Emergency Medical Preparedness and Response in Disasters:

The Need for Balance between Past Experiences and Scientific Basis

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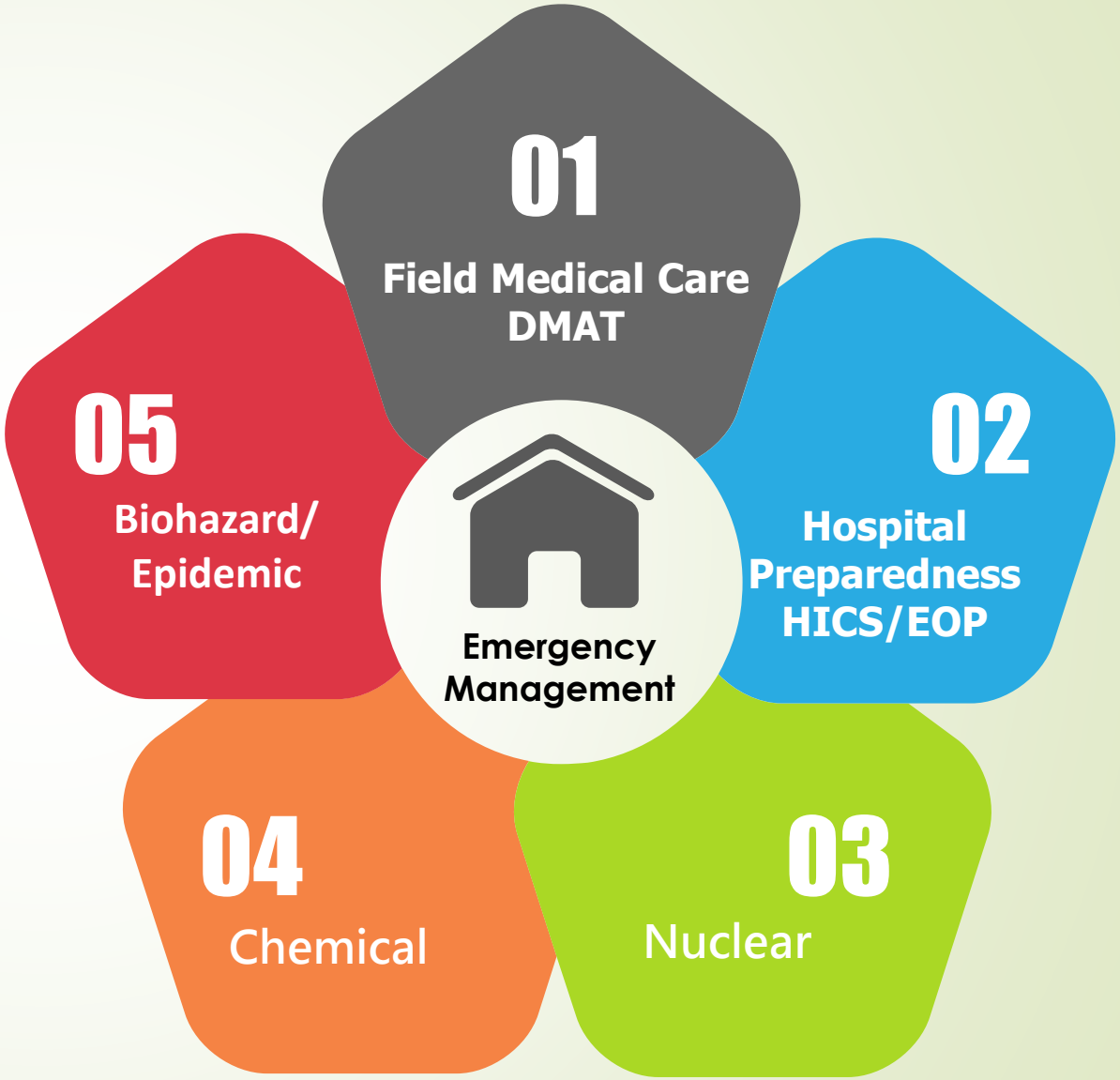
Taipei

- 1999 Disaster Medicine training in George Washington University
- 2000 Designer and team leader of Taiwan DMATs
- 2005 CEO of Taiwan EMOC Taipei region
- 2009 Director of NTUH safety and emergency preparedness Dept.
- ER doctors (since 1991), PhD in NTU public health (2007), EMBA in NTU business school (2015)



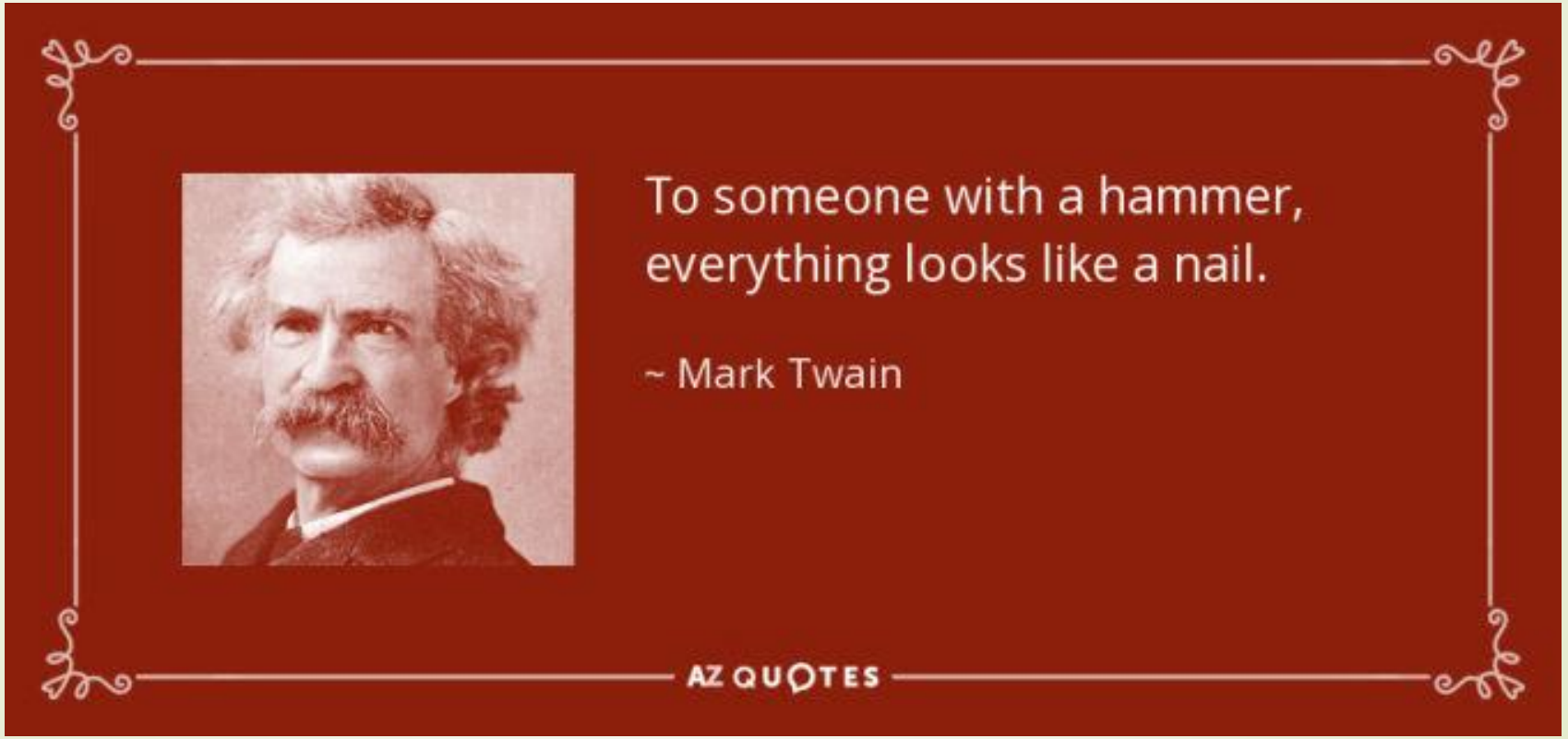
Outlines

- Lessons learned from recent disasters in Taiwan,
- Epidemiology of injury pattern and medical resources needed of disaster victims in Taiwan,
- The fundamental process for medical care in MCI field,
- The differences in special type of events, e.g., nuclear, biological, chemical, hospital internal disasters,
- Tools for evaluating emergency performance (e.g., simulation software, exercise)
- New challenges and potential solutions for emergency room MCI preparedness in Taiwan.

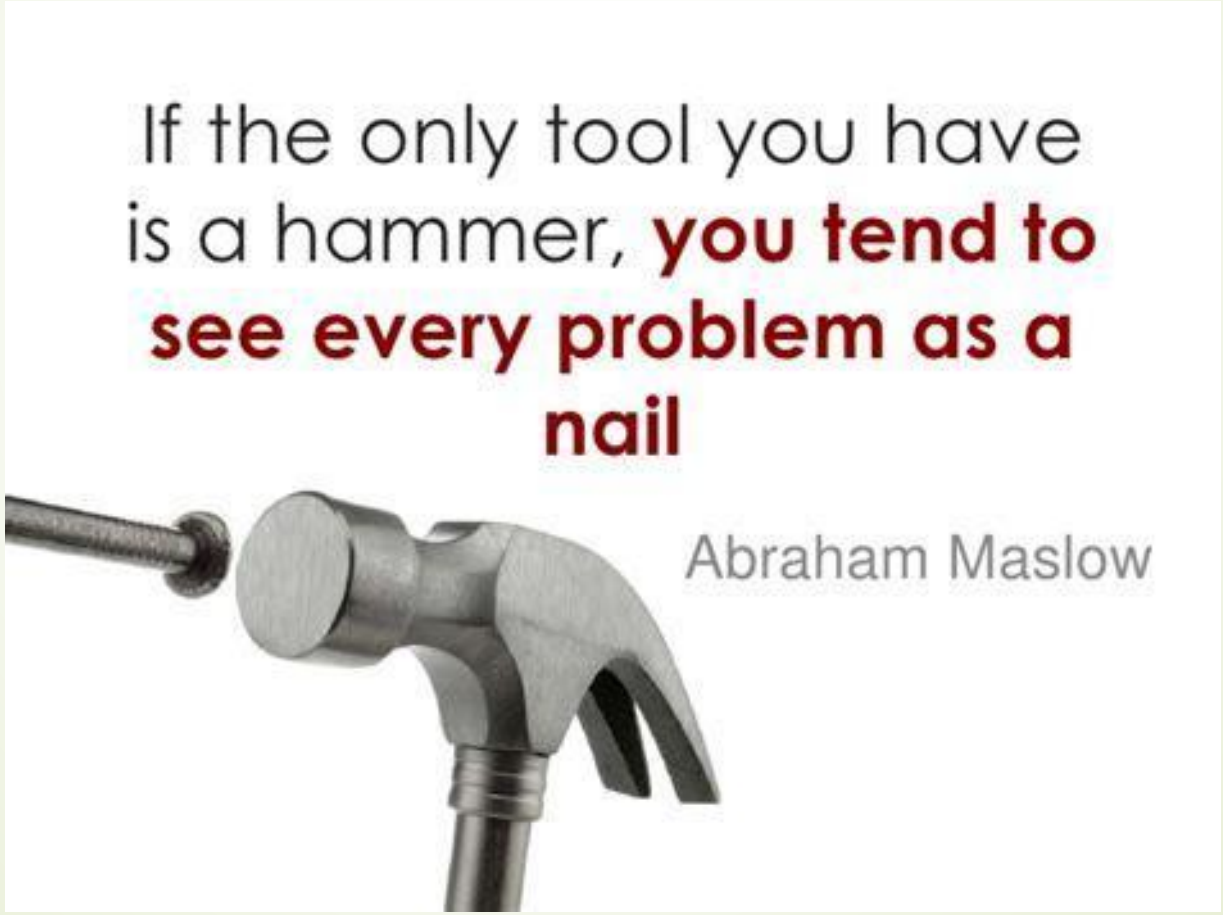
What We Can Do in This Scenario?

What kind of specialty? How many people in your team? Doing what?

We try to practice medicine in all situation……



We try to save people in disasters, so we need know more about them……



Something we need to know about

Emergency Management

Comprehensive Emergency Management

MPRR

Comprehensive Emergency Management

01
HVA

Hazard vulnerability Analysis identify your risks and weak points

02
EOP

Emergency Operation Plan tell you what to do in emergencies

03
ICS

Incident Command System define your command chain and common language in disasters

04
COOP

Continuity of operation guarantee your organization still functioning in disasters

05
Planning P

Planning P improve the decision making and coordination in emergencies

Great Challenges We Met.....


Pan-ch'iao
Taipei
Hsin-chu
Miao-li
Fweng-yüan
Tai-chung
Hua-lien
Nan-tou
Chi-pei Tao
Tou-liu
Taiwan
Ma-kung
Wai-san-ting Chou
Hsin-ying
Tai-nan
Ping-tung
Google
指標 23°37'55.26" 北
121°37'07.62" 東
海拔高度
439.86 公里


