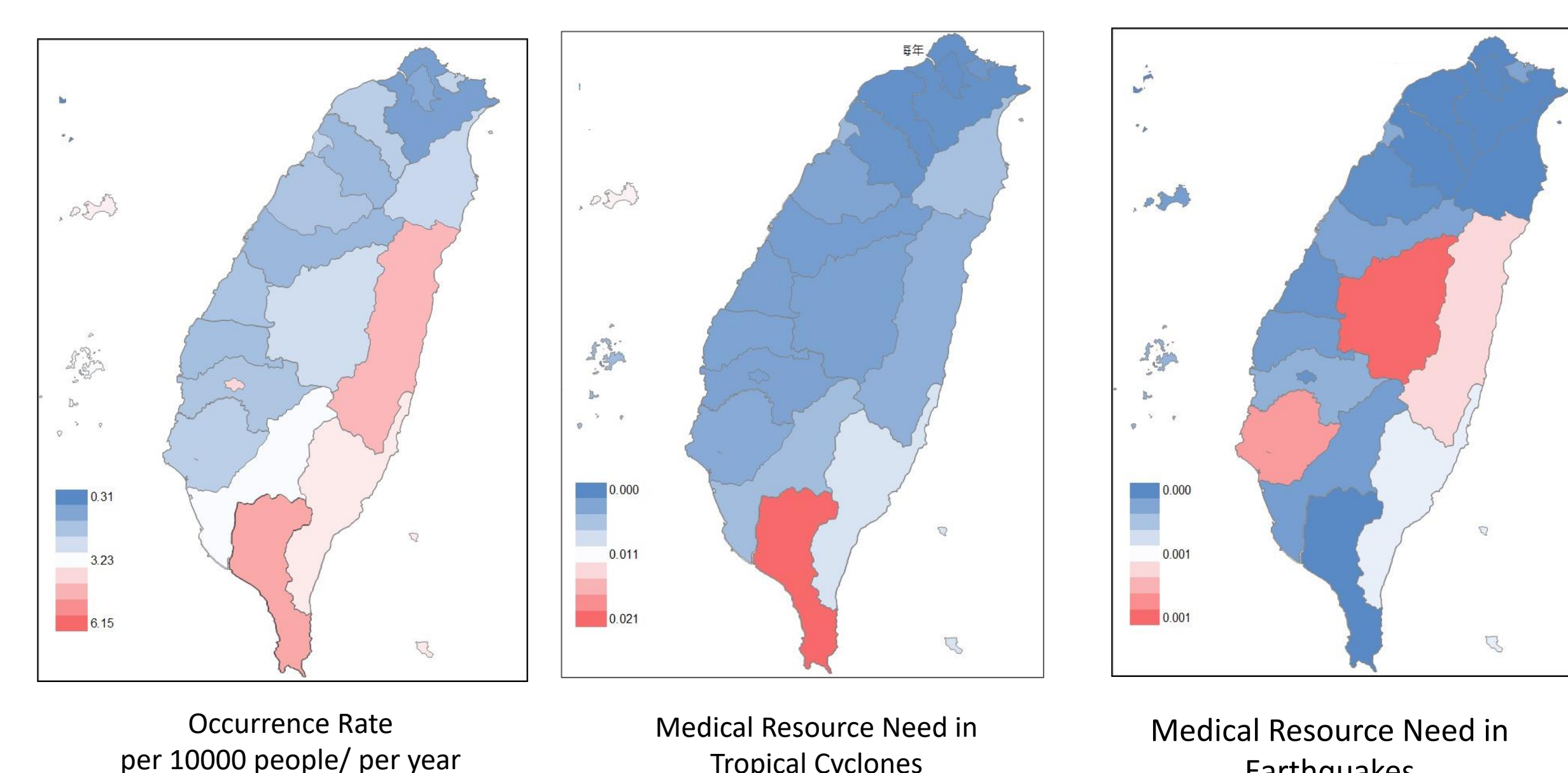|	Triage level-1	Triage level-2
Overall (*Ref)	27.7%	73.2%
Earthquakes/Landslides	21.9%	68.0%
Tropical Cyclones	34.5%	73.6%
Food Poisoning	18.2%	84.4%
Traffic Accident	9.8%	62.0%
Fire/Explosion	37.3%	65.0%