1998, 2000,
2002, : total 500
dead

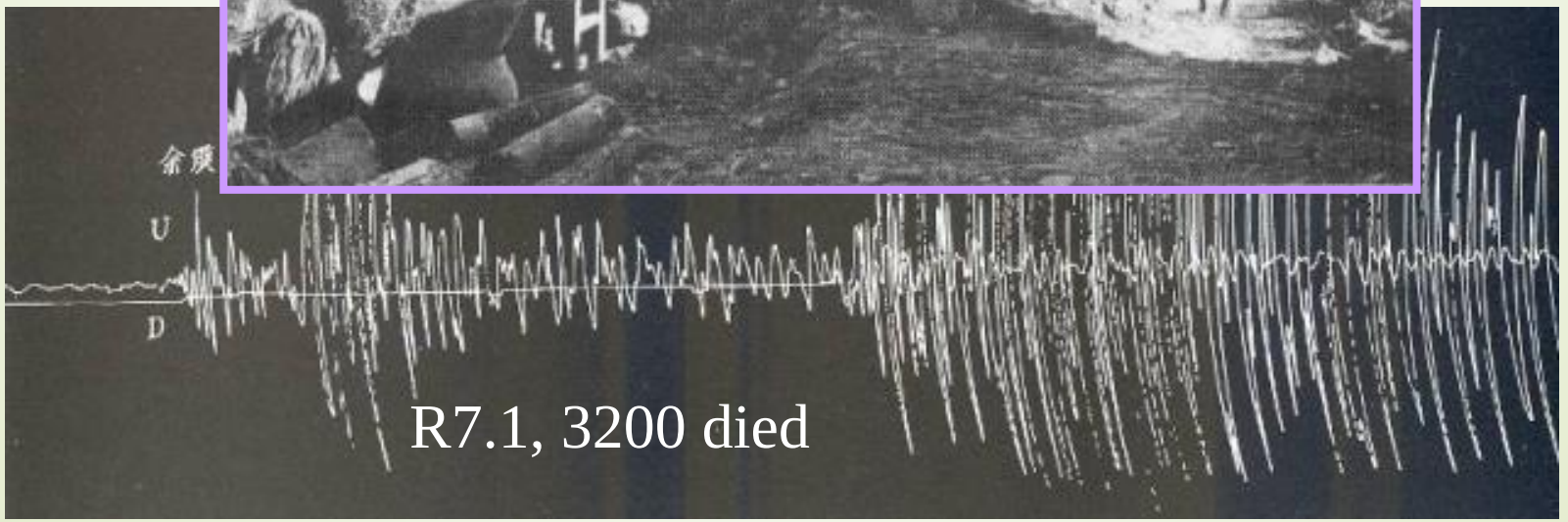

2003:80 dead

1935:3200 dead

1999:2400 dead

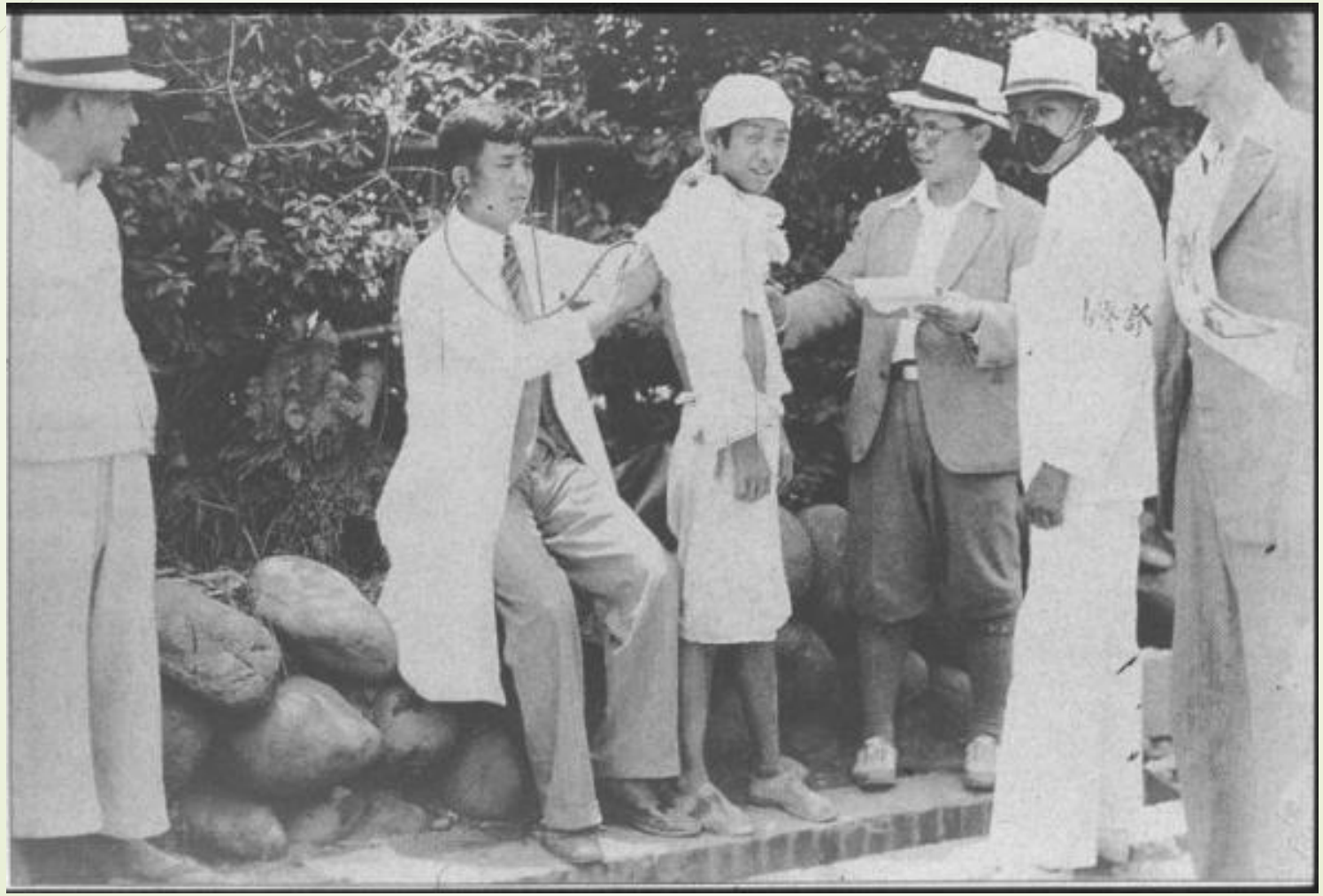
2009:600 dead

Earthquake in Central Taiwan, 1935



R7.1, 3200 died

The physicians provided roadside medical care

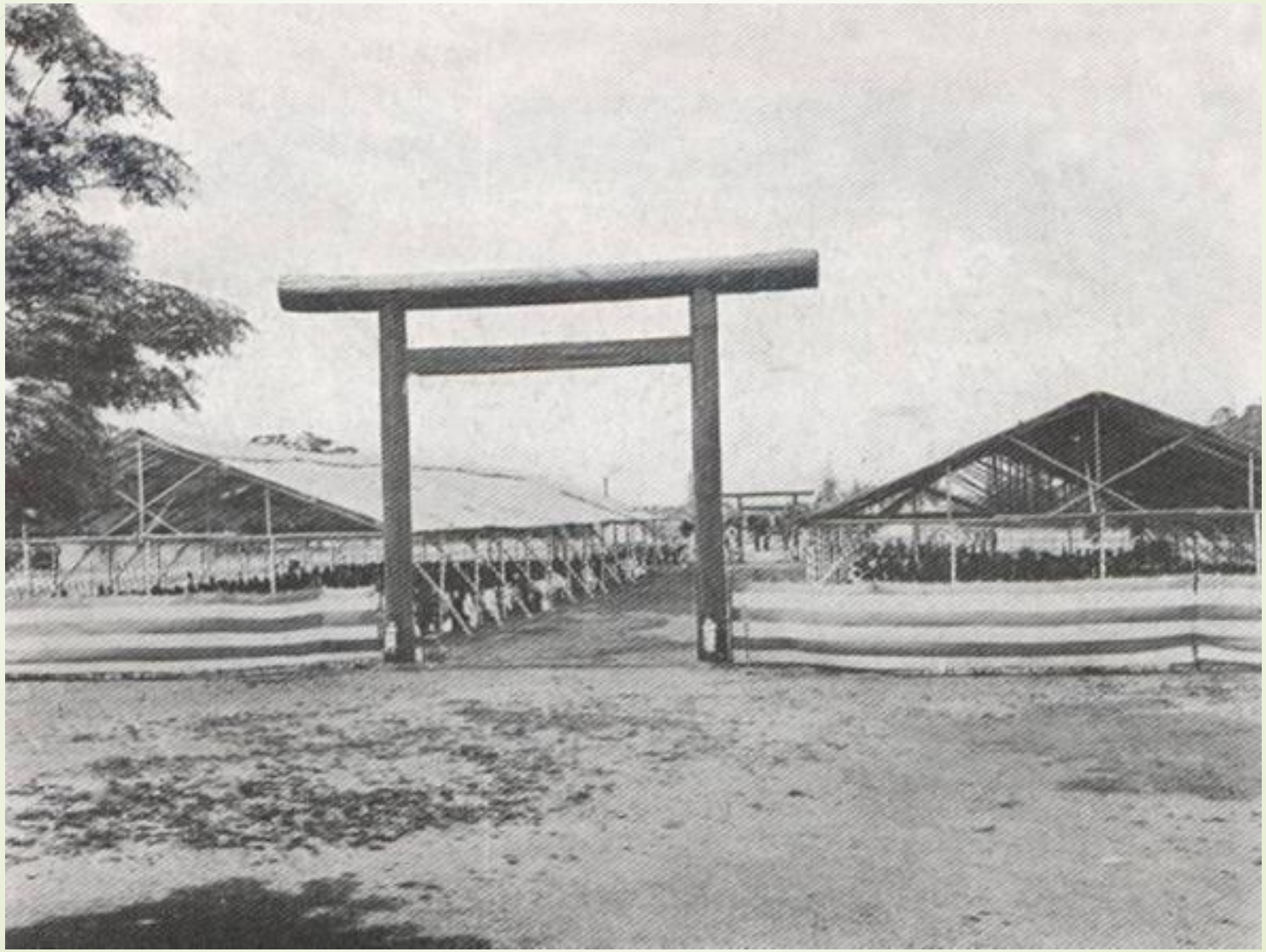


1936 Taiwan earthquake, 3200 died

First Aids

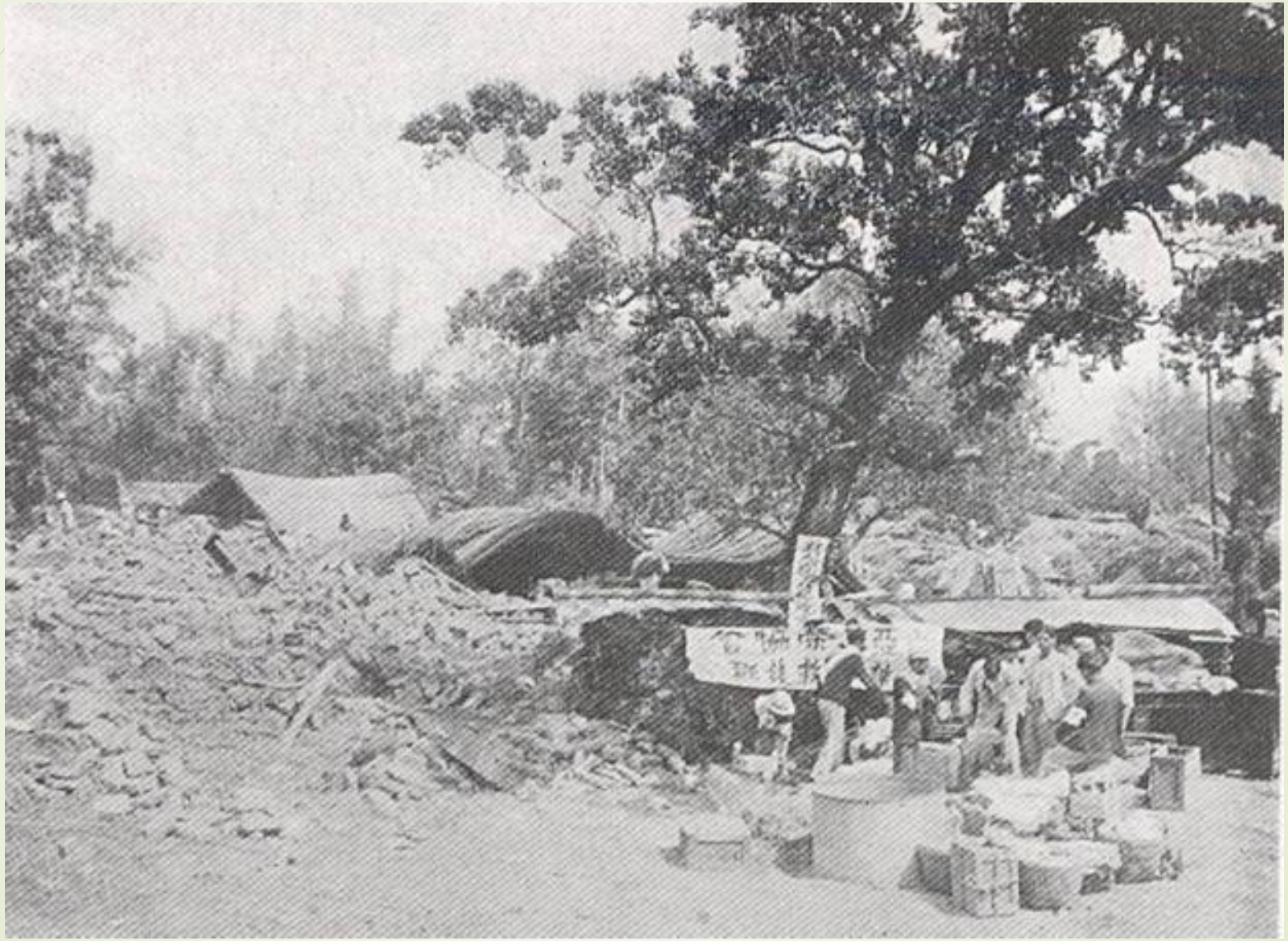
Food Supply

Requiem

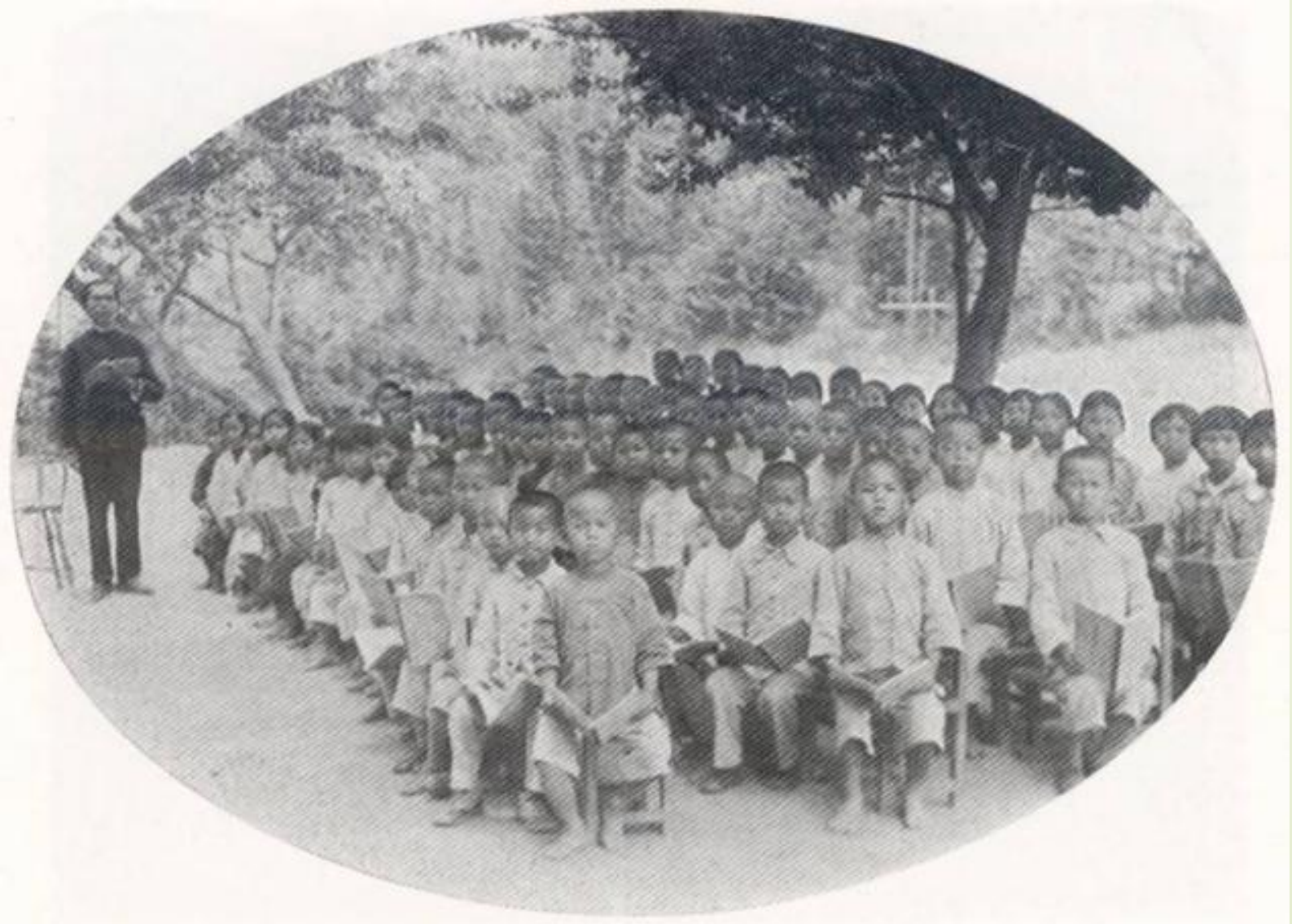


Temporary Shelter

Resources Management



Temporary School



Flood in Central Taiwan,1959

Died and missing :1000

Typhoon Gloria, 1963

Died: 312

Earthquake in Tainan, 1964

Died: 100

Air crash, Far Eastern Airline,1980

Died: 110

Train Derailment, 1981

31 died, 130 injured

NERP: The beginning of **modern** emergency response plan for disasters

- **1981**: The "**Nuclear Emergency Response Plan**" was promulgated by the Atomic Energy Council
- The National Nuclear Emergency Management Committee (NNEMC，核子事故處理委員會)

行政院原子能委員會
ATOMIC ENERGY COUNCIL

Emergency Medical Services System/EMT since 1995

Earthquake in Central Taiwan, 1999

R7.3　2400 died

Confined Space Rescue

Doctors and Fire Fighters/EMT respond to the scene

Temporary Medical Aid Stations

1999 Taiwan earthquake, in Puli

Different departments will work together (but independently)

Some hospitals failed,

1999 Taiwan earthquake, Chu-Shan Hospital

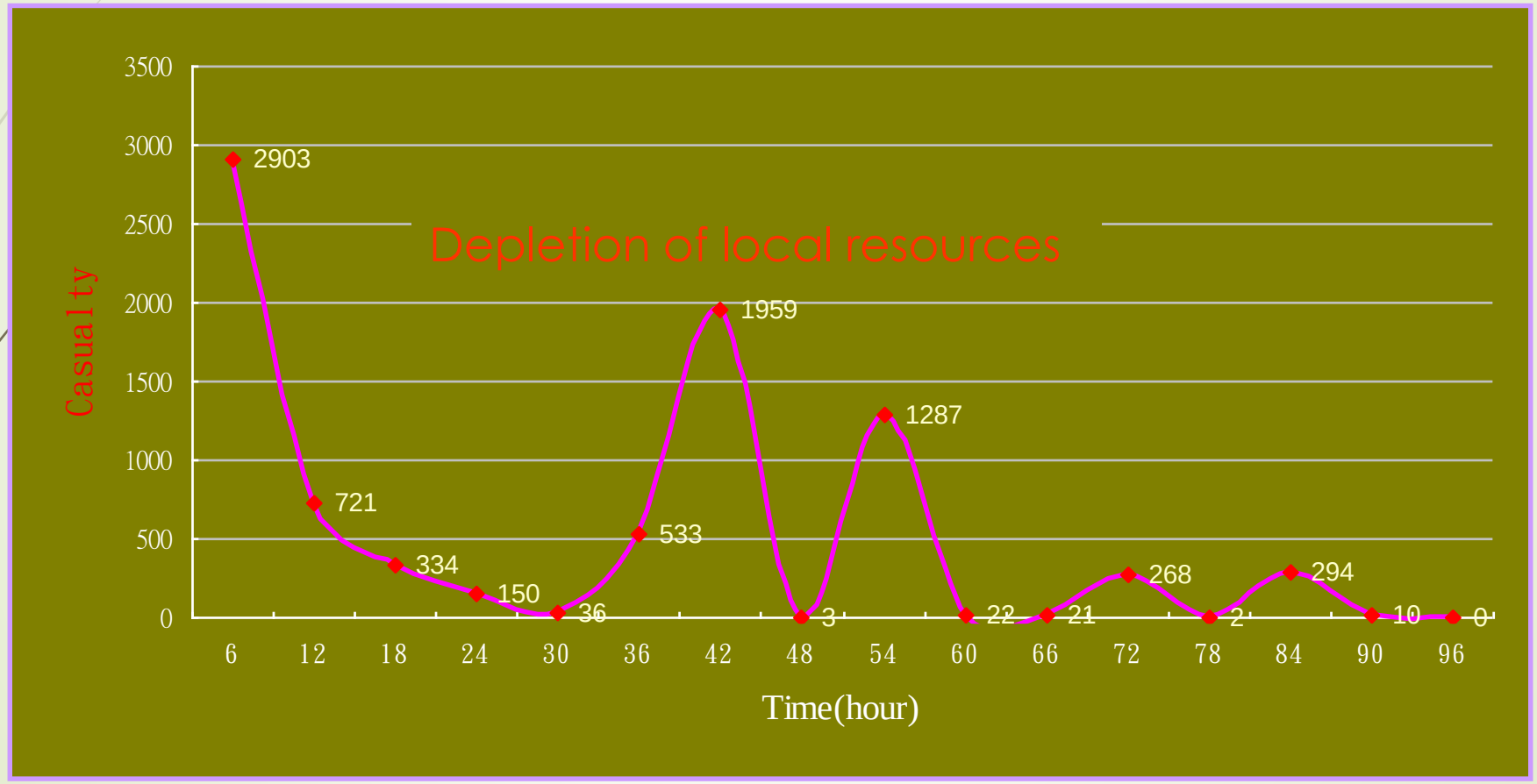
Field clinics outside the hospitals immediately

1999 Taiwan earthquake, Puli Christian Hospital

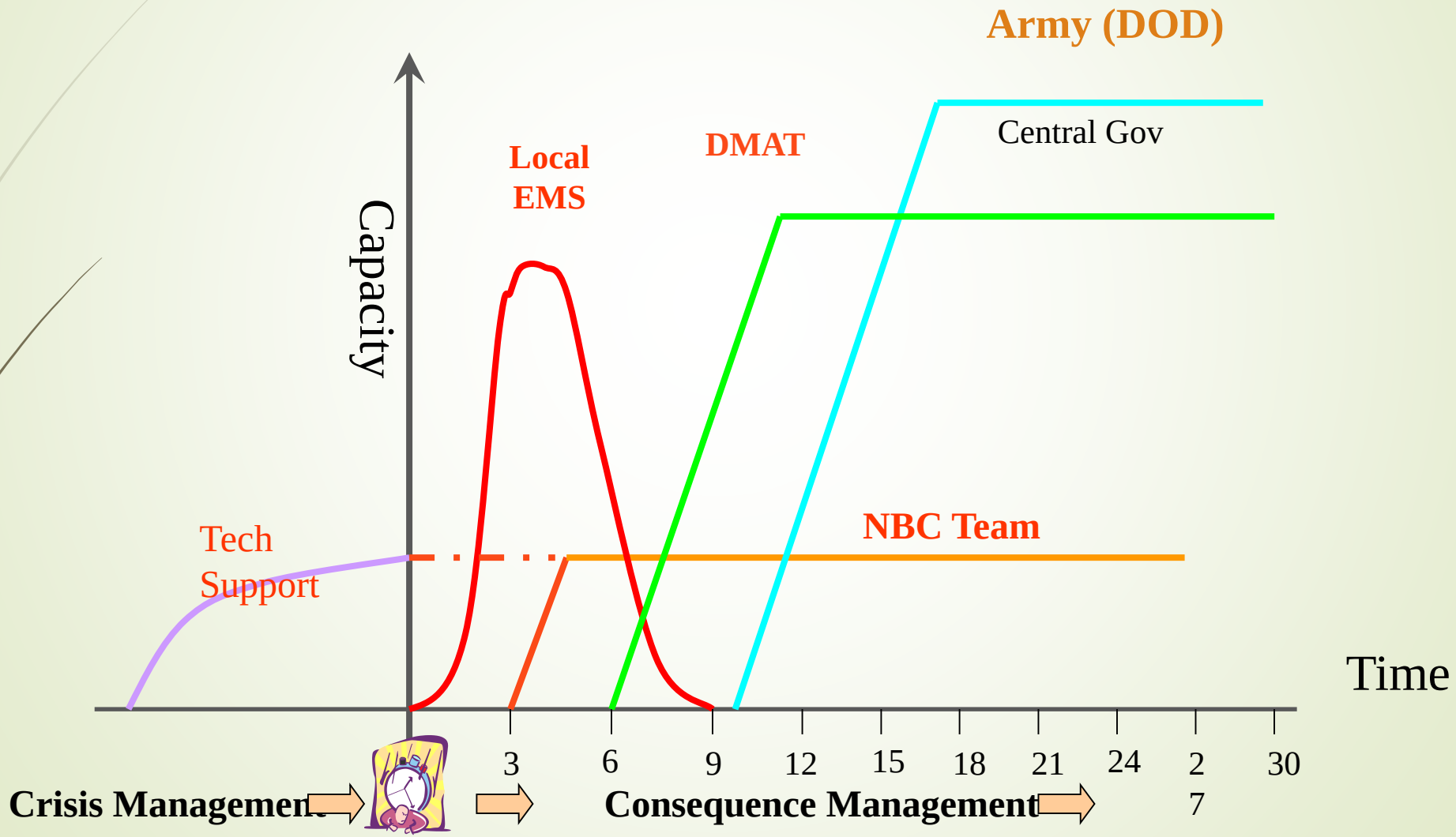
Responders are Coordinated by Fire Dispatch Center

Taipei City Fire Dispatch Center during earthquake

No. of the Wounded in Chi-Chi Earthquake (according to time frame)



The Demand


Army (DOD)
Central Gov
DMAT
Local
EMS
Capacity
Tech
Support
NBC Team
Time
3
6
9
12
15
18
21
24
2
7
30
Crisis Management
Consequence Management

What were the differences in bio-threat/SARS?

And that would be happened in the CBRNE events!

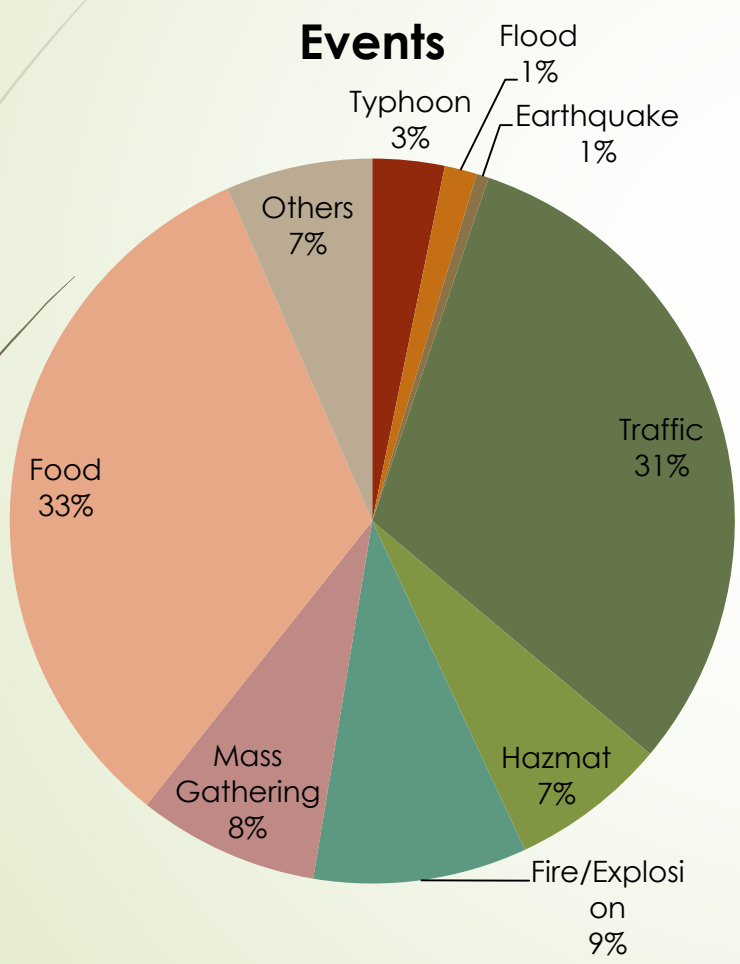
Fever Clinic Outside for possible patients!

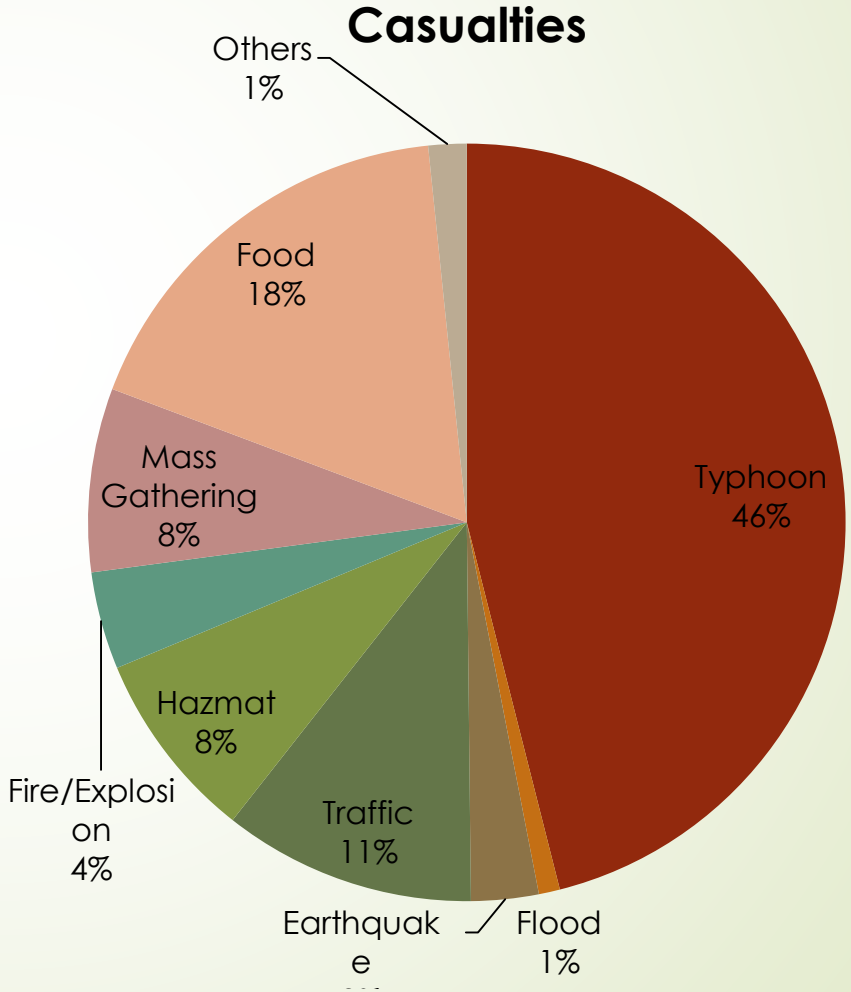
Fever Screening Clinic in NTUH 2003

Psychological Impacts of SARS

- Excessive self-defense measures
- Lack of trust between people
- Negative emotions projection
- Infection control measures isolated feeling of friendship, trust and goodwill
- Alienation in the society

Topic 2
Disaster Epidemiology in Taiwan

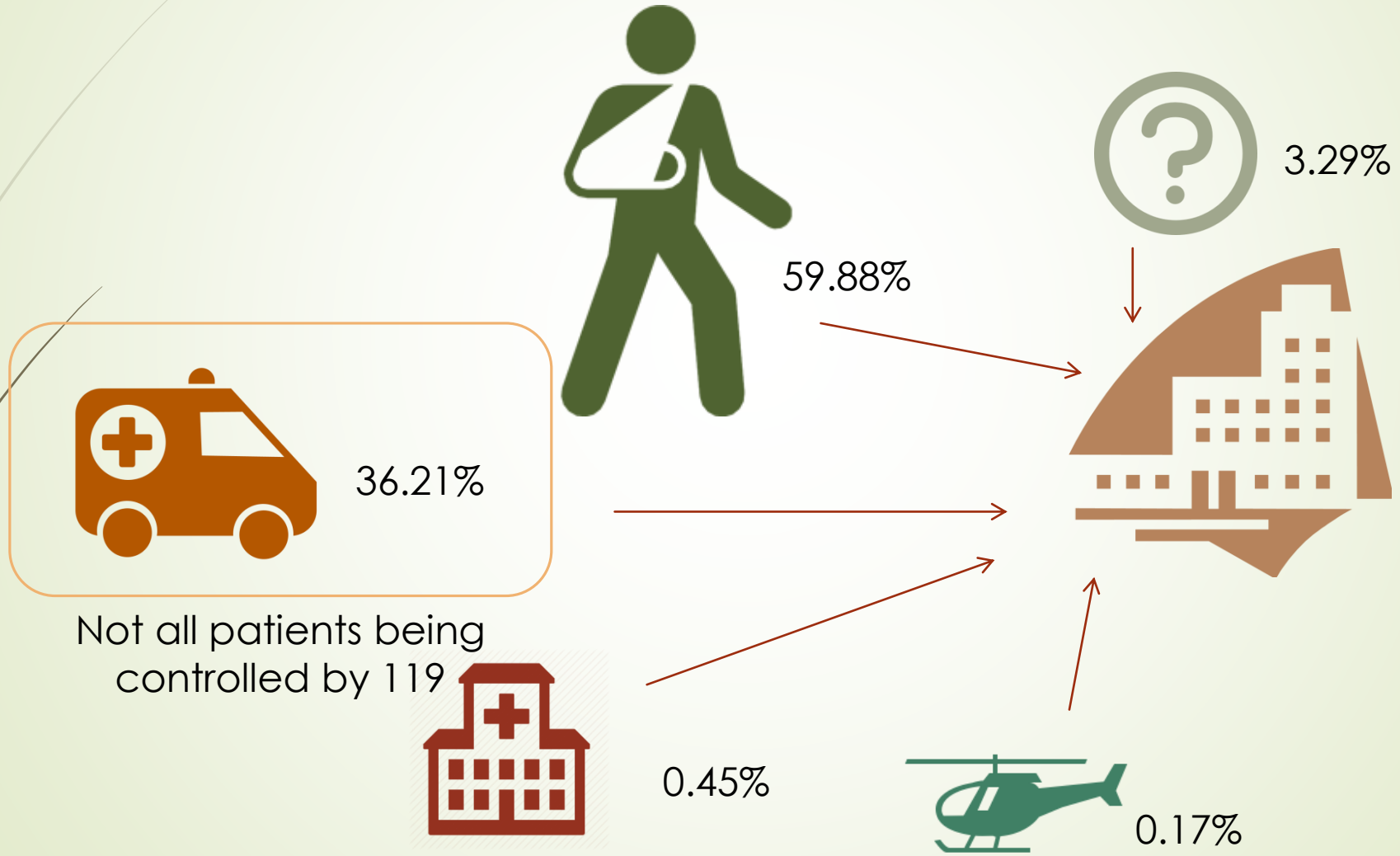




Result: Events and Casualties

	Casualties	Events	Avg No./event
Typhoon	16093	29	554.9
Flood	315	13	24.2
Earthquake	1006	5	201.2
Traffic	3768	279	13.5
Hazmat	2837	63	45.0
Fire/Explosion	1455	86	16.9
Mass Gathering	2739	73	37.5
Food	6166	296	20.8
Others	570	59	9.7
Total	34949	903	38.7

Result: Casualties Arrival



Result: Disposition

ICU
2.14%

OP
0.51%

Ward
8.25%

ER

MBD
77.26%

OBU
7.83%

The majority of patients do not need hospital bed

Transfer
1.05%

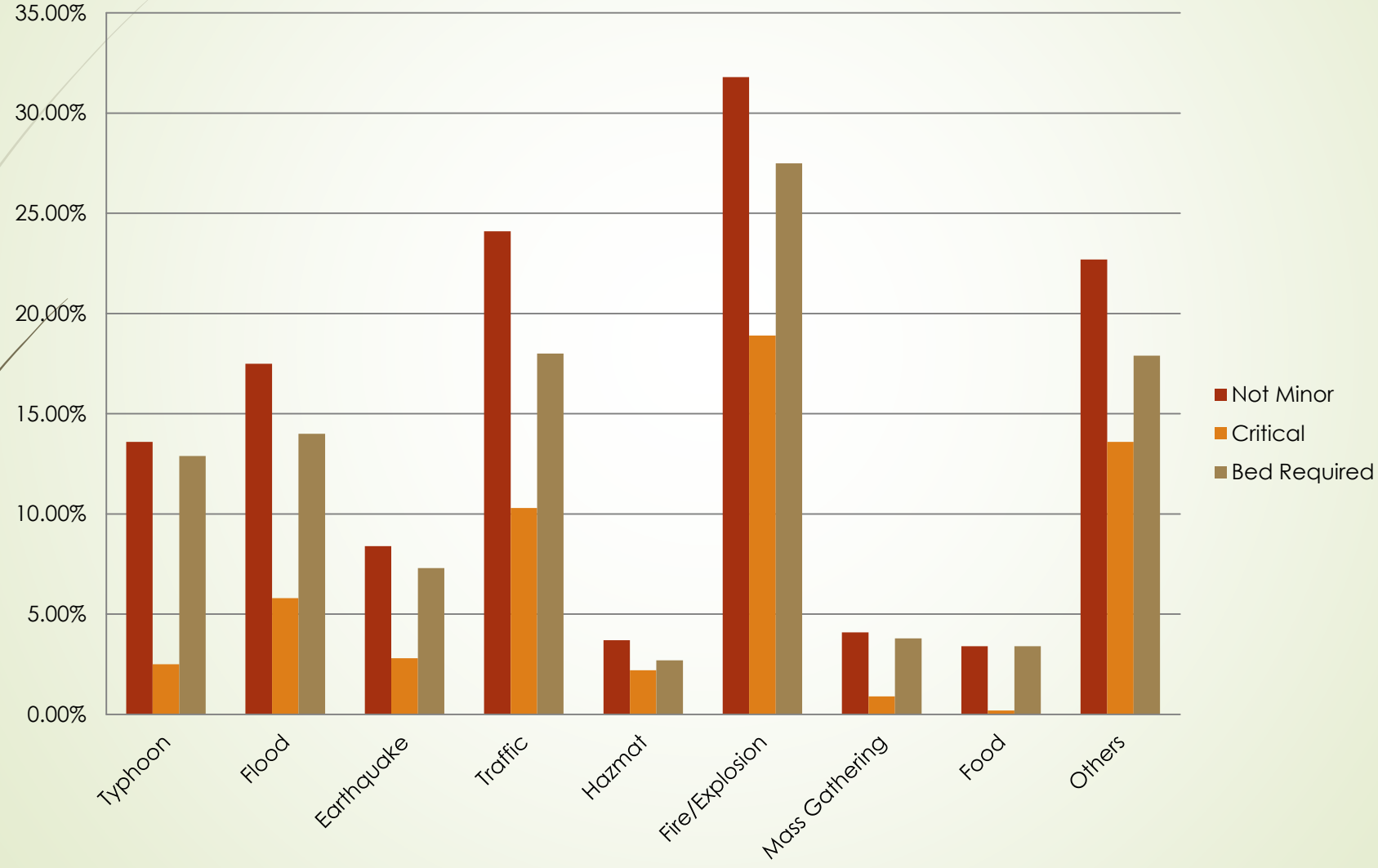
Dead
1.37%

Other 1.59%

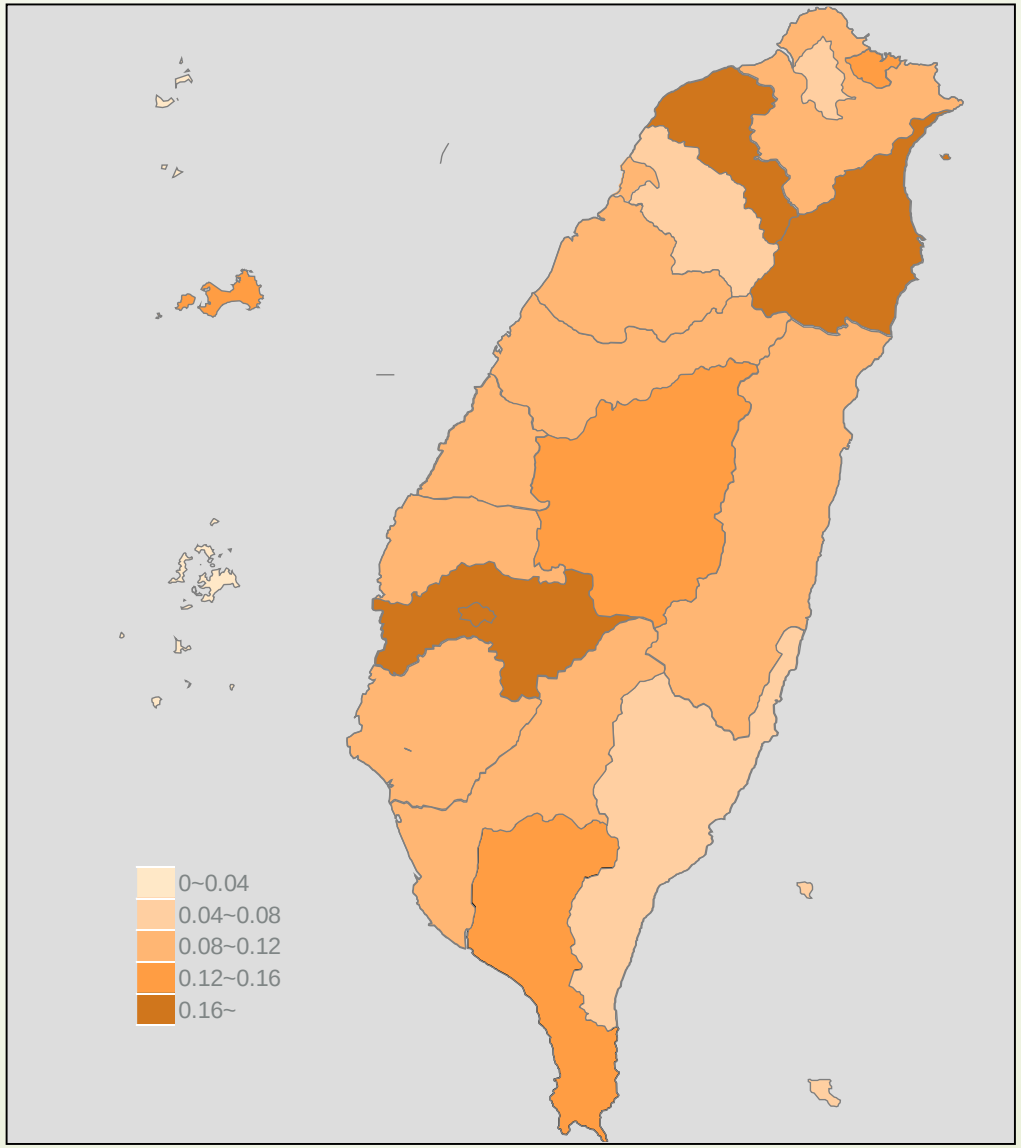
Medical Resources Utilization was different

	Not Minor	Critical	Bed Required
Typhoon	13.6%	2.5%	12.9%
Flood	17.5%	5.8%	14.0%
Earthquake	8.4%	2.8%	7.3%
Traffic	24.1%	10.3%	18.0%
Hazmat	3.7%	2.2%	2.7%
Fire/Explosion	31.8%	18.9%	27.5%
Mass Gathering	4.1%	0.9%	3.8%
Food	3.4%	0.2%	3.4%
Others	22.7%	13.6%	17.9%
Total	12.0%	3.8%	10.5%

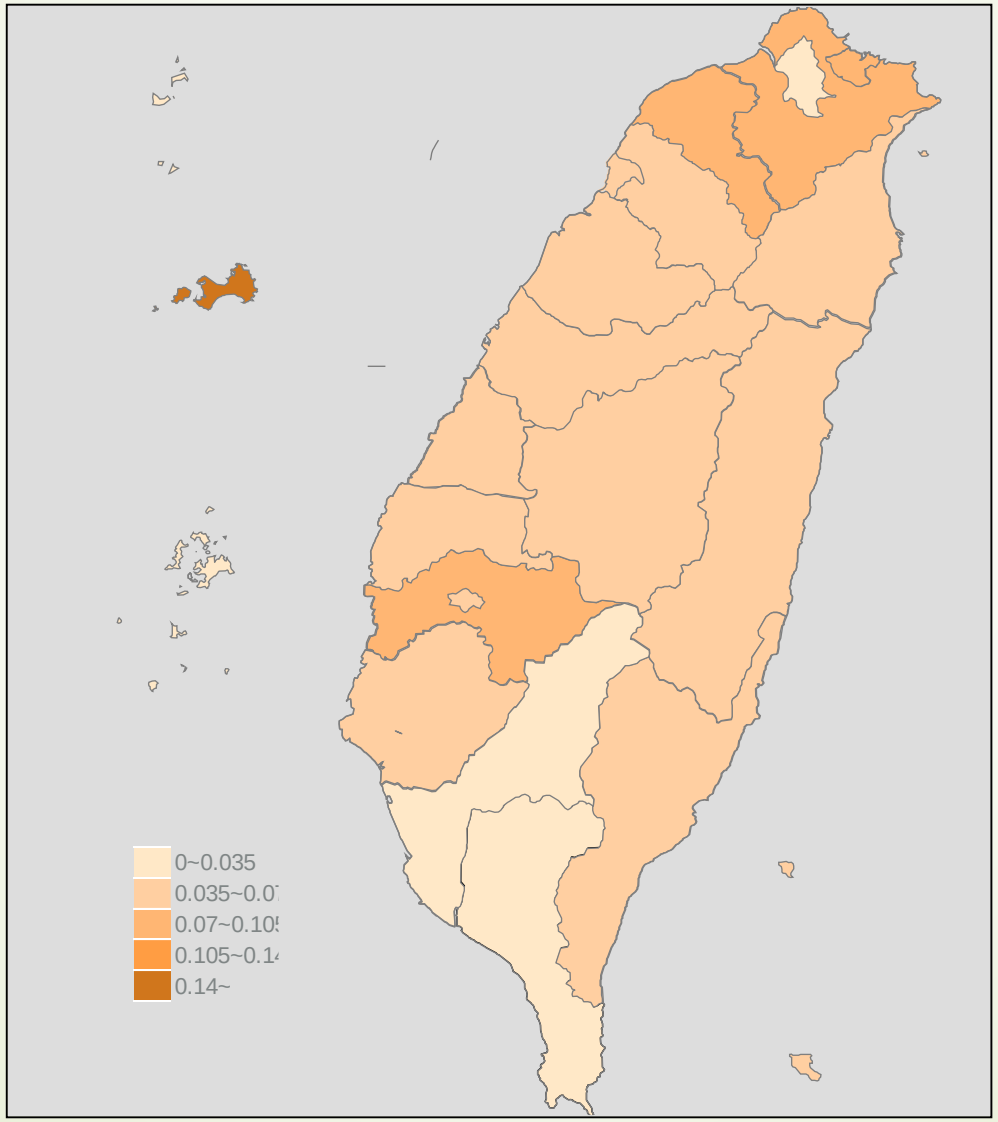
The Comparison of Medical Resources Utilization in Different Disasters



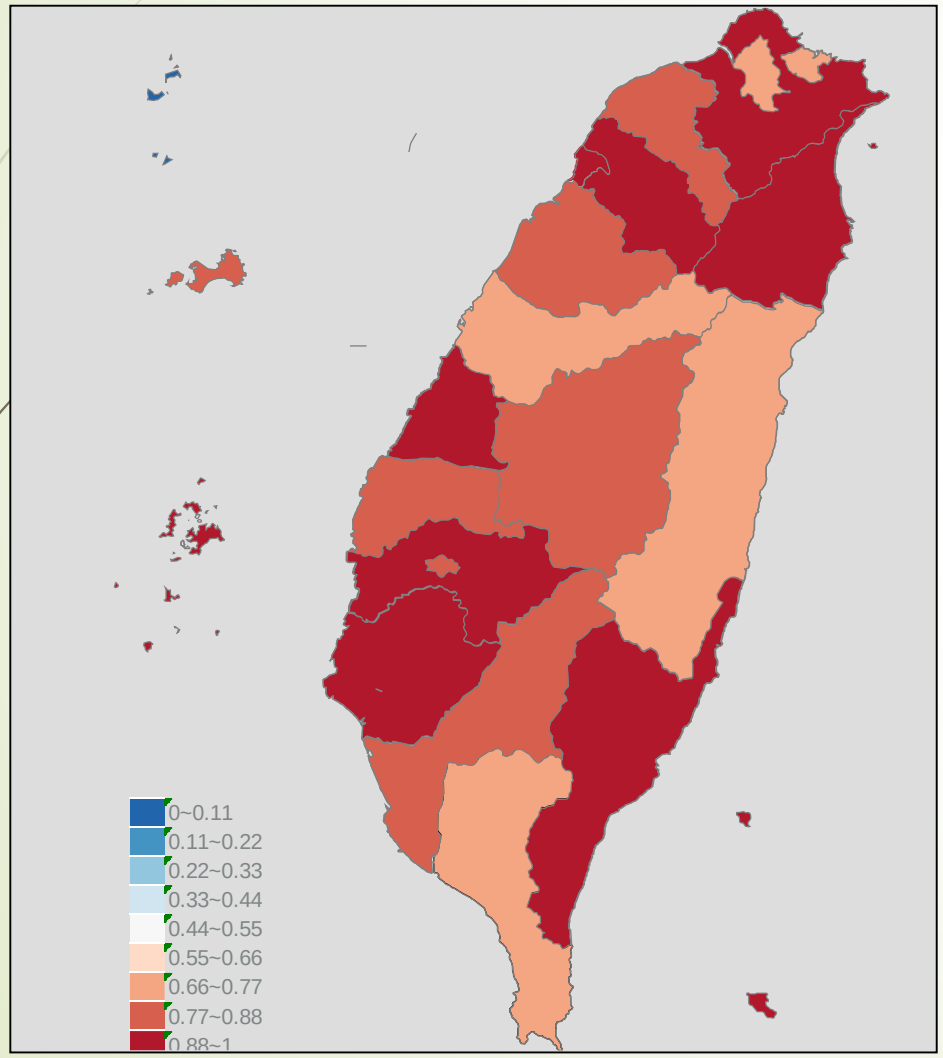
Hospital Bed Requirement was different among different prefectures/cities



ICU Bed Requirement was different among different prefectures/cities

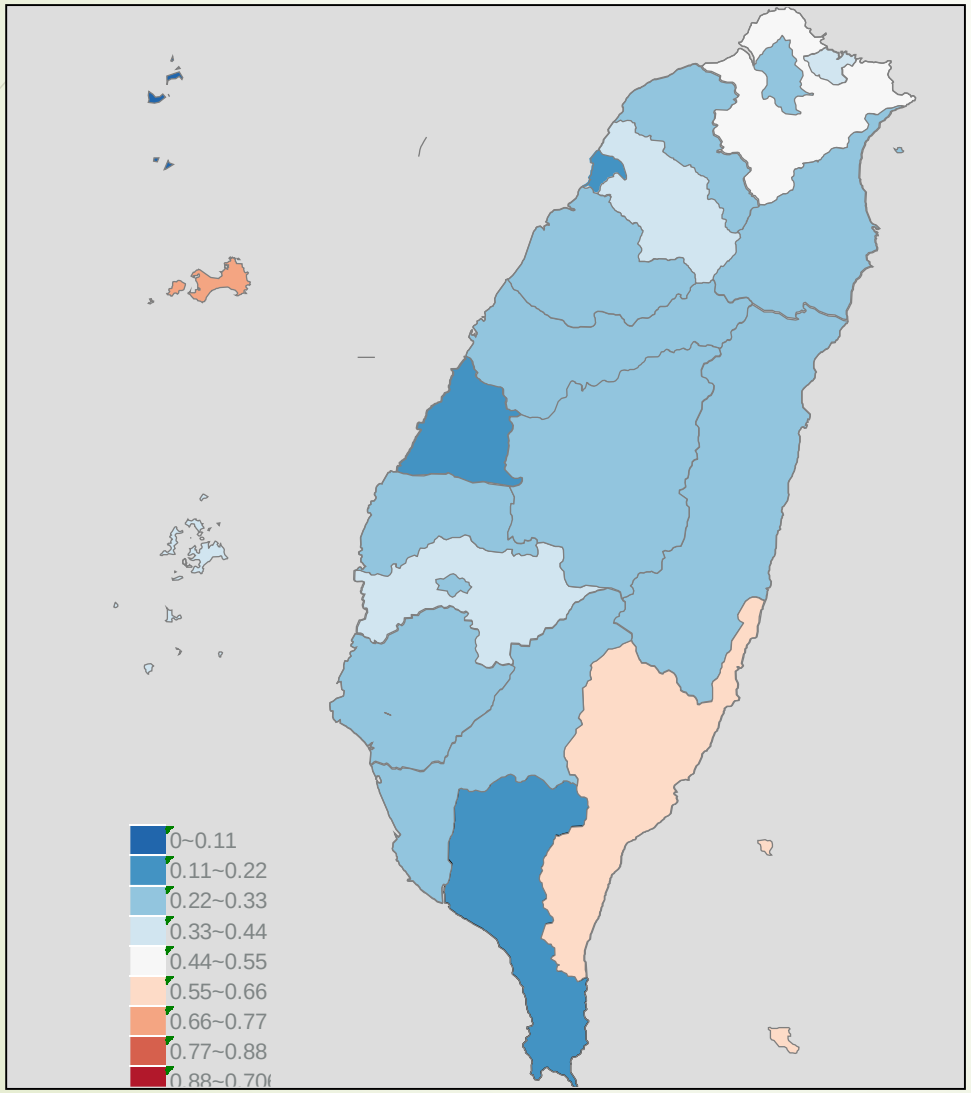


The Role of 119 was Different



- The fire department played different role in disasters. In fire or road accident, the majority were sent by 119.
- The picture showed the percentage of patients sent by 119 in fire incidents.
- The percentage varied in different places.

The Role of 119 was Different



- In typhoons and floods, 119 did not play the majority role.
- The pictures showed the percentage of patients sent by 119 in typhoons.
- Less than 50% of the patients were sent by 119.

The aged people need more attention

	Not Minor	Critical	Bed Reuired
Children 0-14Y	5.90%	1.80%	4.90%
Young Adult 15-64Y	11.30%	3.50%	10.00%
Old >65Y	19.80%	4.70%	18.60%

Common Injury Patterns

Injury Pattern	Casualties	Ratio
Soft Tissue Injury	9674	34.28%
Medical (including food)	9512	33.71%
Hazmat	2405	8.52%
Head Injury	2014	7.14%
Bone Fracture/Dislocation	1816	6.44%
Burn (Inhalation)	1703	6.04%
OHCA	352	1.25%

- Many patients had more than one injury pattern
- Among medical illness, 60% was GI problem
- Among burn patients, 35% was inhalation injury.

Disasters are different……

- The epidemiology for disaster health impact was different among different places, local governments should tailored their system.
- Medical resources (esp. ICU and general ward) in different disasters varied, but not as high as we expected.
- Fire department play an important role in pre-hospital medical care, but in some disasters they were not activated.
- We should pay more attention on the aged population in disaster preparedness

Solution 1:
Disaster Medical Assistance System Since 2000

Solution 2:

Regional Emergency Operation Center

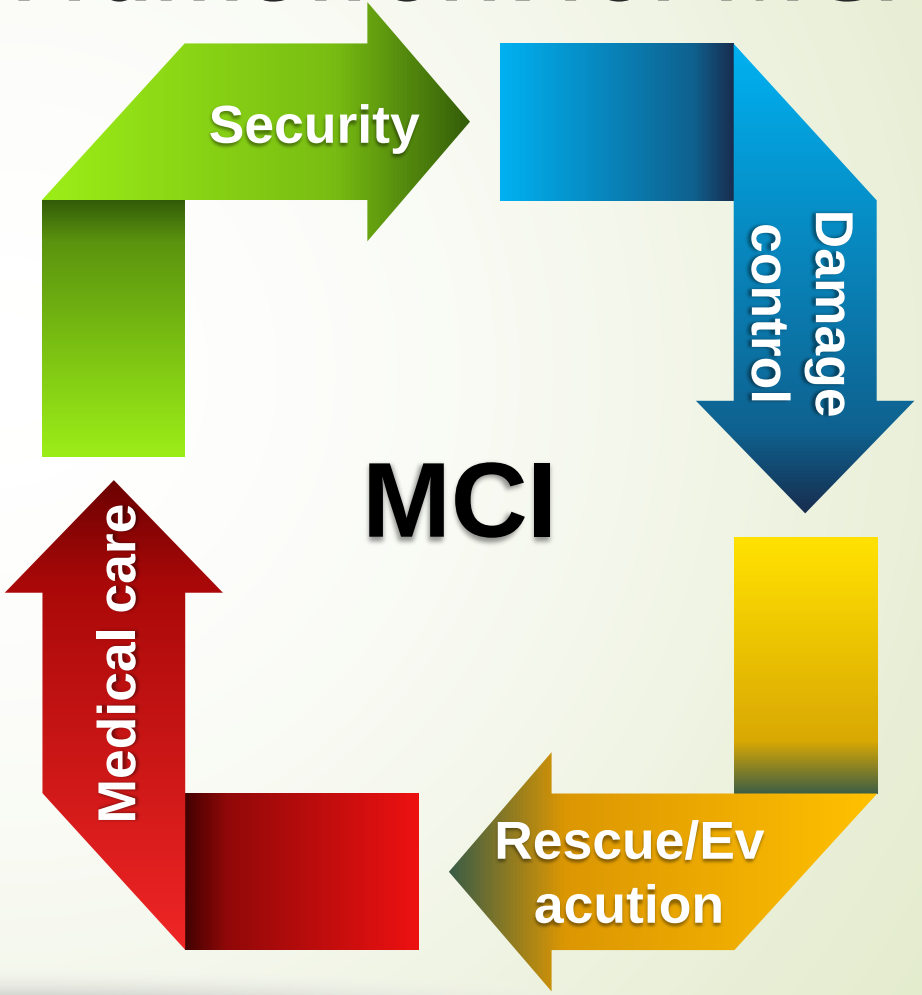
Solution 3:
Web-based Medical Resources Platform Emergency Medical Management System

（http://220.228.12.173/）

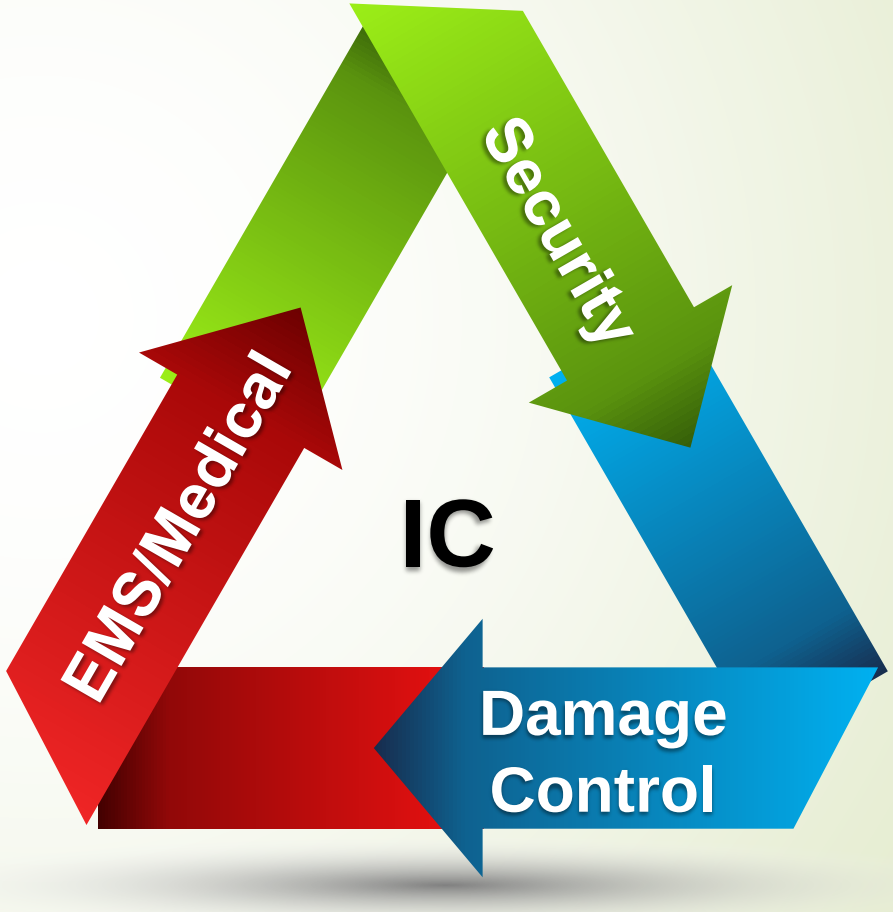
Solution 4:

Medical Care for Hazmat Casualty in designated hospitals

Topic 3
Ideal Response Framework for MCI



Rescue Scene Control for MCI in Taiwan

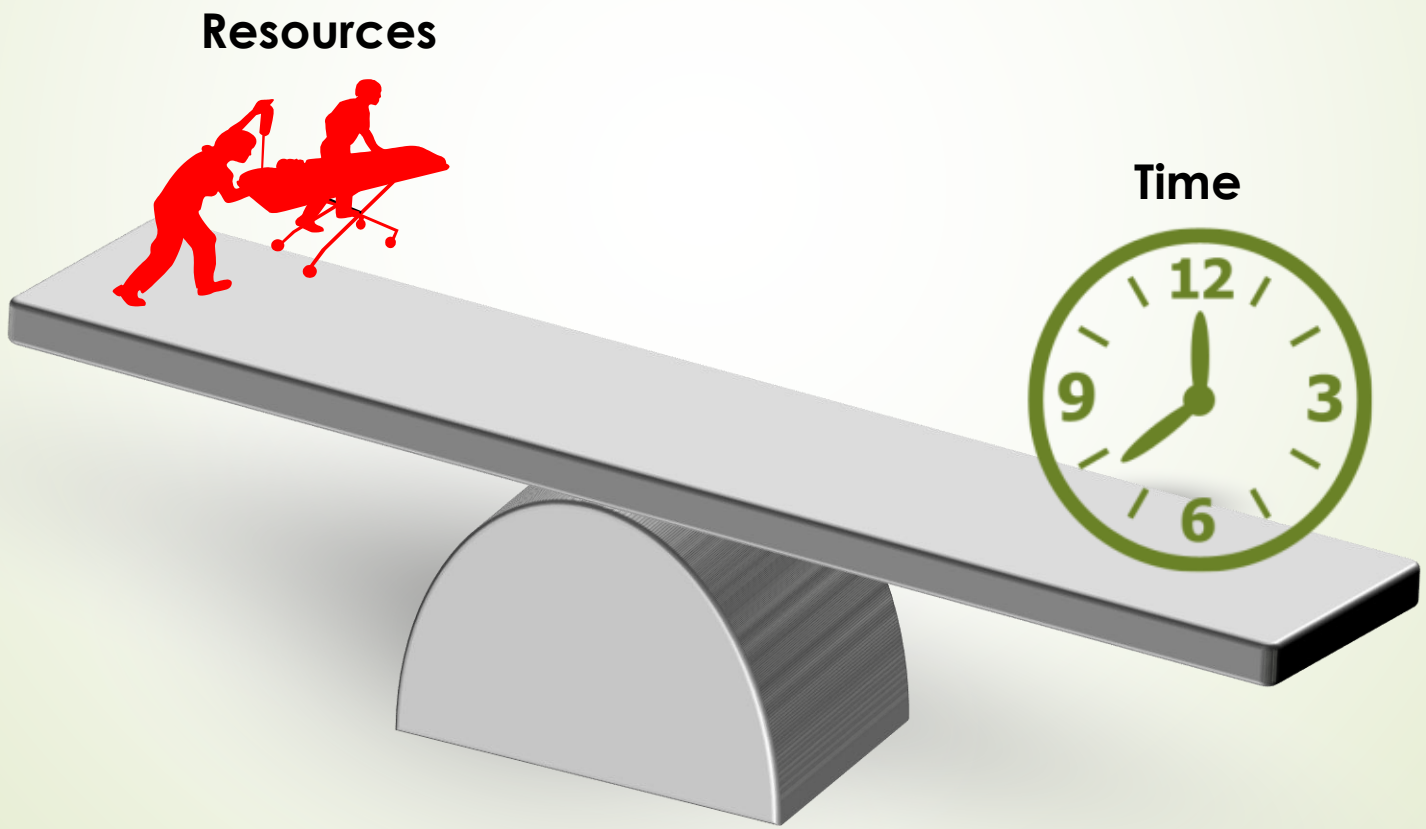


Fundamental Process for Field Medical Care

Disaster Scene → Casualty Collecting Point (CCP) → Emergency Room (ER) → Definite Care