Triage level-2   Triage level-1

Figure 3. Mis-classification rate in different affected scale of incidents (percentage of non-severe affected people within triage level 1 and 2)
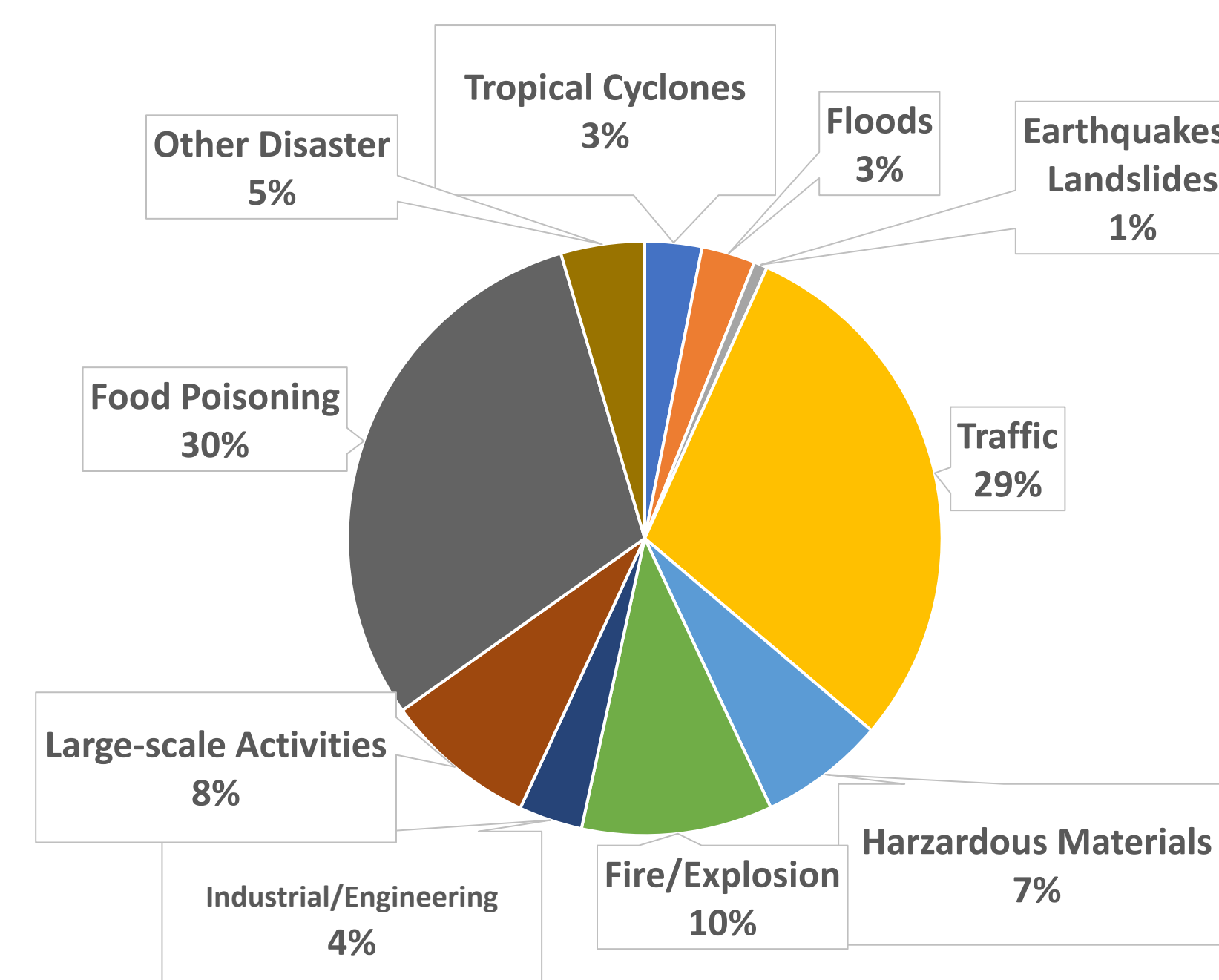
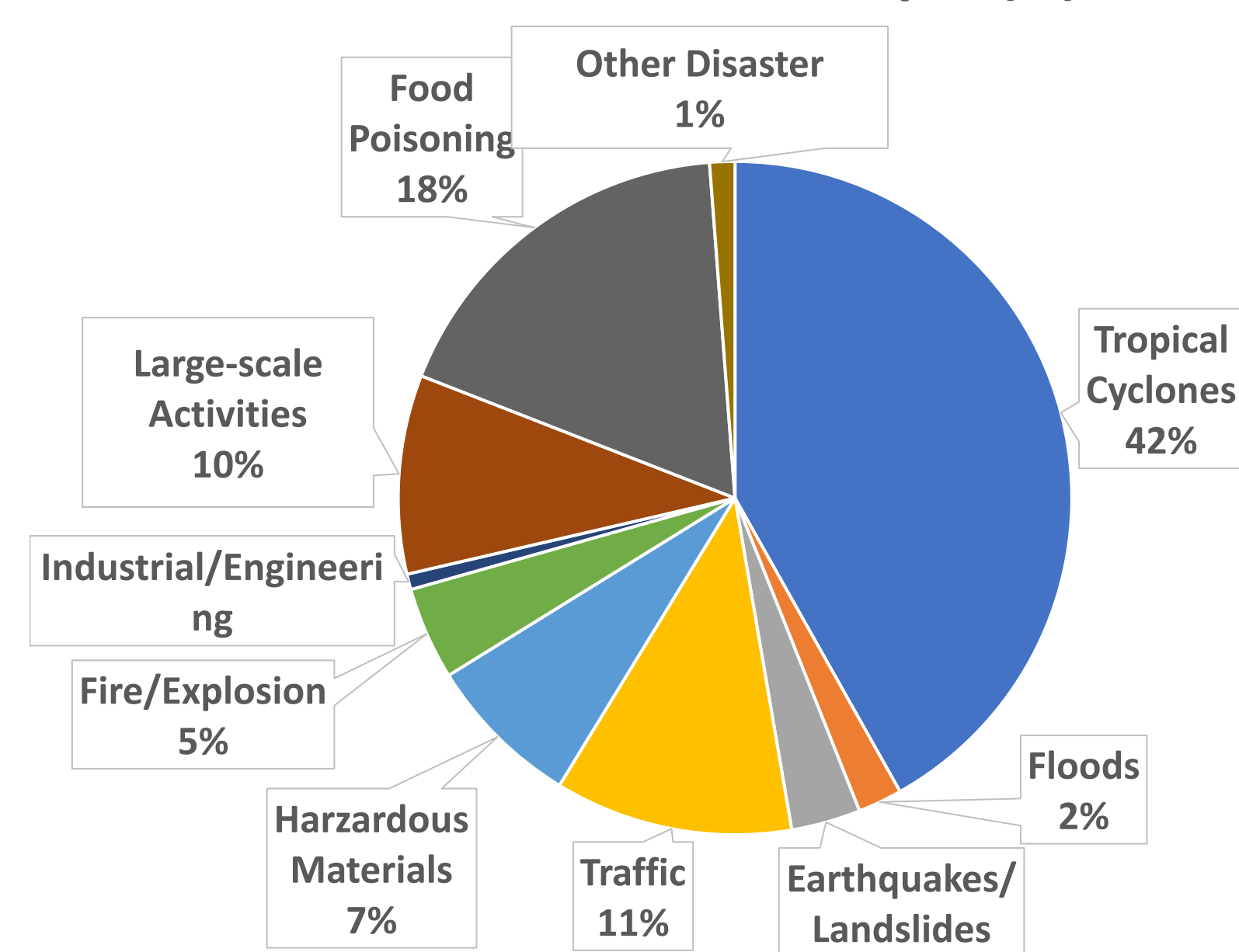|	Low (0-10)	Mid (11-20)	High (21-40)	Super High (>41)
Overall (*Ref)	25.0%	38.1%	33.9%	37.8%
Fire/Explosion	29.7%	36.9%	31.5%	57.4%
Traffic Accident	17.7%	37.3%	27.1%	23.7%
Food Poisoning	23.9%	0.0%	31.7%	19.7%
Tropical Cyclones	0.0%	35.7%	64.9%	30.2%
Earthquakes/Landslides	0.0%	0.0%	58.3%	0.1%