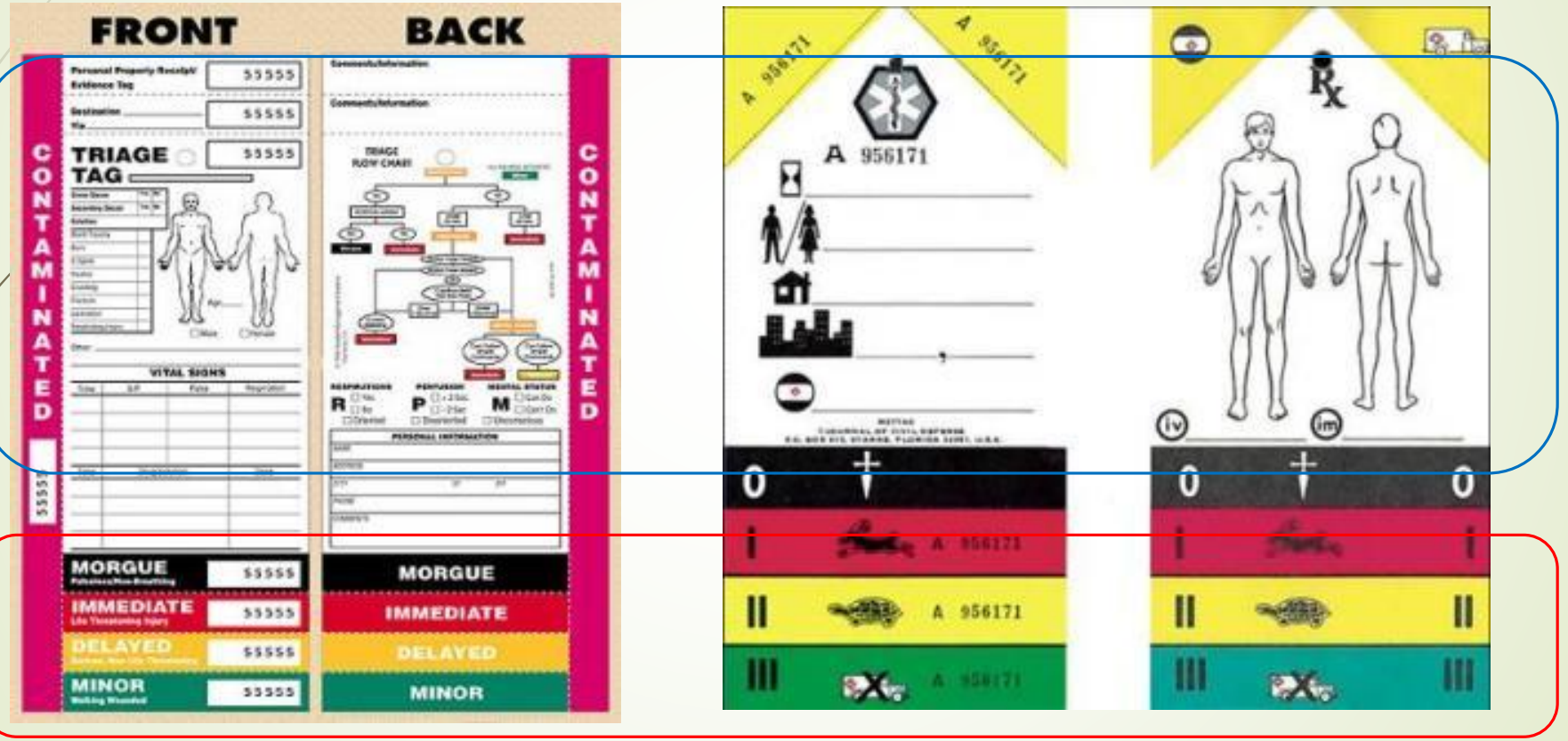
- Incident commander decide the CCP
- Disposition officer decide which ER to send
- ER doctors decide definite cares

Survival of Casualties in Scarce Resources Time vs. Resources



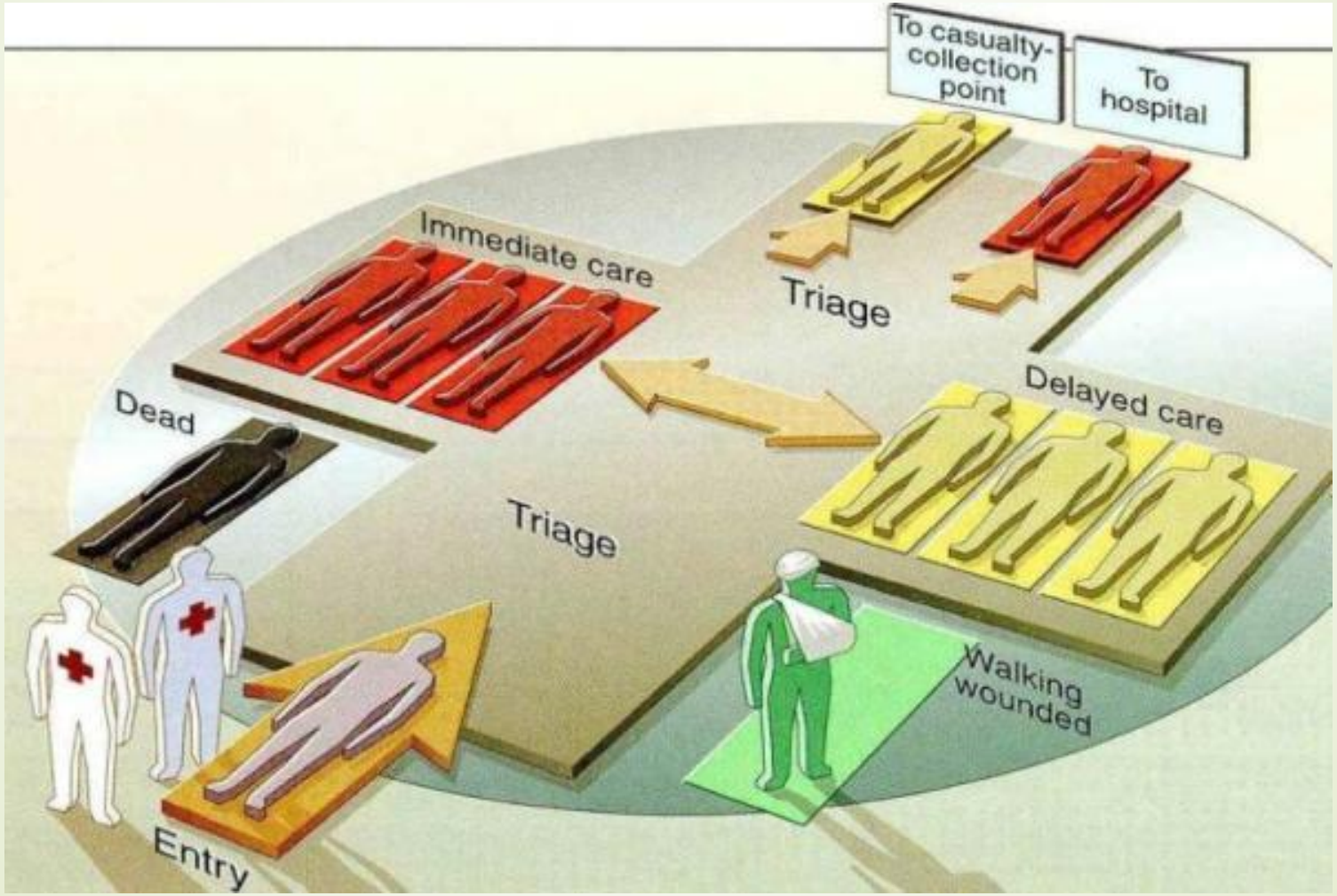
Triage

Patient Information



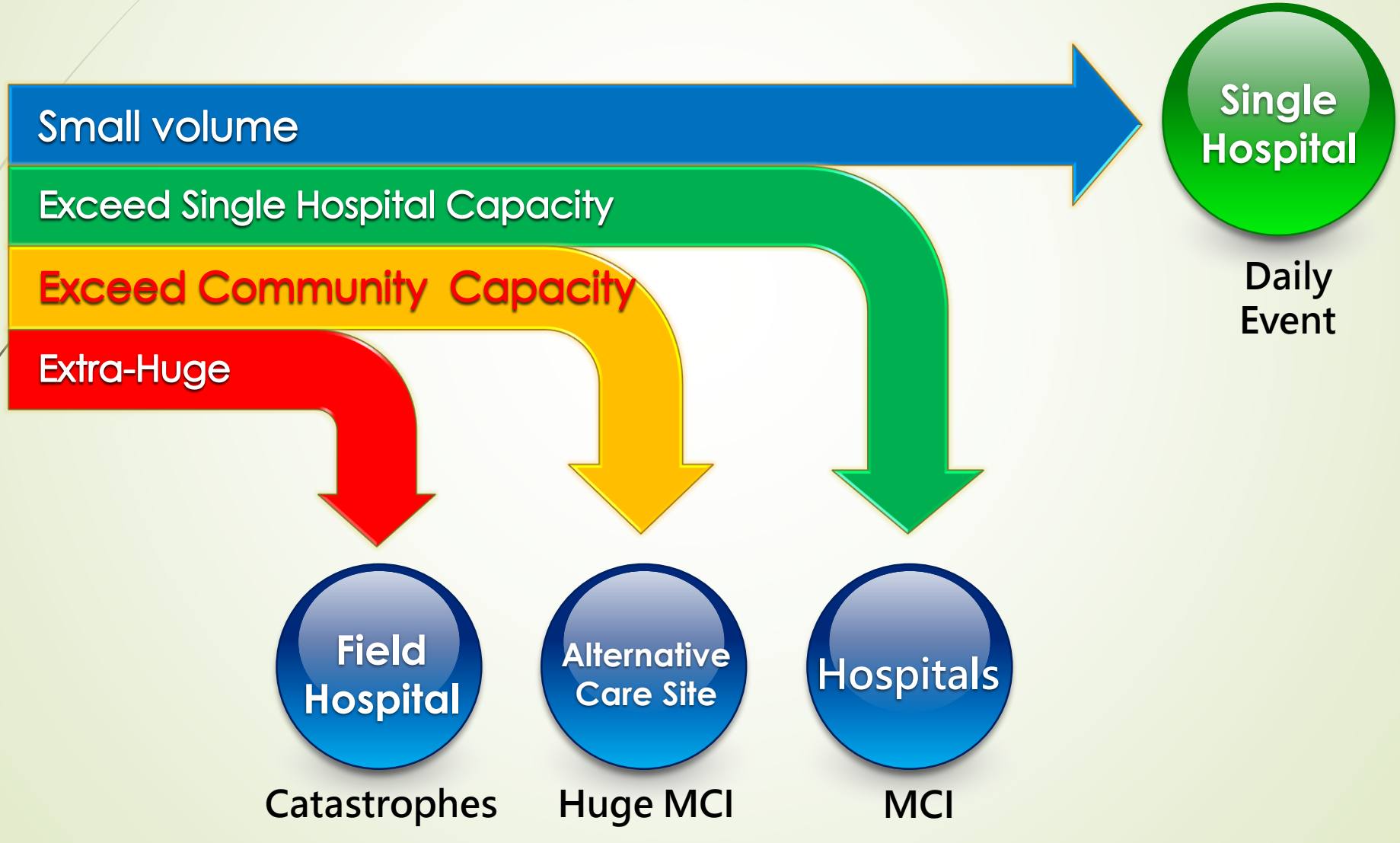
Priority

Triage by Location

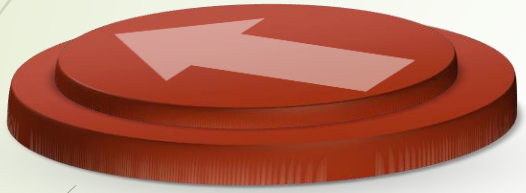


EX: MCI drill (a fir in long tunnel)

Medical Response to Disasters

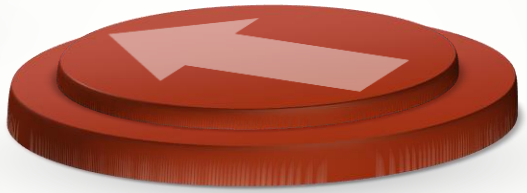


Medical Care for Multiple/Mass Casualty Incident



Step Three
Definite Medical Care

Specific medical need



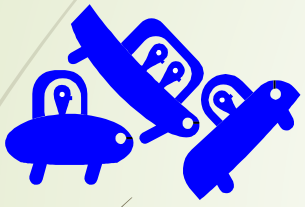
Step Two
Emergency Care

- Nearby
- Appropriate
- Diverse

Step One
Field Medical Care

- Life saving
- Triage

Role of the Disaster Medical Assistant Team



Disaster Scene

Casualty Collecting Point (CCP)

Emergency Room (ER)

Definite Care

Type 1

Type 2

DMAT

Composition of the Disaster Medical Assistant Team

Type 1




Incorporated into City EMSS

Composition of the Disaster Medical Assistant Team

2 Type 2

Medical Operation Unit

Medical Support Unit

Disaster Medical Assistant Team

Including medical, ancillary and support personnel

Topic 4a Special situation
Hazmat Involved in Disasters

1

Rescue

Evacuate
Stop leakage

2

Detection

Identification
Set priority for Decon

3

Decon

Washing out
All hazmat

4

Triage & Transfer

MCI process

Hot Zone

Warm Zone

Cold Zone

Detection, Decontamination and Provide Definite Care

Integrate Live Saving and Hazmat Management

Separate entry for contaminated patients in ER

Decon facility within an ER

Shower nozzles outside an ER

PPE in an ER

Radiation monitoring system in an ER

Topic 4b
Hospital Resilience in Disasters

HCFs play roles for communities

Hardware and Environ Safety

Protect personnel and patients

Surge Capacity

Response to large volume of patients

Hospital continuity of operation

Electricity, Water, IT, Medical gas, logistic supply

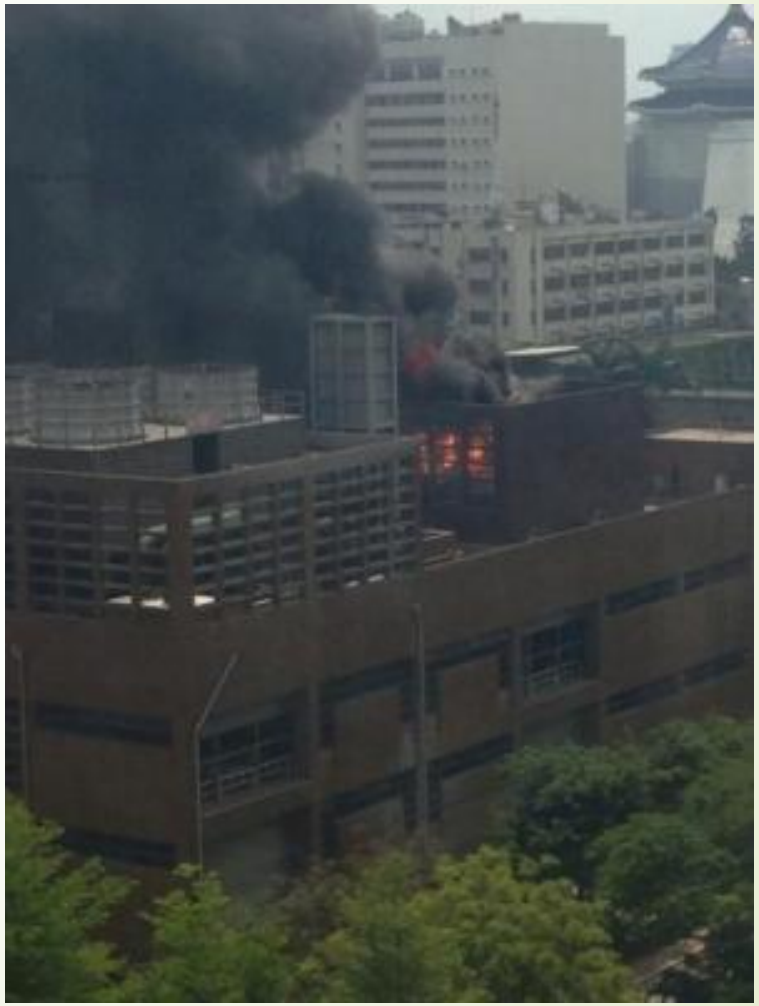
Hospital fires are very dangerous!

Very difficult to evacuate!

Smoke killed a lot of people!

Recently forgot to close doors killed 13!

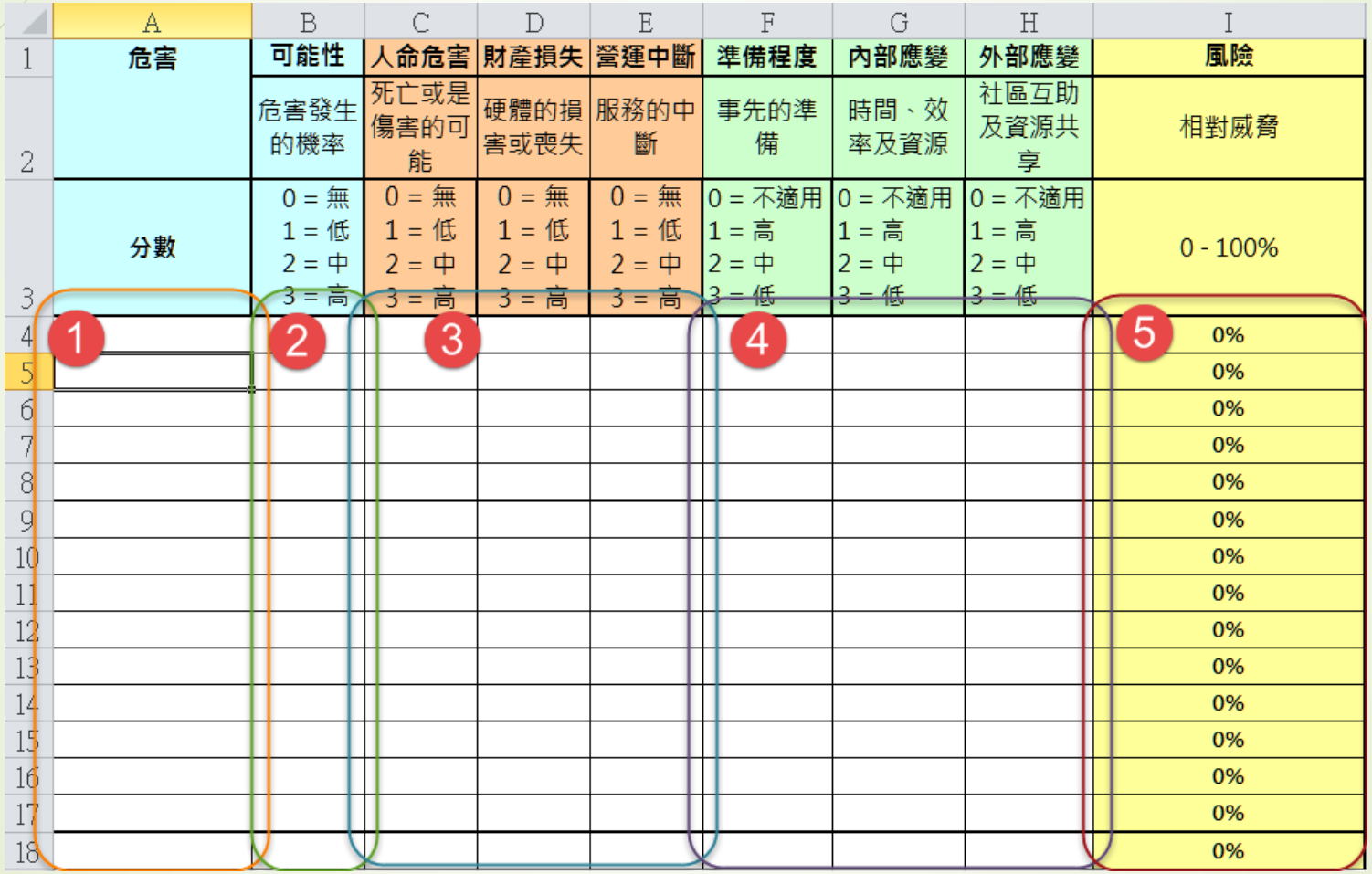
In case of a fire in the power plant of hospitals ?



Human factors related safety issue

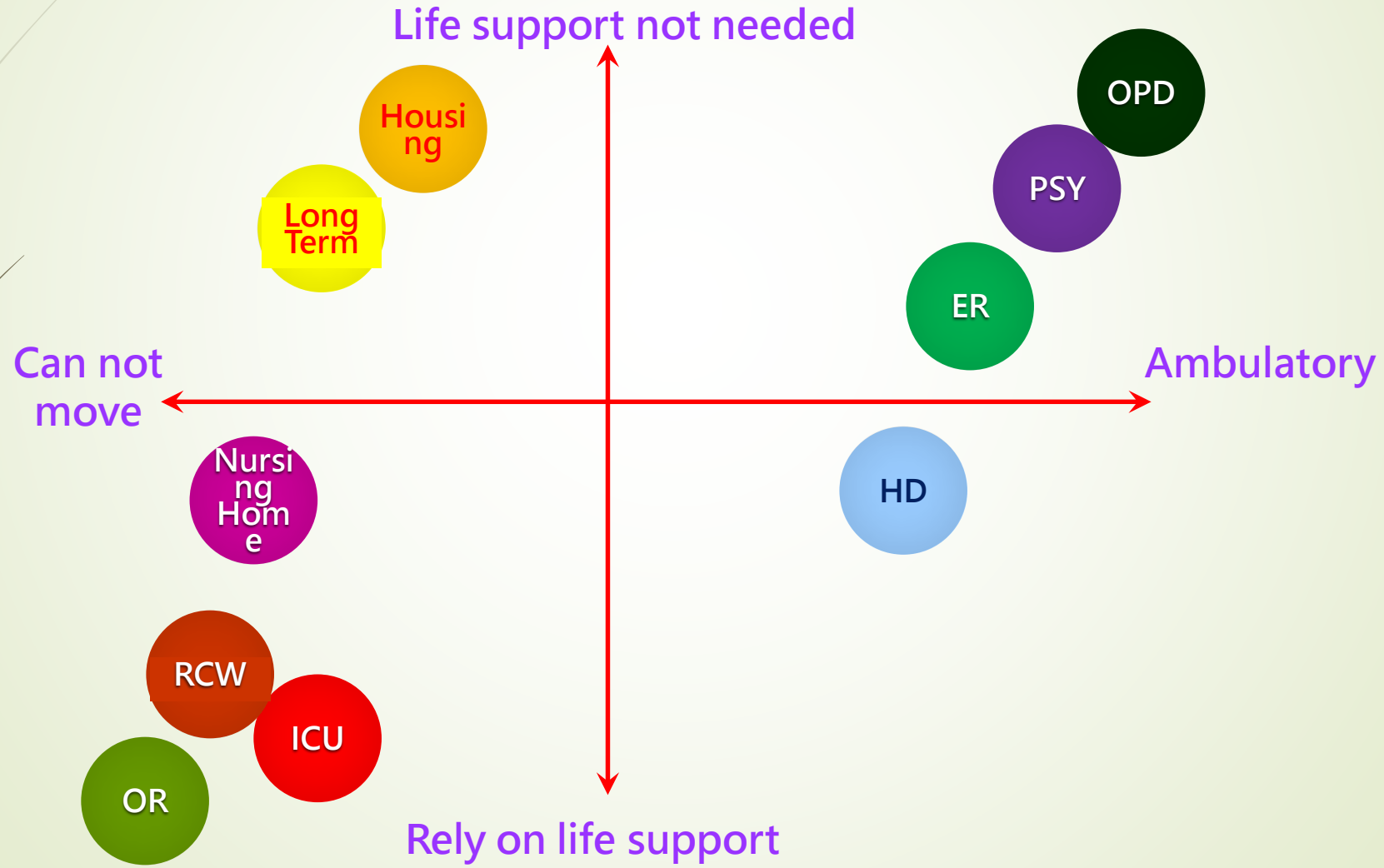
SHEL Model

Hazard Vulnerability Analysis for Hospitals

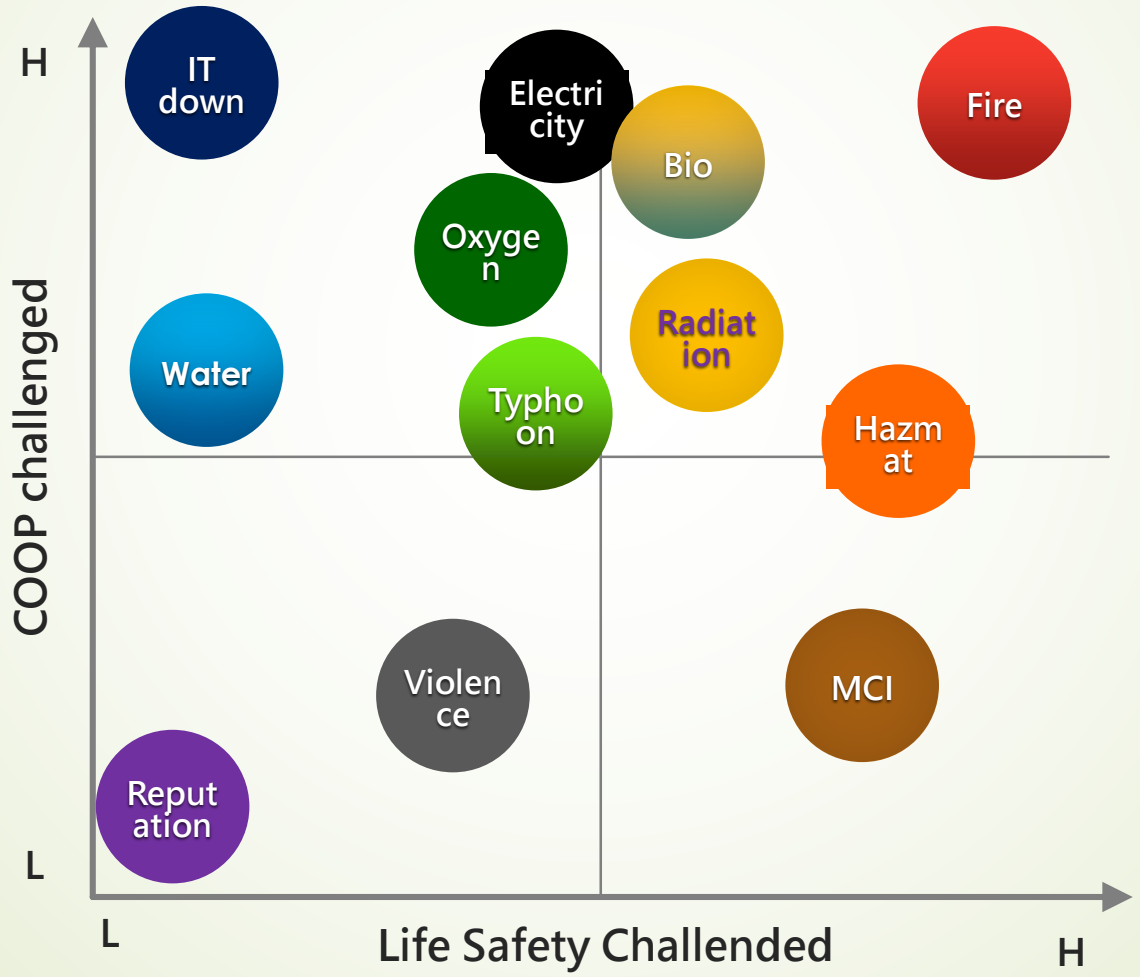


	A	B	C	D	E	F	G	H	I
1	危害	可能性	人命危害	財產損失	營運中斷	準備程度	內部應變	外部應變	風險
2		危害發生的機率	死亡或是傷害的可能	硬體的損害或喪失	服務的中斷	事先的準備	時間、效率及資源	社區互助及資源共享	相對威脅
3	分數	0 = 無 1 = 低 2 = 中 3 = 高	0 = 無 1 = 低 2 = 中 3 = 高	0 = 無 1 = 低 2 = 中 3 = 高	0 = 無 1 = 低 2 = 中 3 = 高	0 = 不適用 1 = 高 2 = 中 3 = 低	0 = 不適用 1 = 高 2 = 中 3 = 低	0 = 不適用 1 = 高 2 = 中 3 = 低	0 - 100%
4									0%
5									0%
6									0%
7									0%
8									0%
9									0%
10									0%
11									0%
12									0%
13									0%
14									0%
15									0%
16									0%
17									0%
18									0%

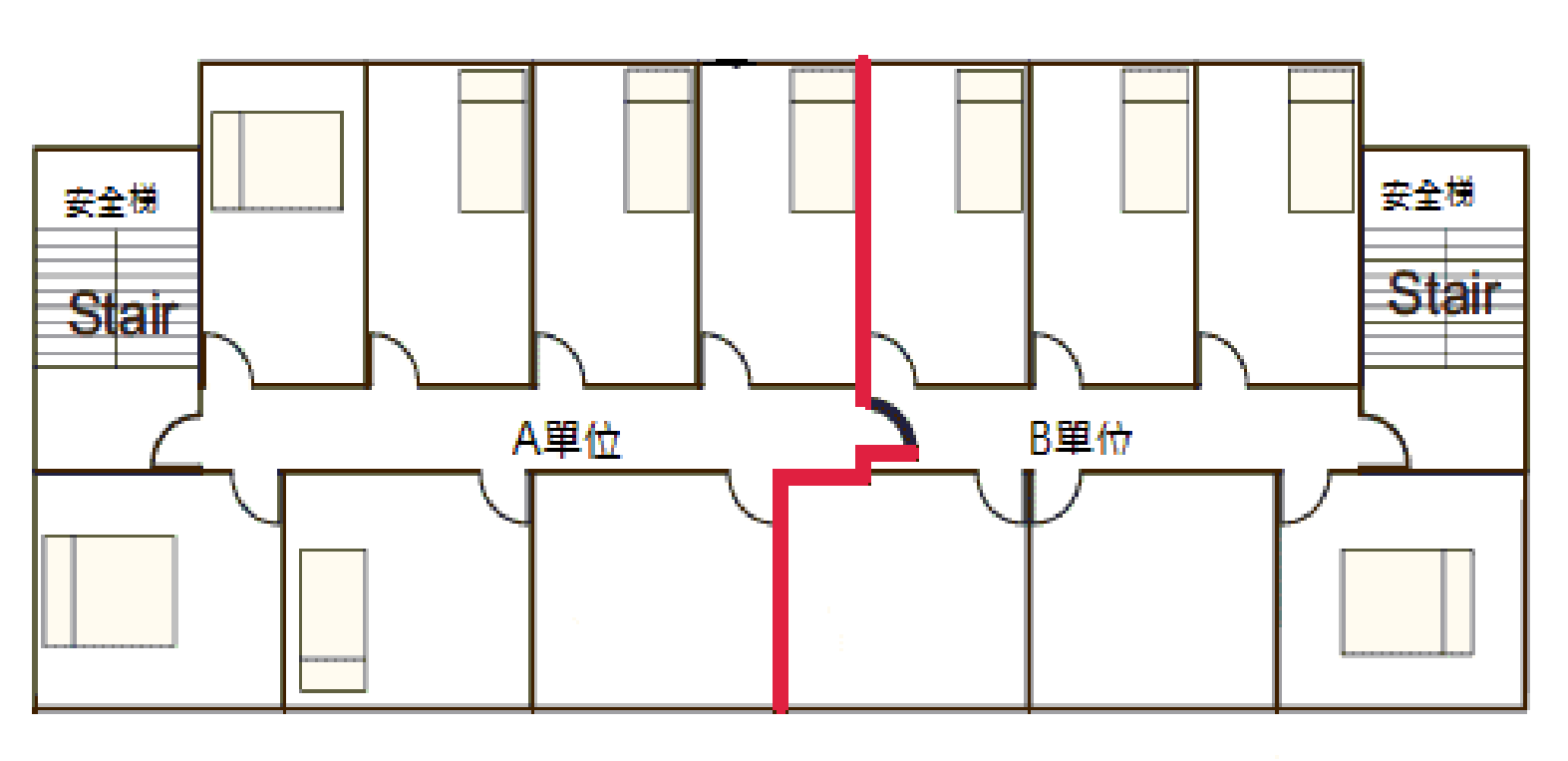
Wards/units are different!



Disasters are different!

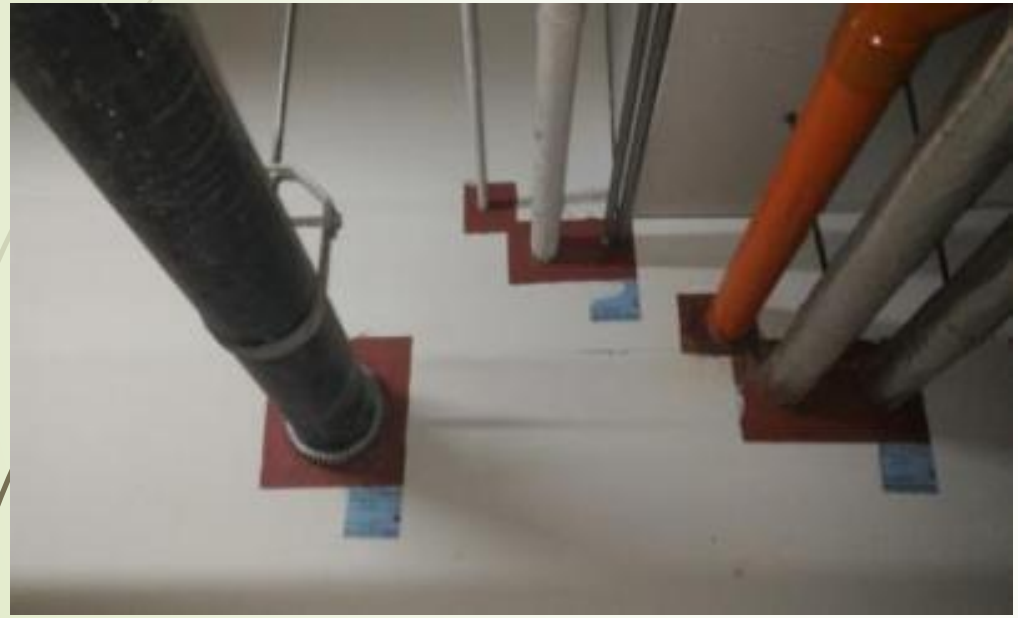


Architecture design



The possibility of shelter-in-place

Fire compartment without penetration!



Combination of clear signage, egress, fire doors……

A pragmatic and readable EOP

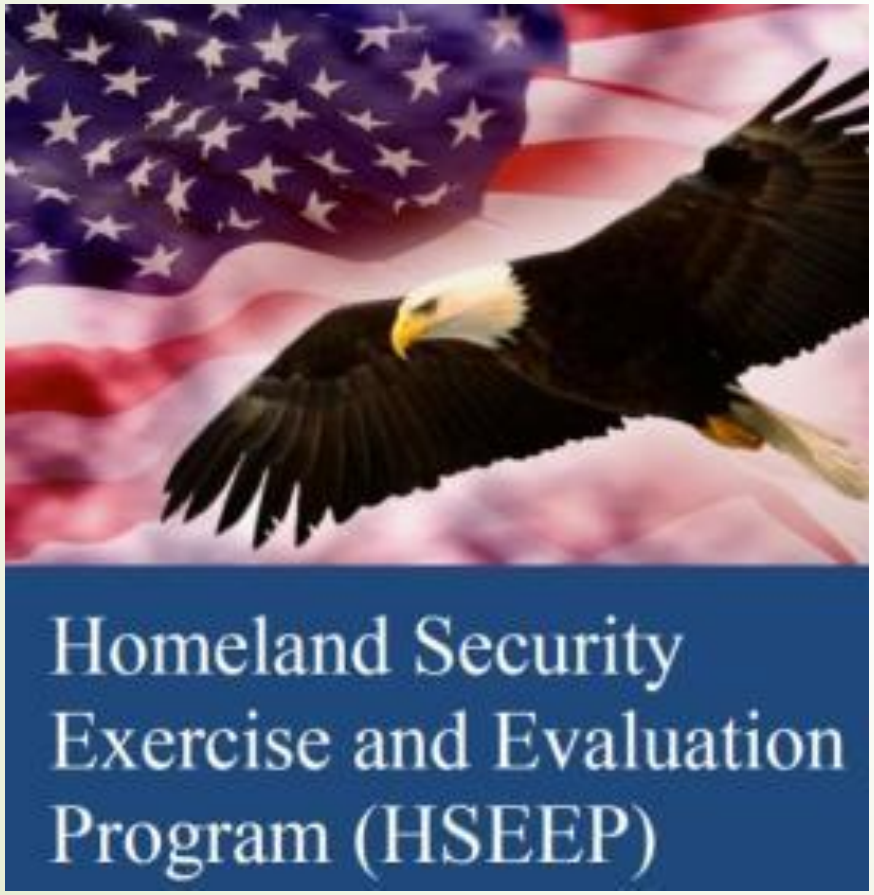
Education/Training and exercise!

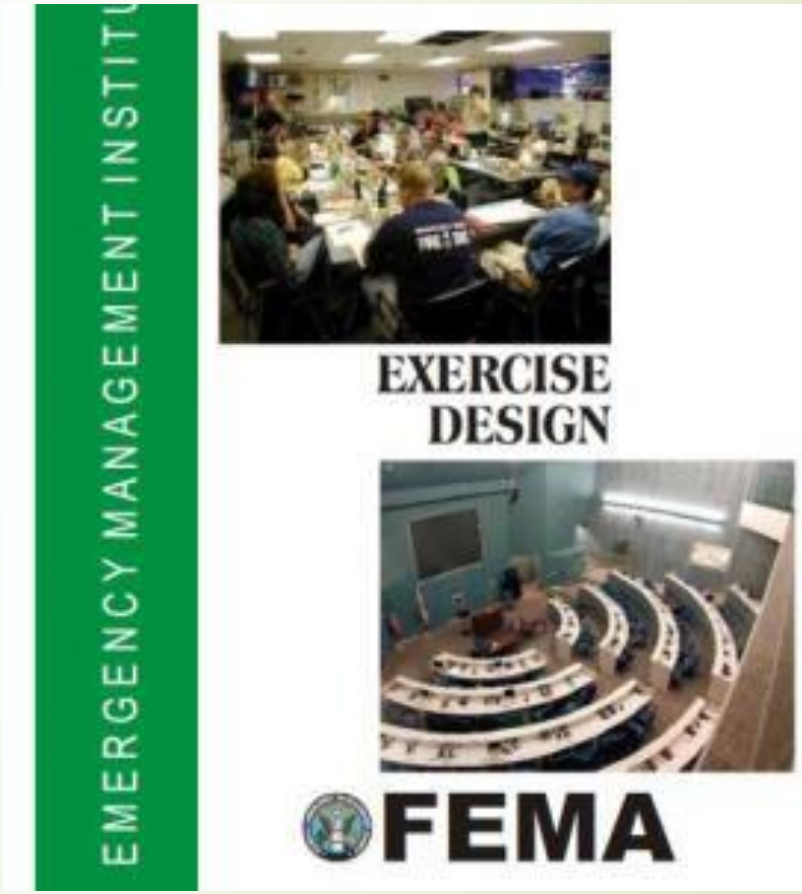
Topics 5
Tools for evaluating emergency performance

Why performance evaluations difficult?

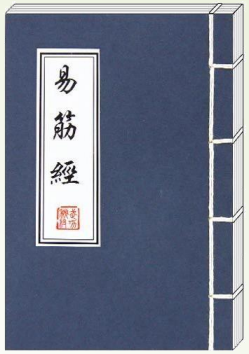
- Events are different!
- Organizations are different!
- Events can not be repeated!
- Rare events
- Performance differs when psychological prepared!
- History effects
- No comparison

A well-designed exercise, is just like a laboratory for scientific study





Basic concept for Exercise

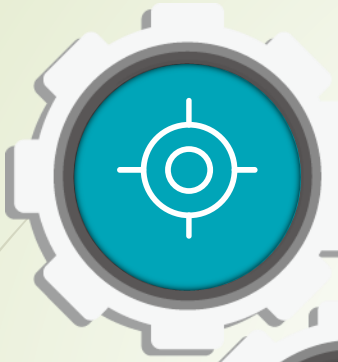


EOP

Training

Exercise

What is a acceptable exercise?



01 Set Objective

02 Well design and conduct

03 Exercise evaluation

04 Identify issues need improvement

Types of Exercises


01
Orientation
02
Drill
03
Tabletop
04
Functional
05
Full-scale

Orientation

Drill

Tabletop

Functional

Full-scale Exercise

Blended Learning: Tabletop Drills

HCF management

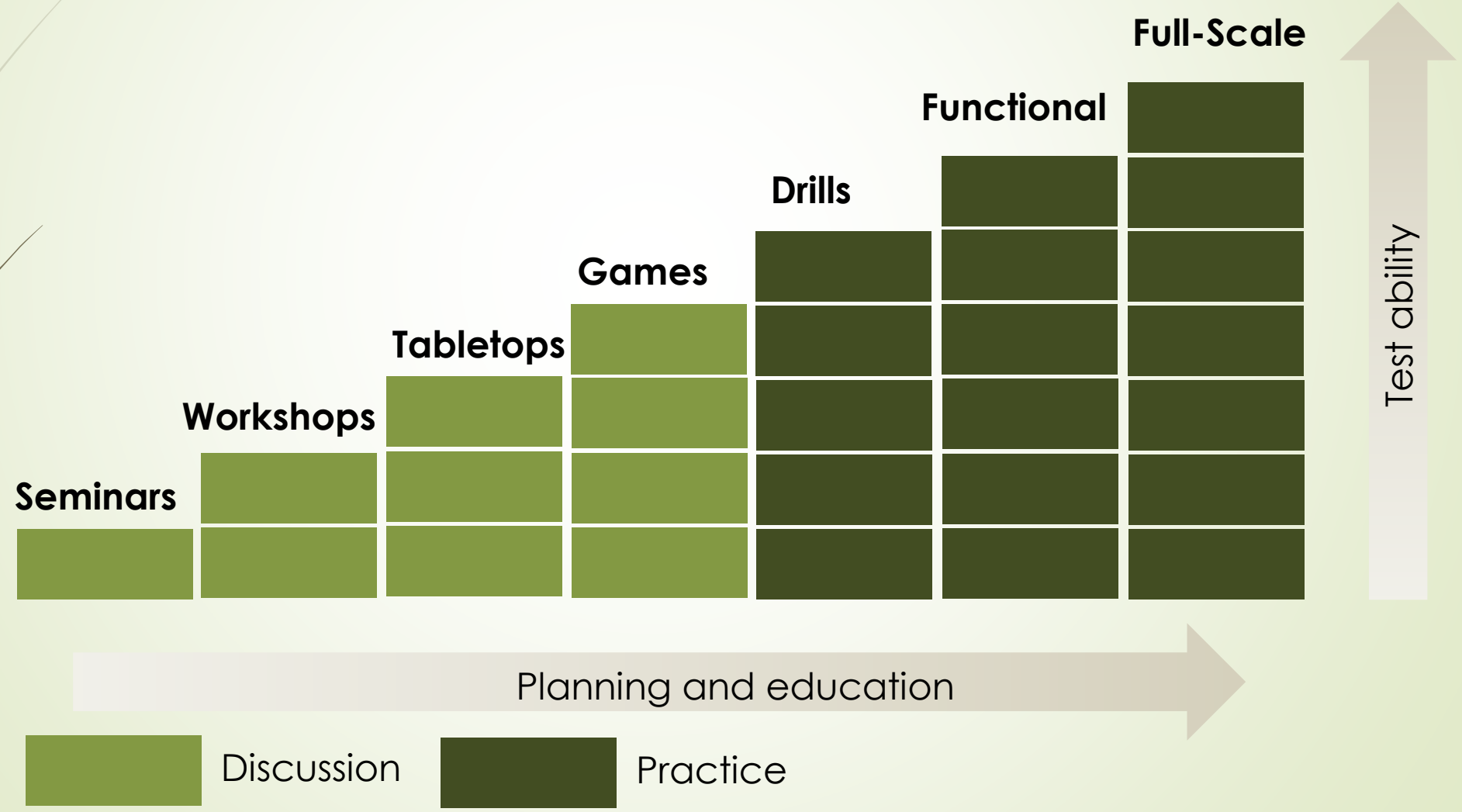
PPE

Sampling technique and Lab

Risk communication

Patients sampling

Choose appropriate types of exercise



Contr
oller

Eval
uator

Simu
lator

Play
er

Exercise design 4 steps

Master Scenario and Events Listing

Event #	[#]	**Event Time:**	**[Time]** ***(Expected)***	**[Time]** ***(Actual)***
Via:	[Inject Method]	**Objective(s):**	[Insert appropriate related objectives]	
Who Delivers?		[Controller]	**Recipient Player(s):**	[Recipient name(s)]
Event Description:				
[Insert Description]				
Inject:				
[Insert Inject Detail]				
Expected Action(s):			**Notes**	
[Insert Expected Actions]				
Expected Outcome:			**Notes**	
[Insert Expected Outcome]				

MSEL (SUMMARY)

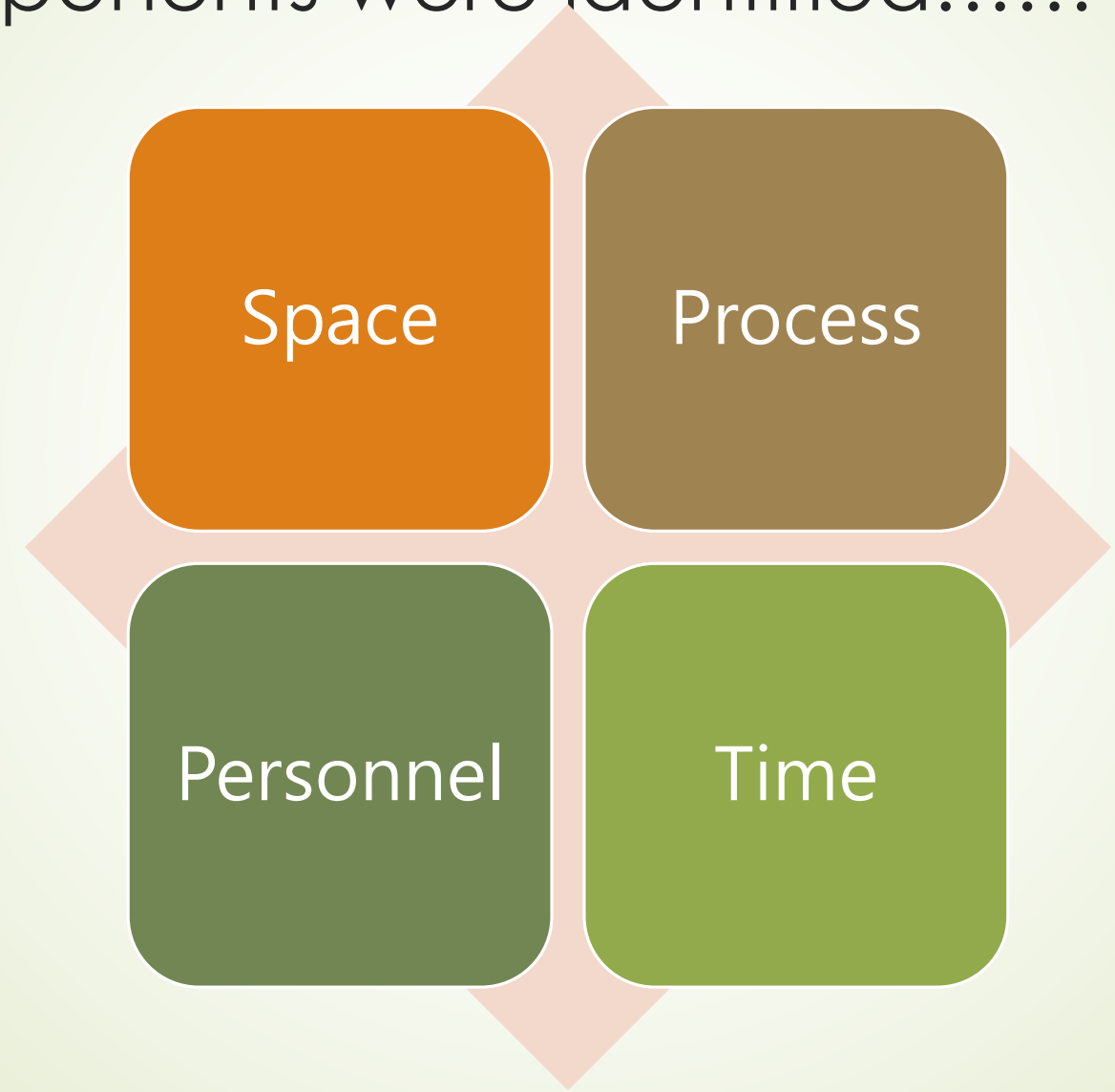
The summary of the MSEL follows. This is a high-level view of MSEL injects in chronological order.

Event #	Event Time	Event Description	Responsible Controller	Recipient Player(s)	Expected Outcome of Player Action
	[Time]	Start of Exercise (StartEx)			
01	[Time]				
02	[Time]				
03	[Time]				
04	[Time]				
05	[Time]				
06	[Time]				
07	[Time]				
08	[Time]				
09	[Time]				
10	[Time]				
11	[Time]				
12	[Time]				
13	[Time]				
14	[Time]				
15	[Time]				
16	[Time]				
17	[Time]				
18	[Time]				
19	[Time]				
20	[Time]				
21	[Time]				

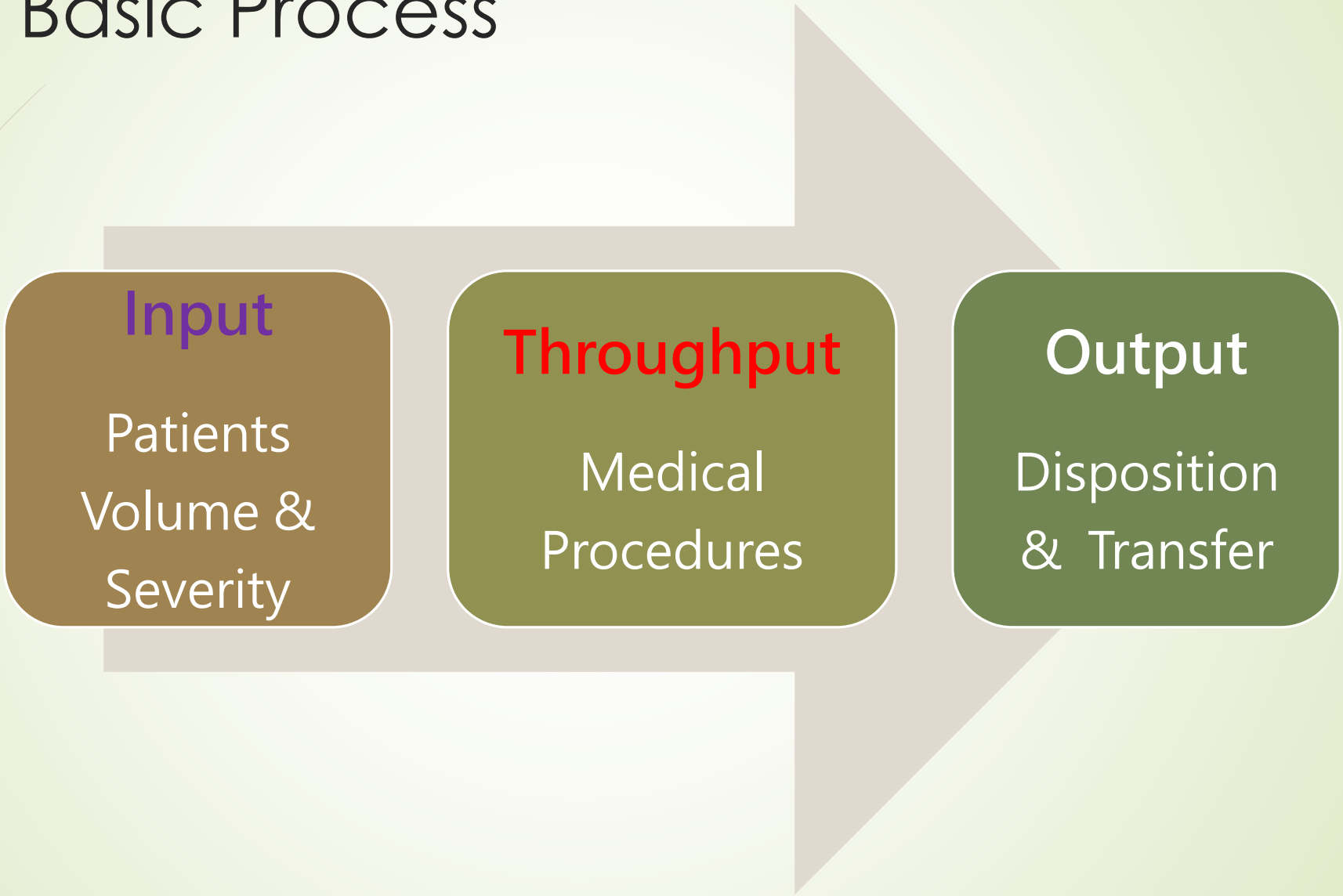
Example 1: Improving MCI process through Anylogic software

How many personnel are appropriate for our disasters?