Table 1. Category and Impact of Disaster

Disaster Type	Disaster Category	Affected People (N/)		Mass Casualty Incident (n)		Average No. of affected people per incident (N/n)
Natural	Tropical Cyclones	16,517	41.8%	34	3.1%	485.8
	Floods	838	2.1%	32	2.9%	26.2
	Earthquakes/ Landslides	1,315	3.3%	8	0.7%	164.4
Technical	Traffic	4,509	11.4%	323	29.4%	14
	Harzardous Materials	2,939	7.4%	75	6.8%	39.2
	Fire/Explosion	1,755	4.4%	114	10.4%	15.4
	Industrial/Engineering	295	0.7%	38	3.5%	7.8
Civil	Large-scale Activities	3,767	9.5%	91	8.3%	41.4
Bio	Food Poisoning	7,056	17.9%	332	30.3%	21.3
Other of 4 type	Other Disaster	477	1.2%	50	4.6%	9.5
	Total	39,468	100.0%	1097	100.0%	36

Occurrence Rate per 10000 people/ per year

Medical Resource Need in Tropical Cyclones

Medical Resource Need in Earthquakes

Disaster Affected People (N)

Tropical Cyclones 42%
Food Poisoning 18%
Other Disaster 1%
Large-scale Activities 10%
Industrial/Engineering 5%
Fire/Explosion 5%
Harzardous Materials 7%
Traffic 11%
Earthquakes/Landslides 3%
Floods 2%

Disaster Events (n)

Tropical Cyclones 3%
Floods 3%
Earthquakes/Landslides 1%
Other Disaster 5%
Food Poisoning 30%
Large-scale Activities 8%
Industrial/Engineering 4%
Fire/Explosion 10%
Harzardous Materials 7%
Traffic 29%

Practical Implications

The study highlights the limitations of current triage methods during MCIs and emphasizes the need for more effective predictors to optimize resource allocation. Misclassification can increase morbidity and mortality, so efforts should be made to develop an emergency incident risk stratification system, possibly through a machine learning model using past MCI records. Efforts should also be made to understand misclassification in the United States through similar types of research.