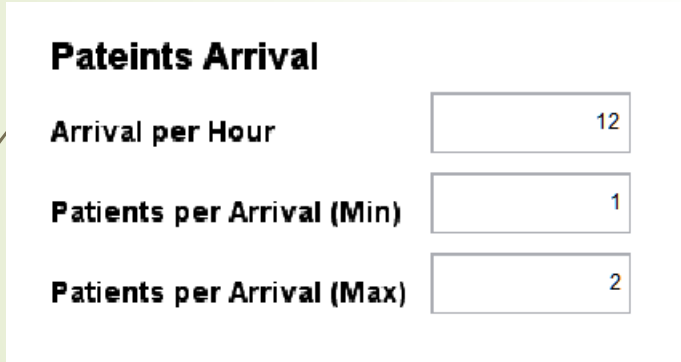
Through Blue Print Analysis, 4 critical components were identified……



Basic Process



Setting the Severity and Volume according to our databank

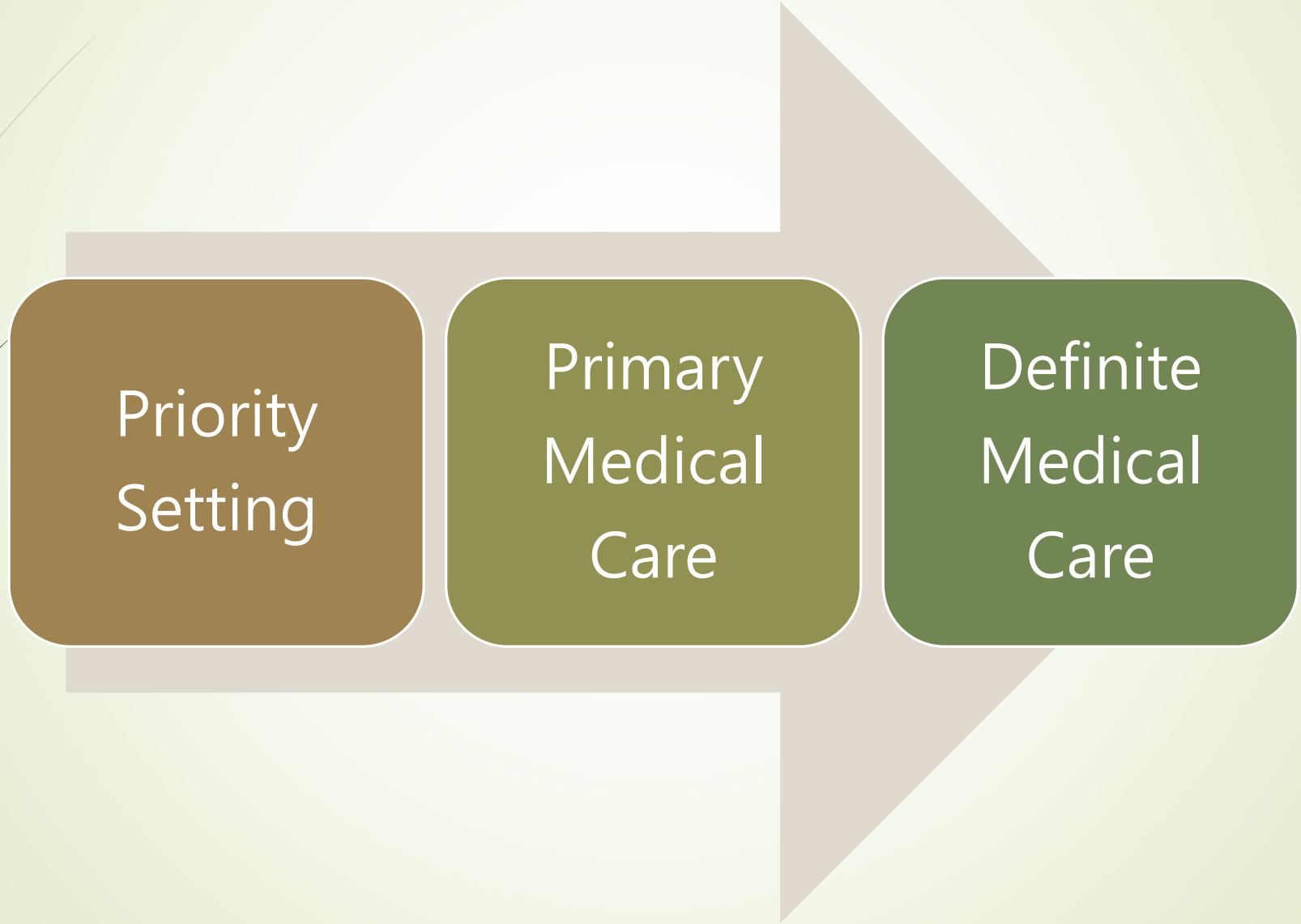


Data

Loaded from database

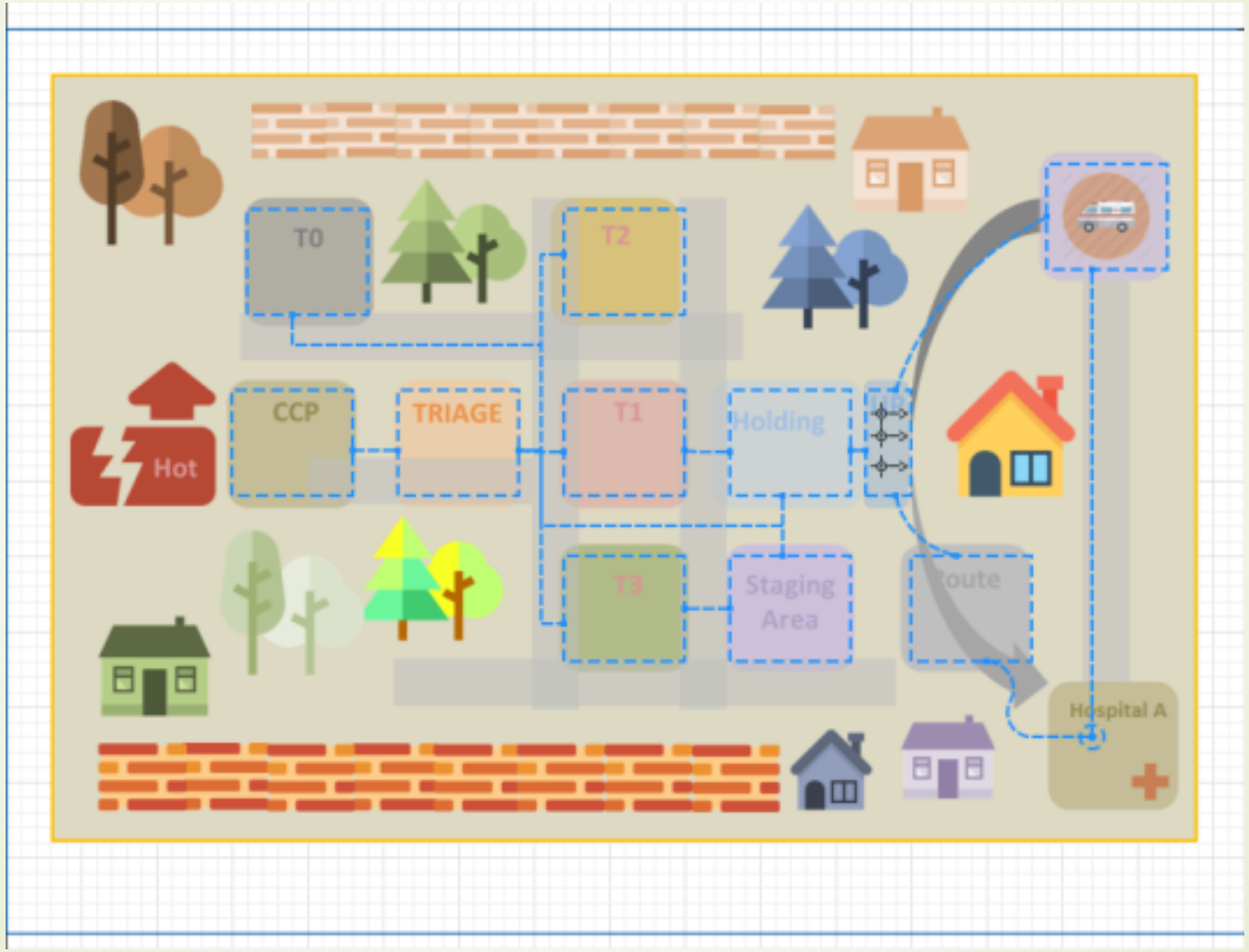
Interval start	Interval end	Number of observations
0	0	8.0
1	1	12.0
2	2	20.0
3	3	60.0

Basic Medical Process



For space and layout

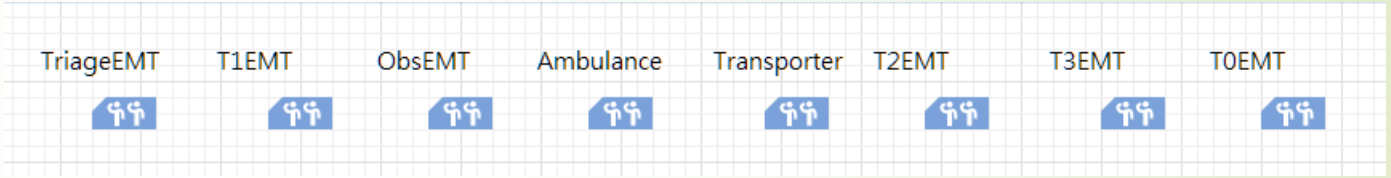
Paths to connect the areas



Setting the numbers of staffs in every locations, adjust later

Resources

No. of Traige EMT	1
No. of T1 EMT	2
No. of T2 EMT	2
No. of T3 EMT	1
No. of T0 EMT	1
No. of Obs EMT	1
No. of Transporter	3
No. of Ambulance	2



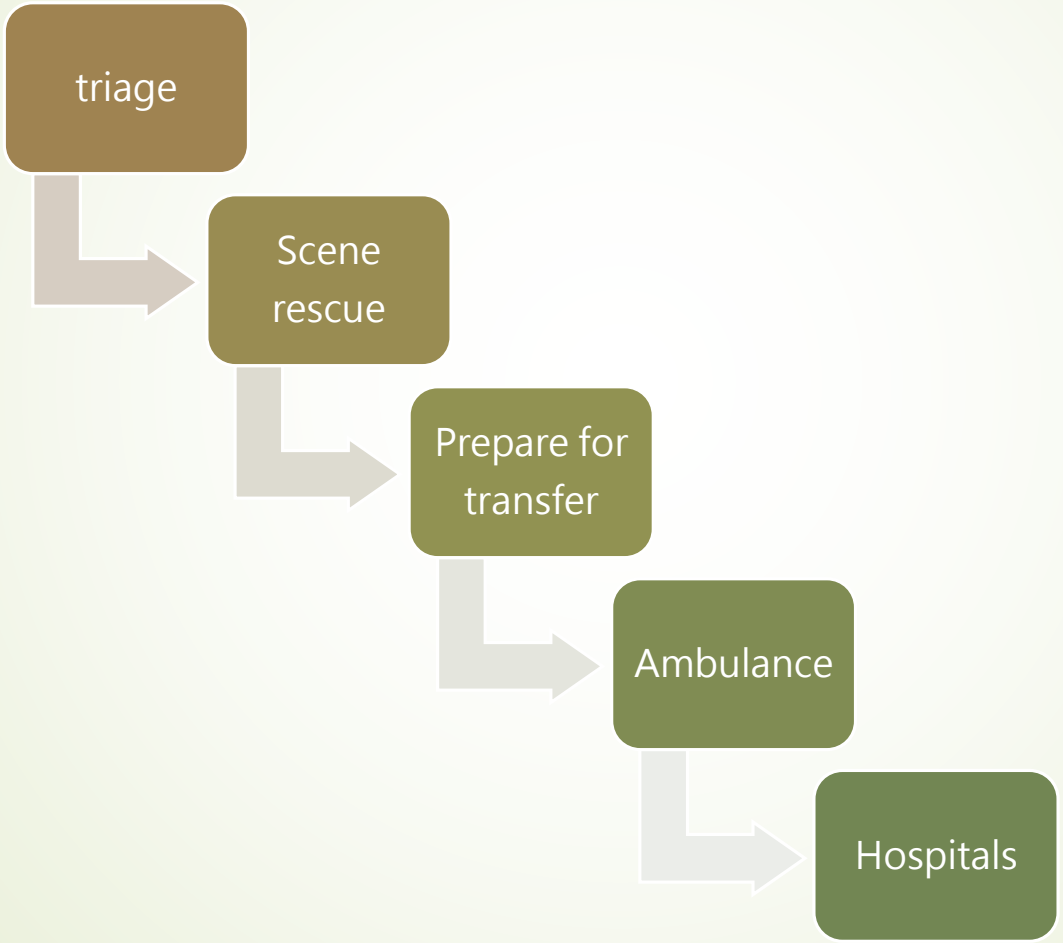
Setting the time consumed for every process (observed in ordinary EMS activity)

Pateints Treatment

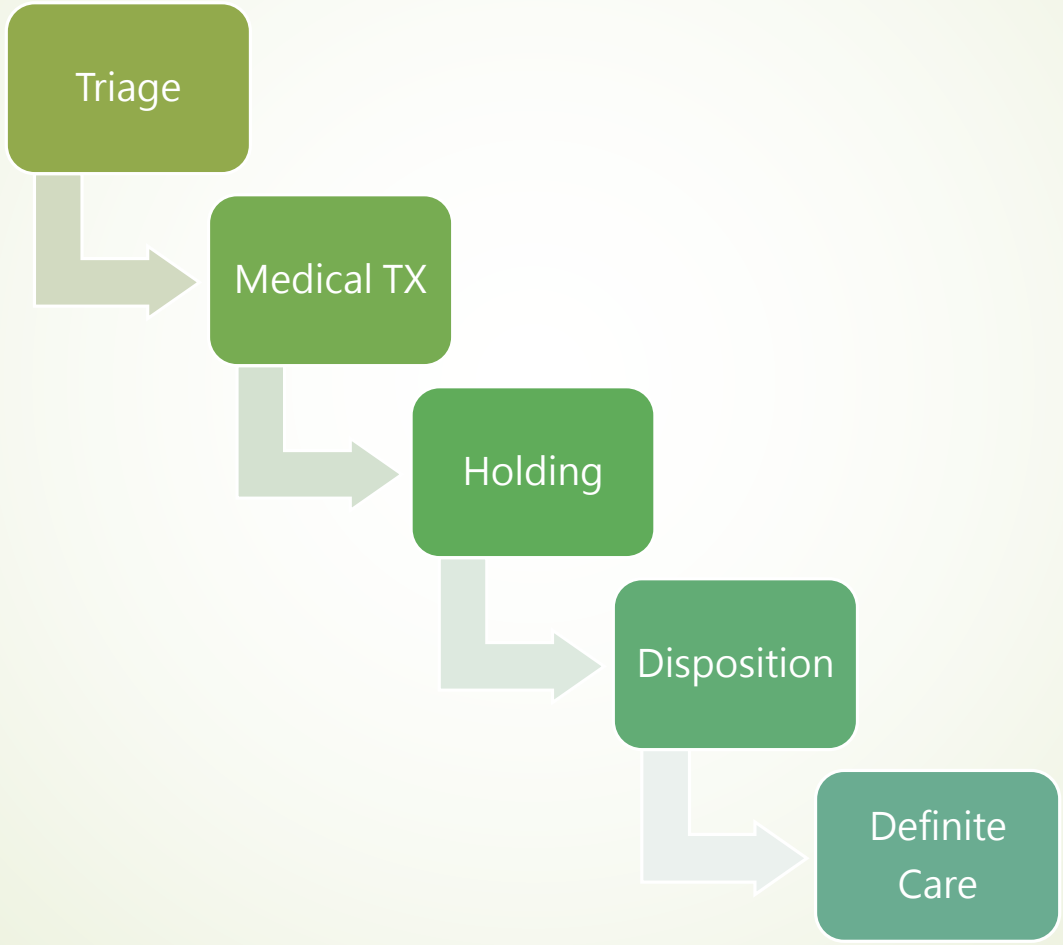
Triage Time Min	1
Triage Time Mean	2
Triage Time Max	4
T1 Time Min	6
T1 Time Mean	8
T1 Time Max	15
T2 Time Min	4
T2 Time Mean	7
T2 Time Max	12
T3 Time Min	3
T3 Time Mean	5
T3 Time Max	10
T0 Time Min	3
T0 Time Mean	5
T0 Time Max	7

Route Time Min	4
Route Time Mean	6
Route Time Max	12
Obs Time Min	3
Obs Time Mean	5
Obs Time Max	10

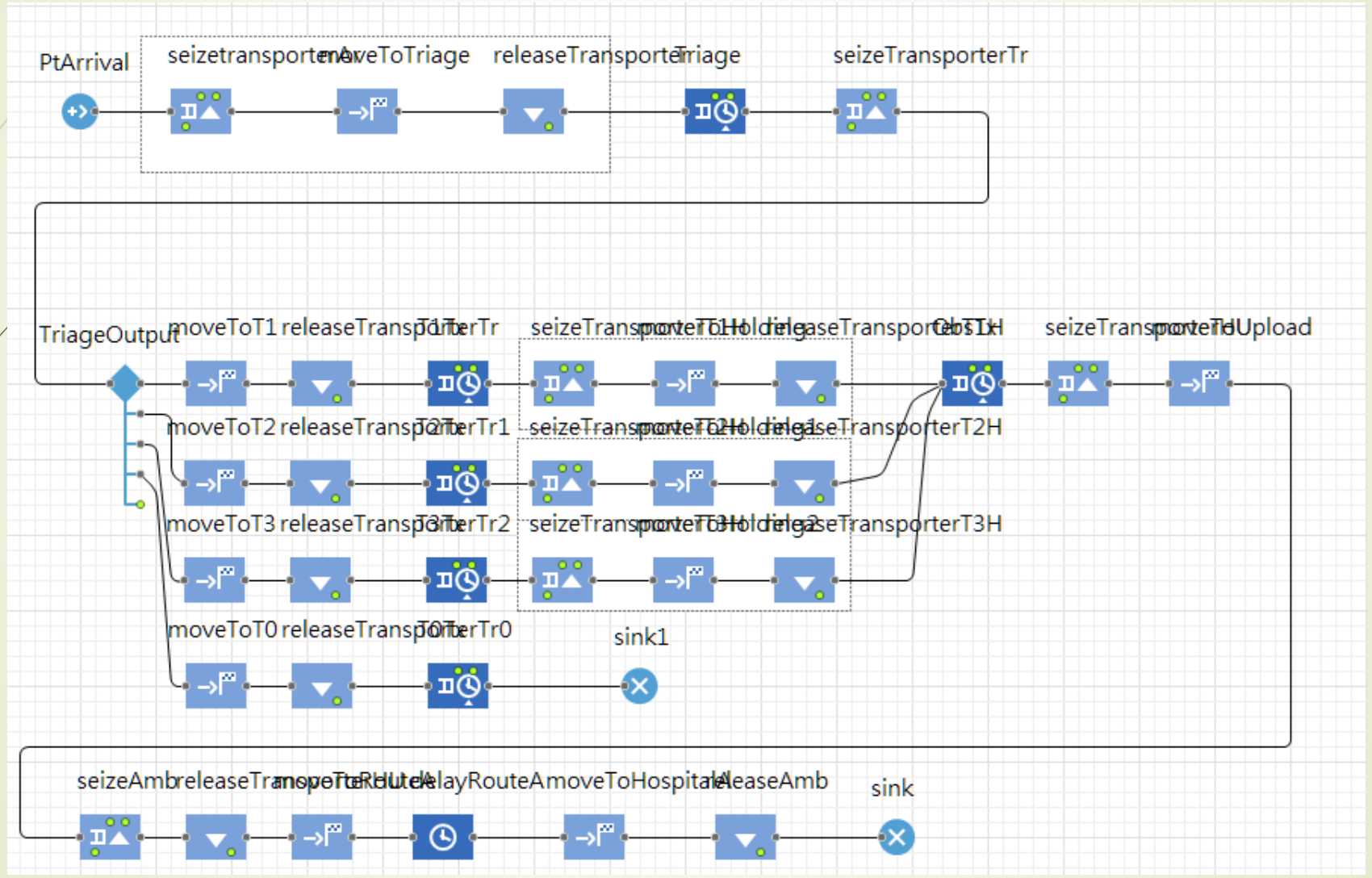
Process for Field MCI



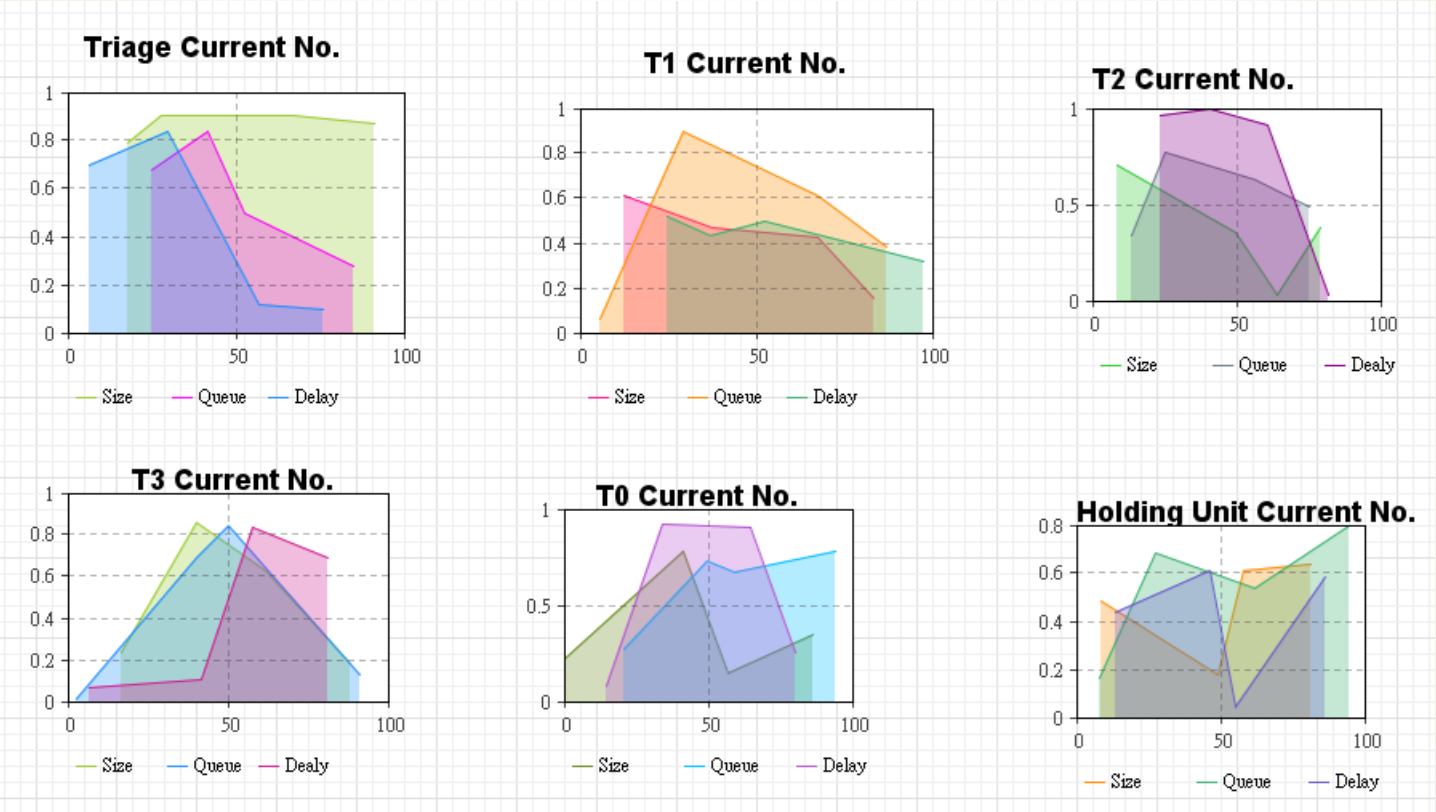
Process for Hospital MCI



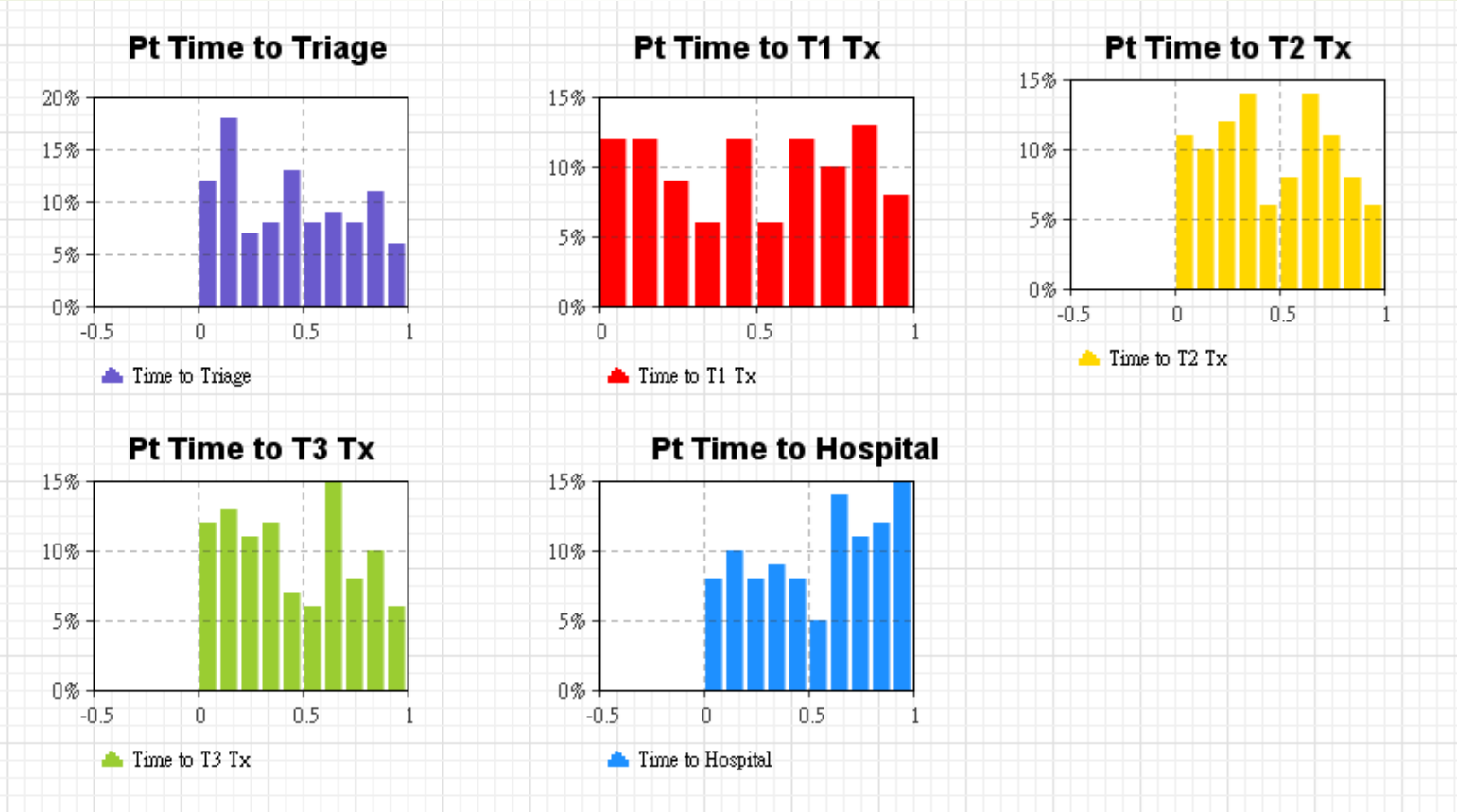
More detailed procedures with resources required



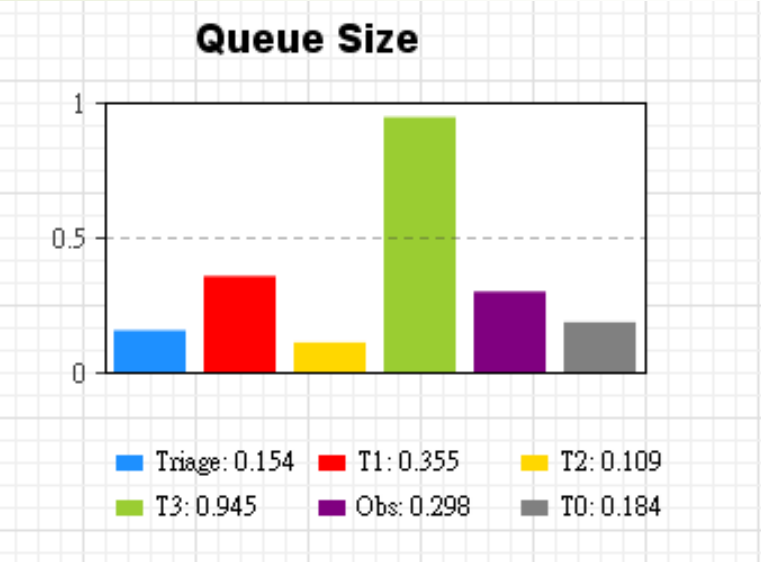
KPI Parameters



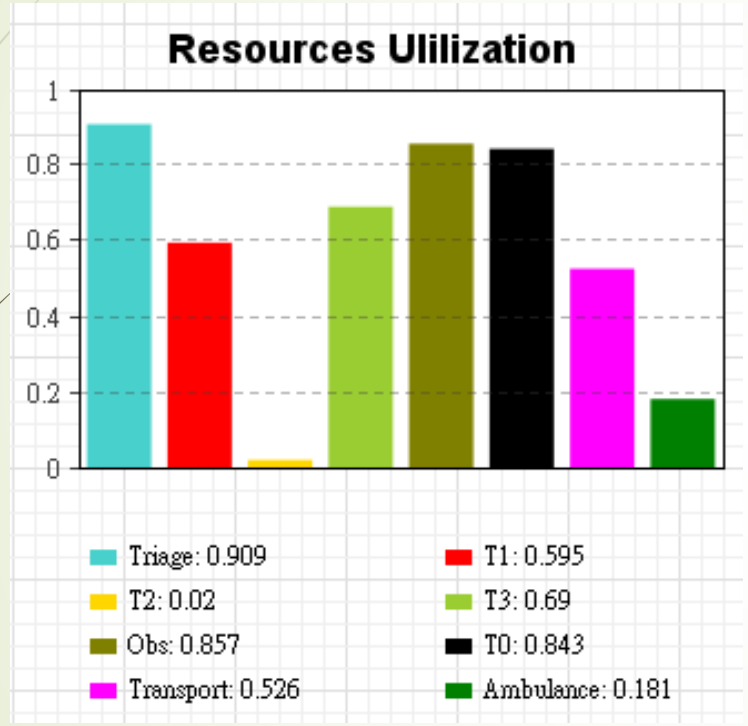
For example: Time to triage, treatment, hospitals



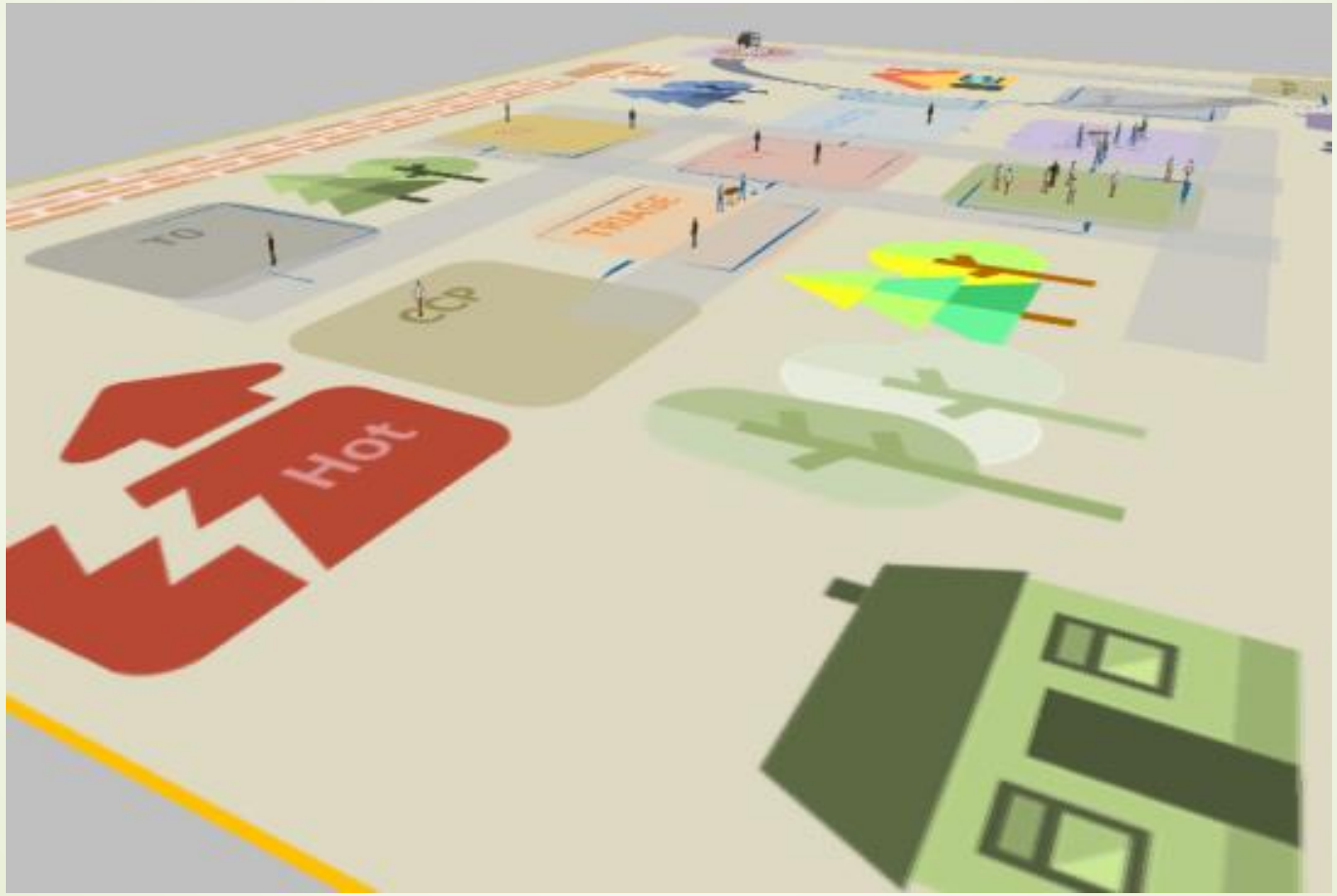
For Example: No. of patients treated



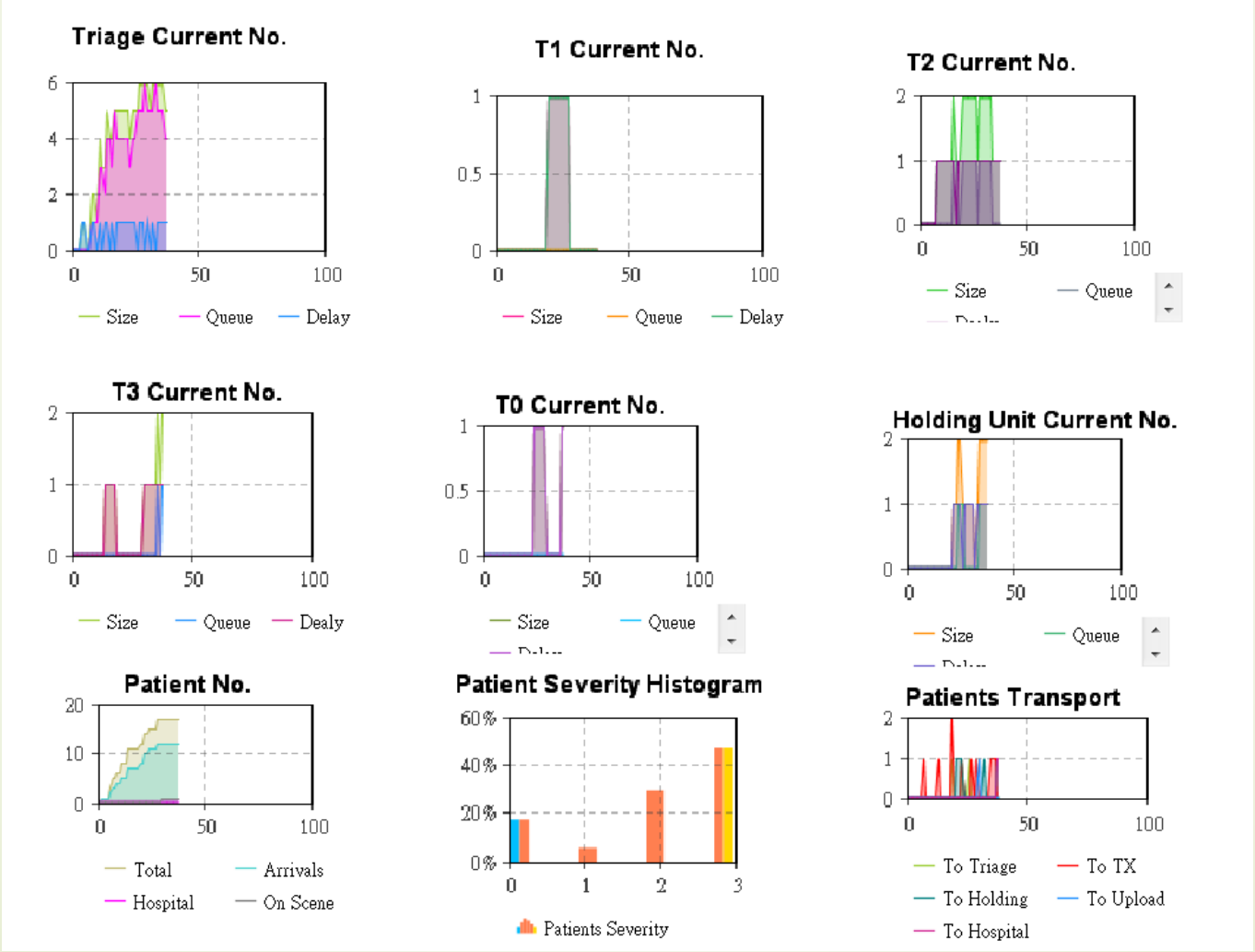
For Example: Resources Utilization



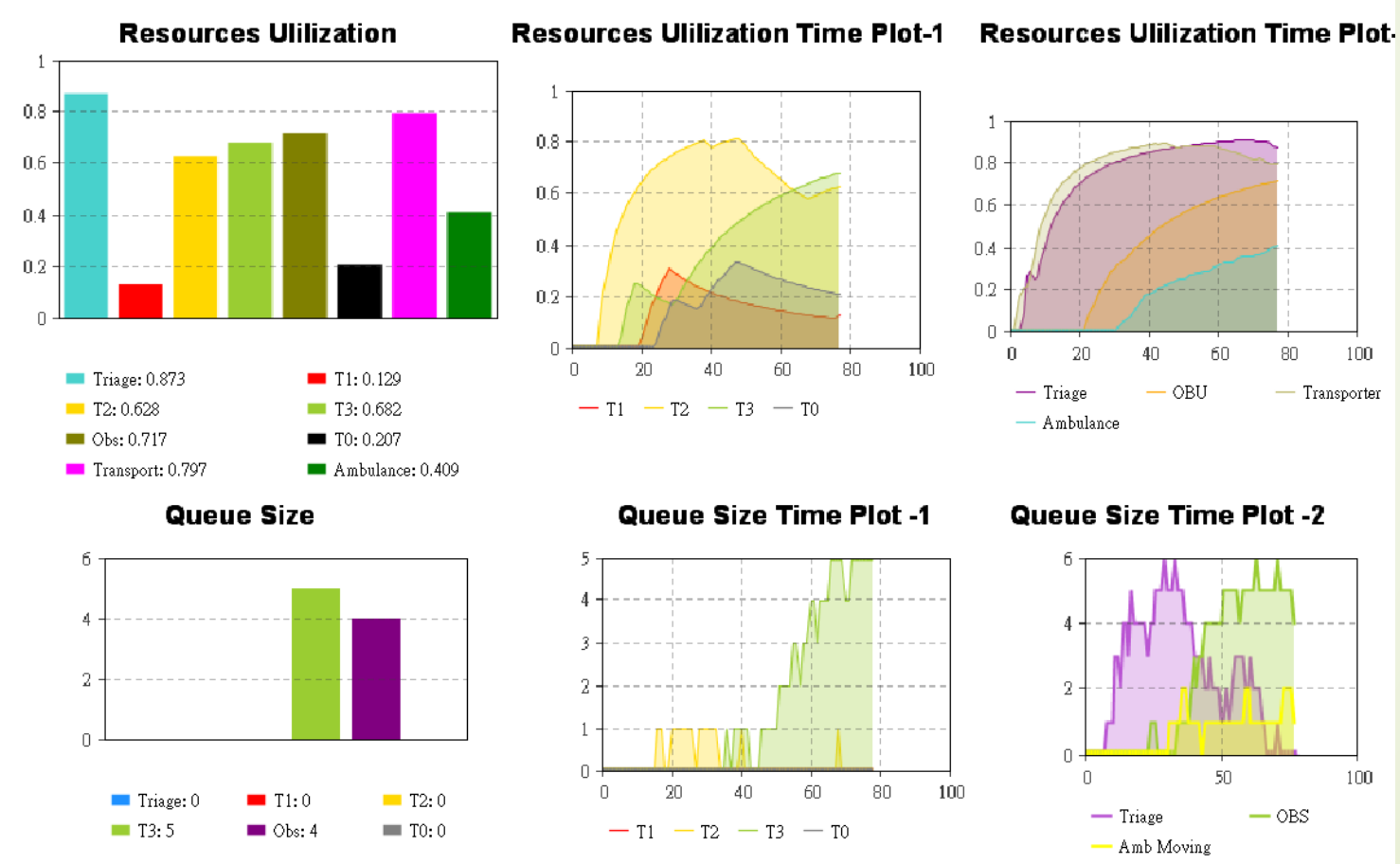
We can view in 3D



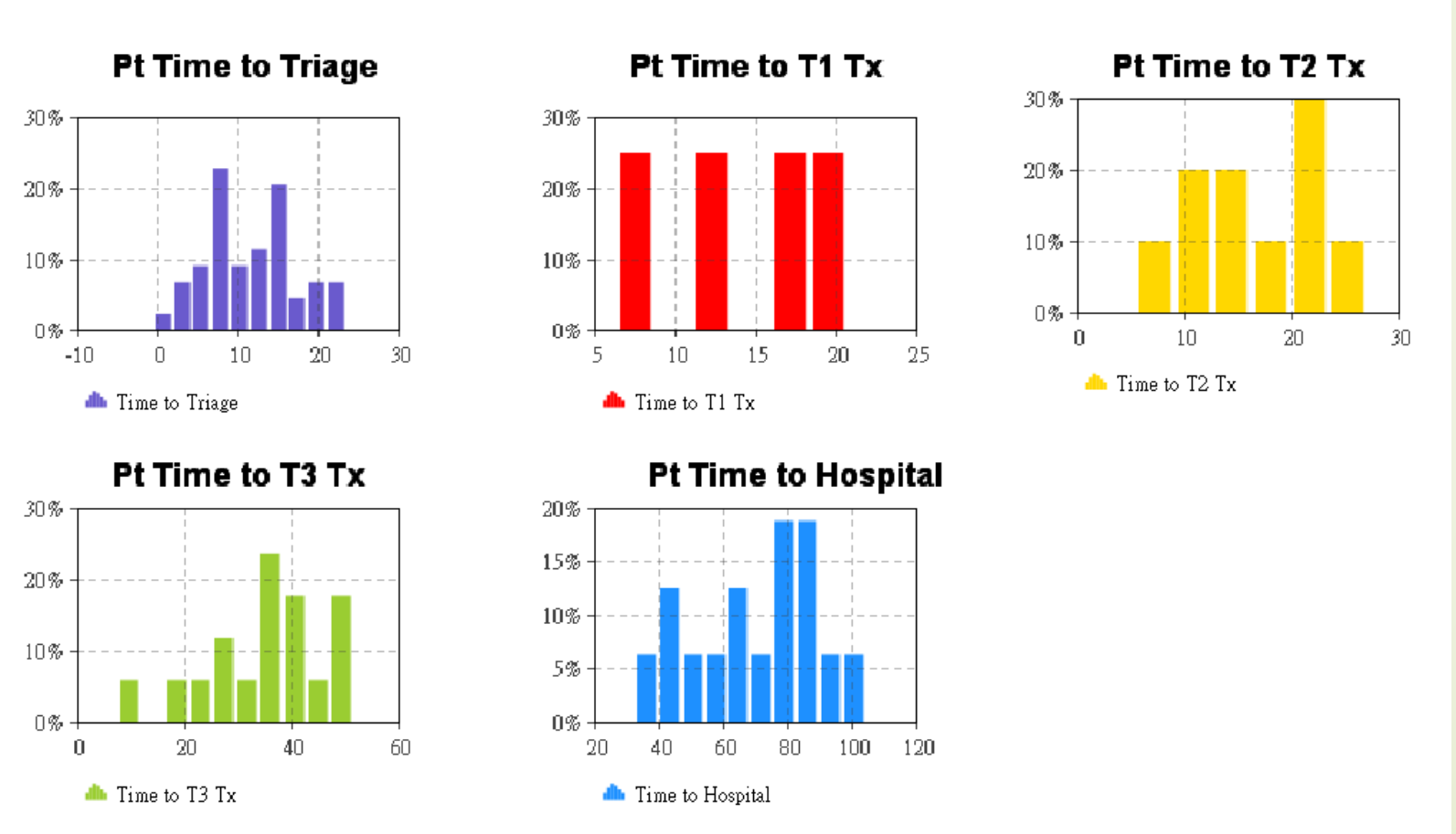
Outcomes of the model



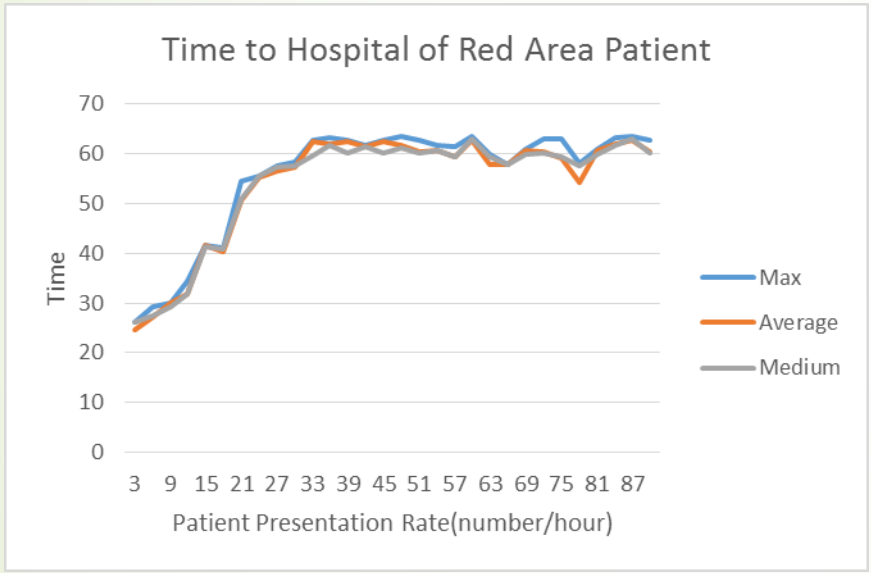
Outcomes of the model

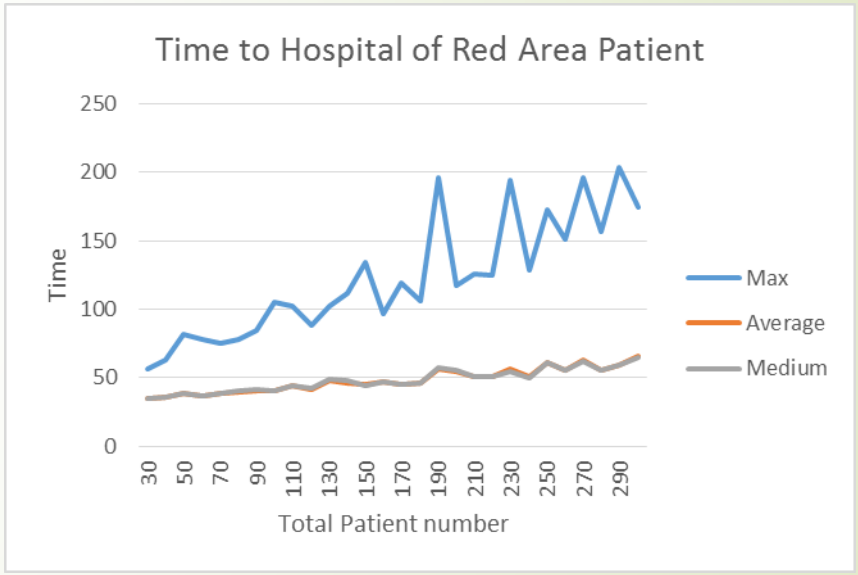


Outcomes of the model



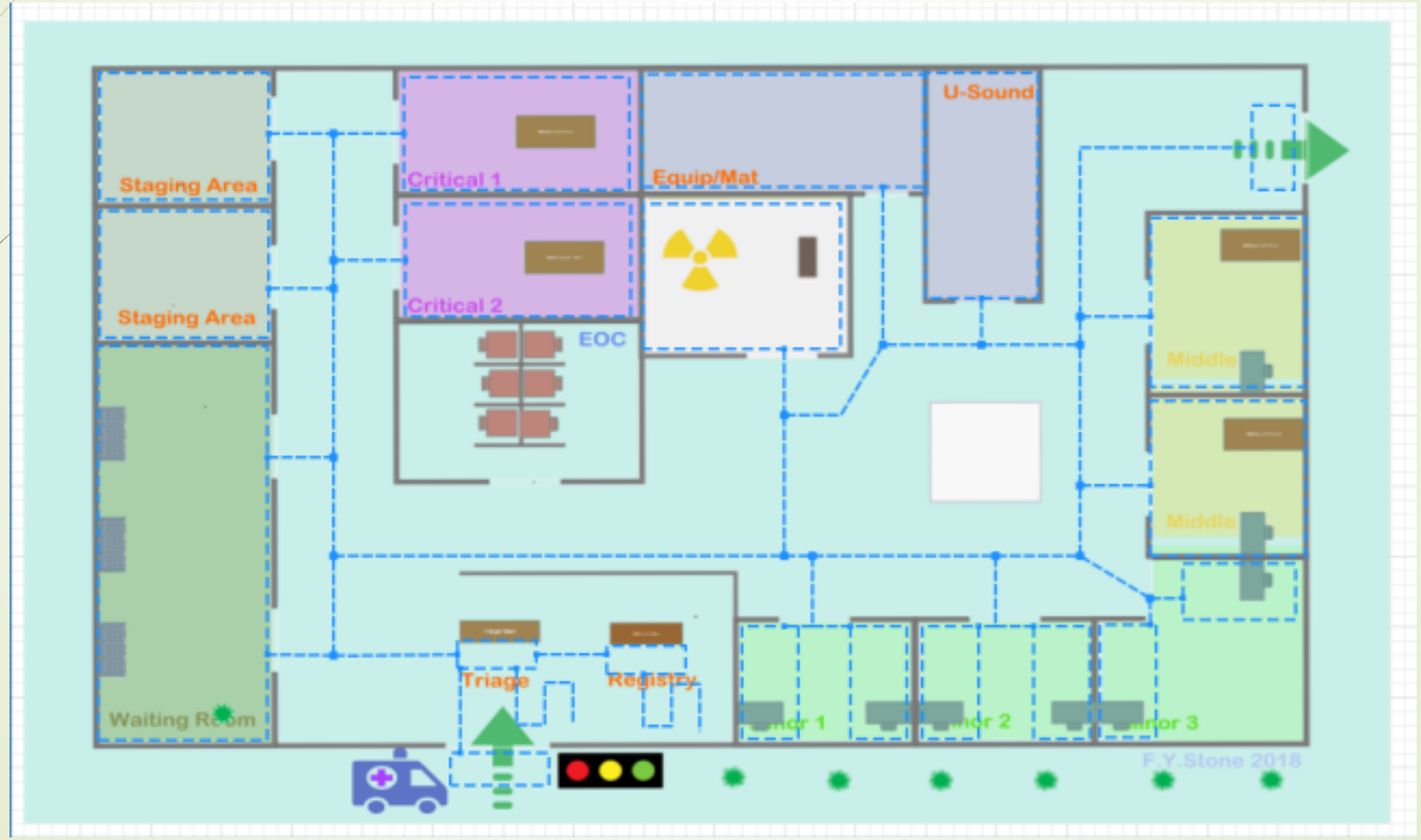
We can compare between different resources and challenges



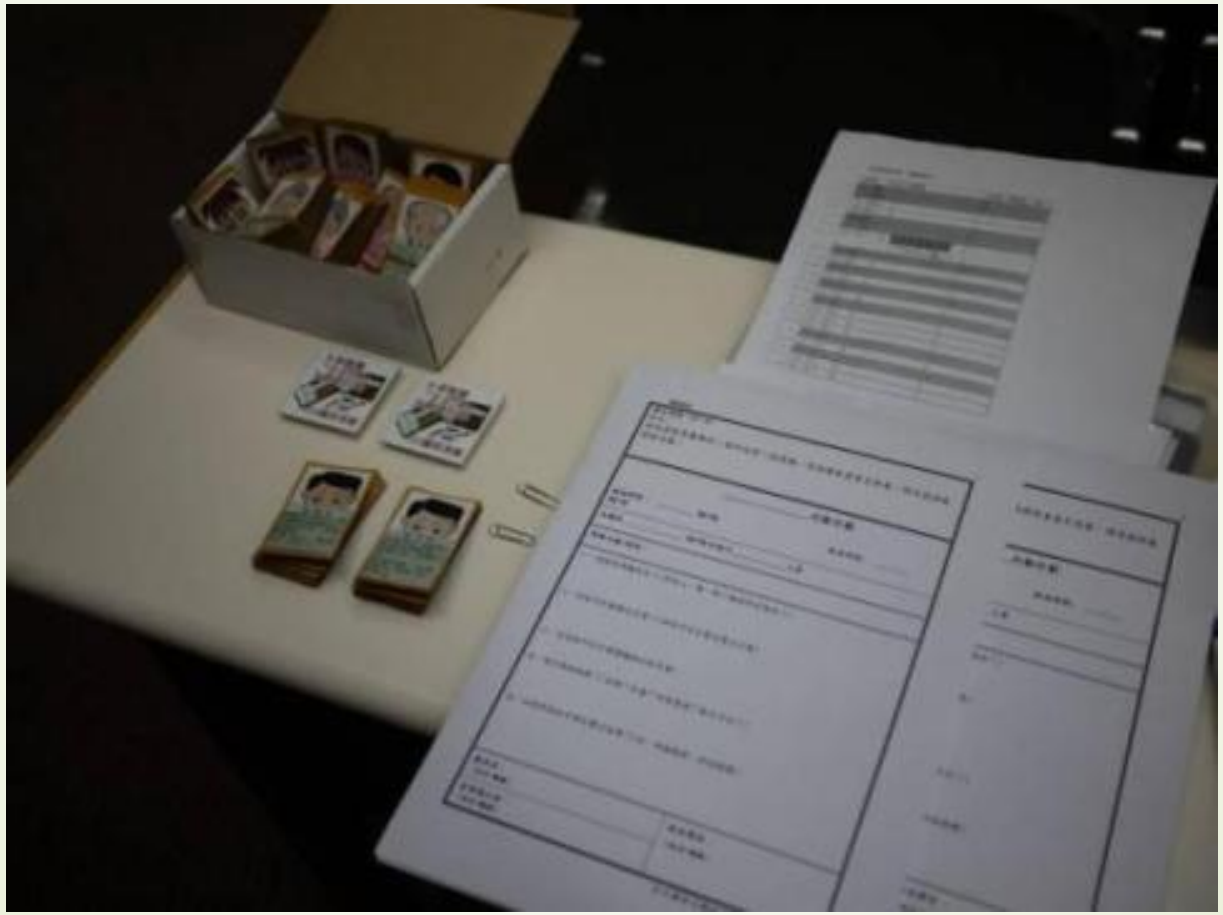


Validating in full scale exercise

We can also use it for ER……



Example 2
New style of Tabletop Drills for Validating EOP, or education purpose



Functional Tabletop Exercise ver2 since 2008

Functional Tabletop Exercise ver2
Resources are monitored

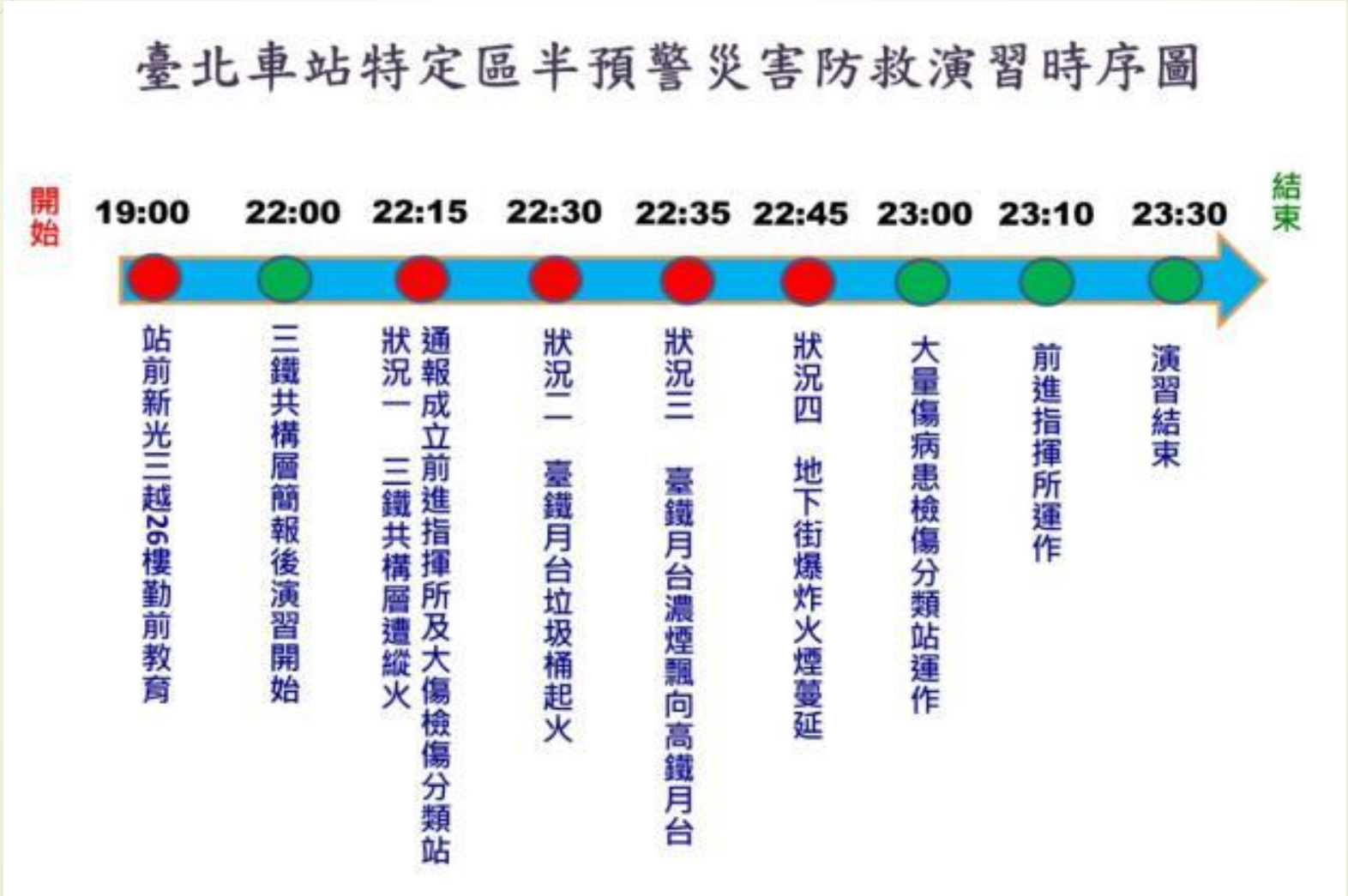
An MCI tabletop drill in NTUH

Too validating current EOP for MCI

Example 3
Full-scale exercise in Taipei Main Station

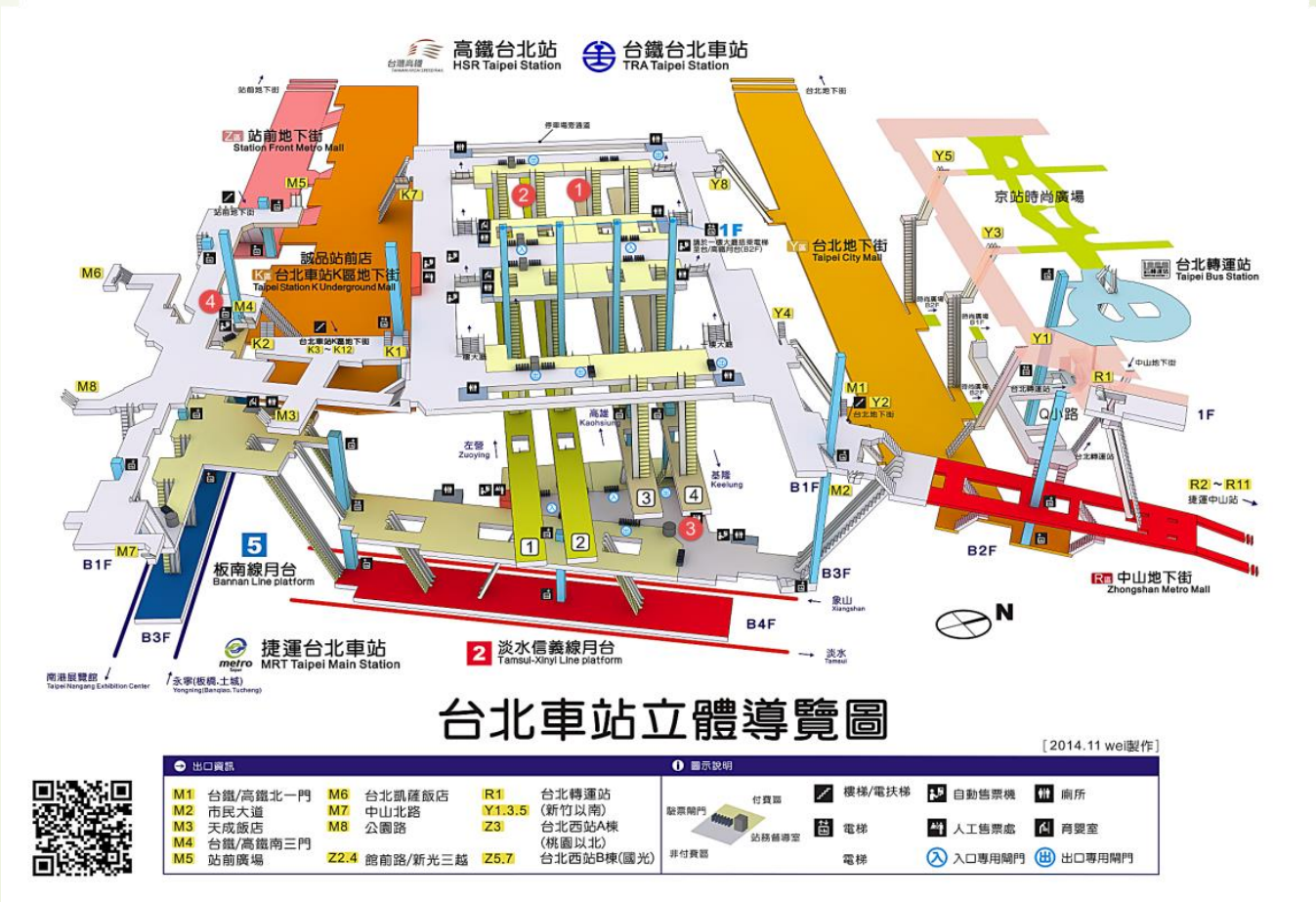
Survey and choose spots in advance

Time-sequences



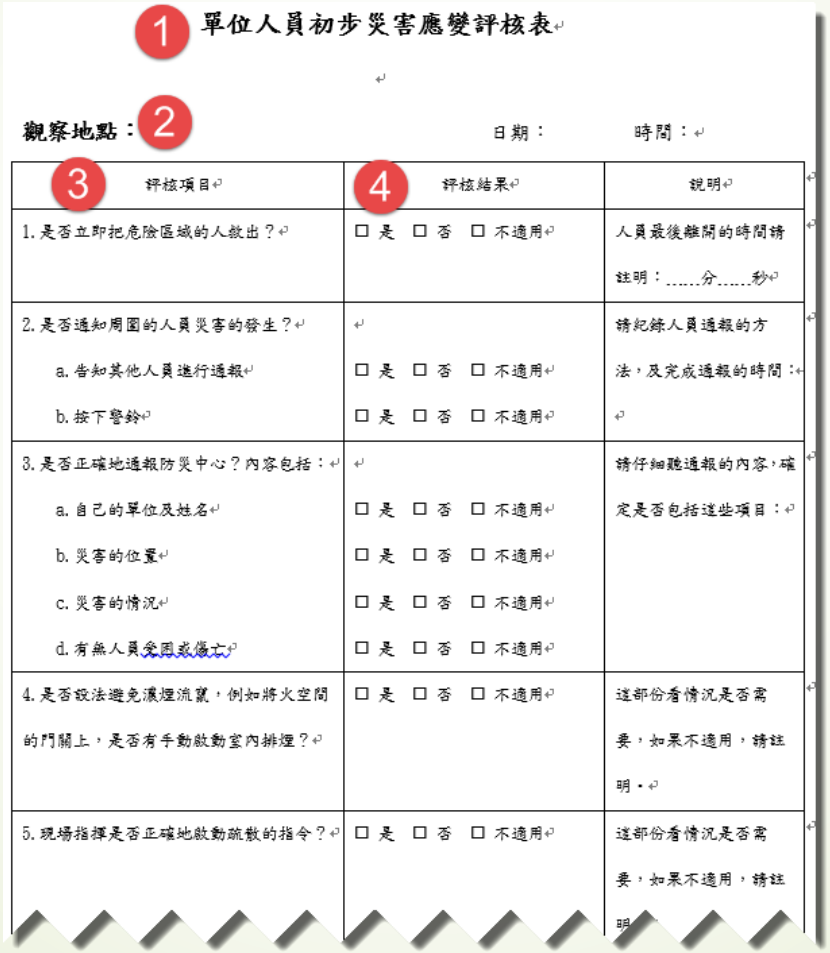
範例：

Maps for the events



For example

Evaluation form (to evaluate first responder)



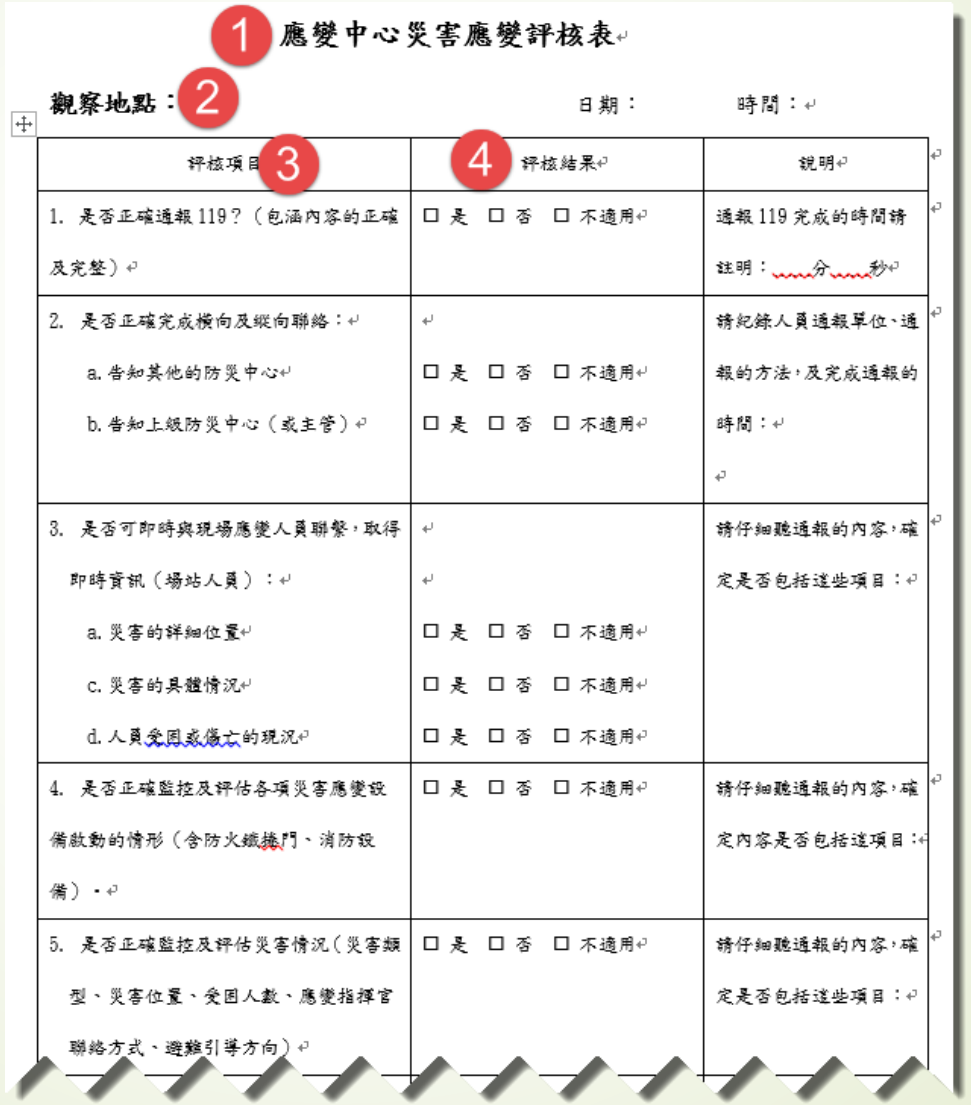
1 單位人員初步災害應變評核表

觀察地點：2　　日期：　　時間：

3 評核項目	4 評核結果	說明
1. 是否立即把危險區域的人救出？	□ 是 □ 否 □ 不適用	人員最後離開的時間請註明：_____分_____秒
2. 是否通知周圍的人員災害的發生？ a. 告知其他人員進行通報 b. 按下警鈴	 □ 是 □ 否 □ 不適用 □ 是 □ 否 □ 不適用	請紀錄人員通報的方法，及完成通報的時間：
3. 是否正確地通報防災中心？內容包括： a. 自己的單位及姓名 b. 災害的位置 c. 災害的情況 d. 有無人員受困或傷亡	 □ 是 □ 否 □ 不適用 □ 是 □ 否 □ 不適用 □ 是 □ 否 □ 不適用 □ 是 □ 否 □ 不適用	請仔細聽通報的內容，確定是否包括這些項目：
4. 是否設法避免濃煙流竄，例如將火空間的門關上，是否有手動啟動室內排煙？	□ 是 □ 否 □ 不適用	這部份看情況是否需要，如果不適用，請註明。
5. 現場指揮是否正確地啟動疏散的指令？	□ 是 □ 否 □ 不適用	這部份看情況是否需要，如果不適用，請註明

For example

Evaluation form (to evaluate EOC)



1 應變中心災害應變評核表

觀察地點：2　　日期：　　時間：

評核項目3	評核結果4	說明
1. 是否正確通報 119？（包涵內容的正確及完整）	□ 是 □ 否 □ 不適用	通報 119 完成的時間請註明：＿＿分＿＿秒
2. 是否正確完成橫向及縱向聯絡：		請紀錄人員通報單位、通報的方法，及完成通報的時間：
a. 告知其他的防災中心	□ 是 □ 否 □ 不適用	
b. 告知上級防災中心（或主管）	□ 是 □ 否 □ 不適用	
3. 是否可即時與現場應變人員聯繫，取得即時資訊（場站人員）：		請仔細聽通報的內容，確定是否包括這些項目：
a. 災害的詳細位置	□ 是 □ 否 □ 不適用	
c. 災害的具體情況	□ 是 □ 否 □ 不適用	
d. 人員受困或傷亡的現況	□ 是 □ 否 □ 不適用	
4. 是否正確監控及評估各項災害應變設備啟動的情形（含防火鐵捲門、消防設備）。	□ 是 □ 否 □ 不適用	請仔細聽通報的內容，確定內容是否包括這項目：
5. 是否正確監控及評估災害情況（災害類型、災害位置、受困人數、應變指揮官聯絡方式、避難引導方向）	□ 是 □ 否 □ 不適用	請仔細聽通報的內容，確定是否包括這些項目：

For example

Evaluation form (for terrorists identifying)

1 可疑人物發現及追蹤成果報告

2 物品編號	3 發現時間	4 發現地點	5 發現之單位
001			
002			
003			
004			
005			
006			
007			
008			
009			

For example

Evaluation form (for overall management)

1 車站整體災害應變評核表

觀察地點：2　　日期：　　時間：

評核項目3	評核結果4	說明
1. 消防人員搶救作為：		請仔細觀察消防人員的應變流程及時間，各項工作完成時，要記錄時間。
a. 消防隊員進入的位置及時間	□是 □否 □不適用	
b. 是否利用室內消防栓部署水線。	□是 □否 □不適用	
c. 是否建立照明	□是 □否 □不適用	
d. 是否派遣人命搜救小組	□是 □否 □不適用	
e. 是否建立指揮架構	□是 □否 □不適用	
2. 前進指揮所的架設與功能發揮：		請記錄電子系統完成架設時間＿＿分＿＿秒，及完成架設時間＿＿分＿＿秒。
a. 前進指揮所架設位置是否合適	□是 □否 □不適用	
b. 前進指揮所的編組與設施是否合理完整。	□是 □否 □不適用	
c. 各場站派駐人員抵達報到時間，是否在 10 分鐘內完成。	□是 □否 □不適用	請紀錄人員通報資訊的內容與正確性。
d. 是否可與內部搶救人員聯絡，取得災害狀況與搶救資訊。	□是 □否 □不適用	
e. 各場站派駐人員是否可取得防災	□是 □否 □不適用	

Prepare message cards

範例：

Prepare the simulators

範例：

Prepare the simulators (injured with vital sign and wound description)

範例：

Prepare the simulators (suspicious boxes)

We show this photo to the security officers under test, had them to find out the bad guys in the station……

範例：

Prepare the simulators (suspicious bad guys)

範例：

Explain to the evaluation team leaders

範例：

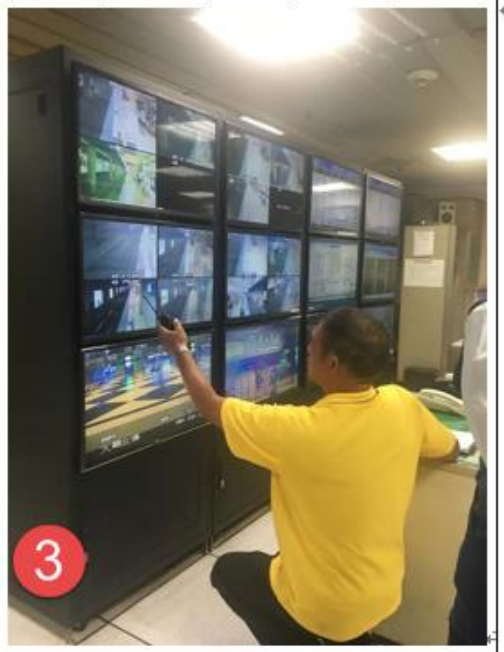
Explain to the evaluators in each area

Logistics for the evaluators and controllers

範例：

Start!

One of the evaluation form

22：58 1	副站以無線電回報，著白衣女子，牛仔褲有帶爆裂物，從 MRT 進入台鐵月台，民眾若有看到可疑人士請協助通報，同時副站(現場指揮官)以無線電指示，車站廣播 2		 3
22：59		副站以無線電回報，3 月台 11 車白衣女子，確認不是嫌疑犯。	
23：15	副站(現場指揮官)以無線電指示，車站廣播請自衛		

Topic 6
New challenges and potential Solutions for ER MCI

The society and healthcare change a lot, but the EOPs do not!

For ER in metro areas, something we learned in recent decades……

- A MCI occurs in the community, usually only a few patients show up in your ER.
- Sometimes large volume of patients showed up in your ER without 119 noticed.
- The MCI patients may not as severe as your in-patients or patients waiting in the ER.
- Only a small portion of MCI patients require admission. (10-15%)
- Some patients require surgical treatment, but not emergent/urgent surgery.
- Only a few MCI patients require transfer. (1-2%)
- During MCI, we need a lot of non-medical personnel, but usually call back medical personnel.

To minimize the disruption of ER operation, an escalating activation would be more realistic

- Awareness
- Alert
- Standby
- Partial activate
- ……
- Fully activate

The arrangement of treatment areas for the MCI patients

Should we have separate areas for green, yellow, and red patients?

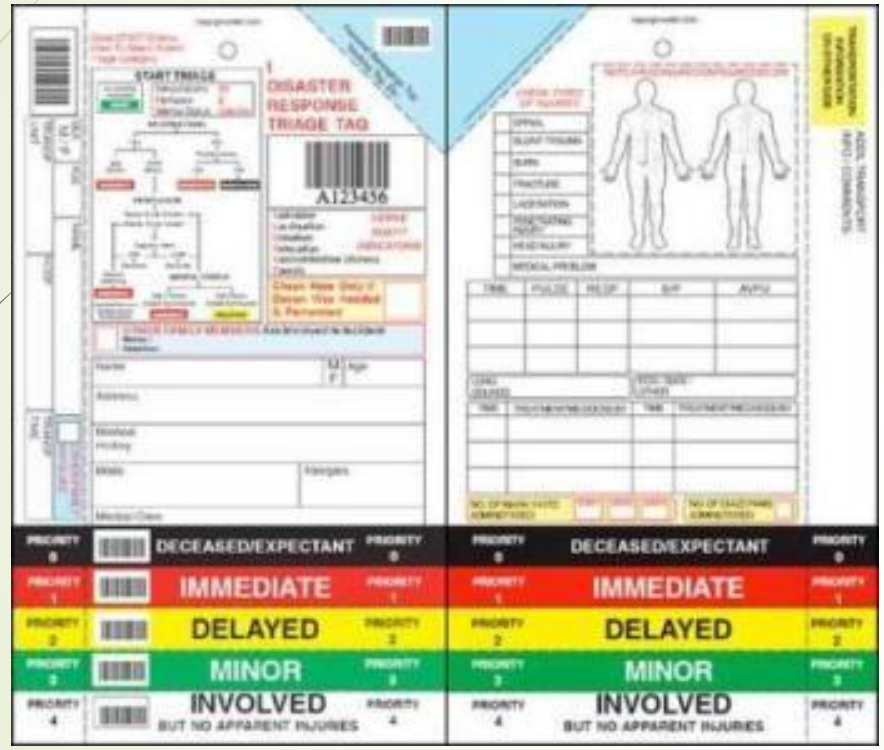
Too much space already occupied by the ER holding patients

We need a more delicate personnel call-back plan……

The cost is very high in new Labor Act, but the effect…….

Staging Area for staffs, cars, supplies

The role and procedure of triage need improvement!



Triage tags = priority + patients ID + records

Maybe IT technology can help a lot!

Patients safety issues, esp. identification

Patient identification errors are common in ER, also in MCI.

Hand writing medical records in paperless ER ?

- Now most of ER in Taiwan are paperless
- If we planned hand writing medical record in MCI, some problems would happened;
  - No image
  - No lab results
  - Difficult in communication between medical personnel
  - No prescription
  - Many IT-assisted patients safety mechanism disappeared.

20 years ago, it was very common in MCI!

Communication and liaison
Not only equipment, but also contact points

- What kind of message?
  - Field information
  - Special hazards
- Related respond dept.
  - Fire
  - Health
  - Social welfare
- Neighborhood hospitals

Do we need radios?
Do we need new social media?

The bottleneck for inter-hospital transfer……

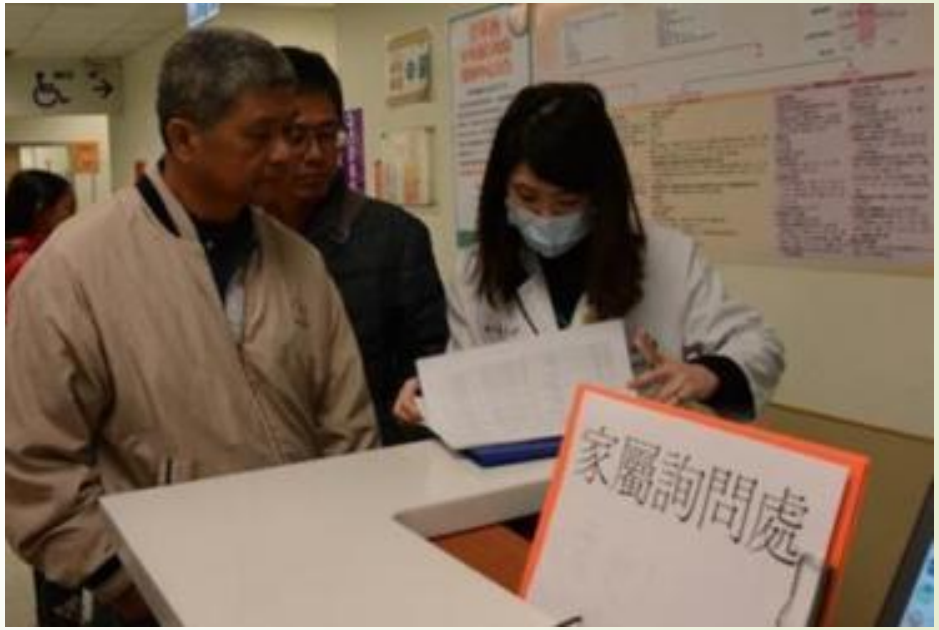
It is not an IT issue only, healthcare, insurance and patients will play the major role !

Taiwanese people do not choose a place that no one wait!

Patients information vs. privacy protection

The status board is for the planning sectors, not for the public!

We need a new model for patients information/family units operation



Should we release patients status/information to the media?

Every culture is different!

In Sunflower Student Movement, the police dept. wanted the hospitals to send the students names, could we do that ?

There are scientific theories behind emergency preparedness-

Emergency Management

Home, home on the range — Taiwanese