Application of ICT in Emergency Rescue Operations

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1 Background

- The 2004 Indonesian tsunami killed more than 1,600 people and caused $660 million in damage

- The 2008 Wenchuan earthquake killed 69,227 people and caused a economic loss of 845.14 billion yuan

- In 2015, a massive explosion in Tianjin's Binhai New Area killed 165 people and caused a direct economic loss of 6.866 billion yuan

- The derailment of a passenger train in India in 2023 resulted in a loss of at least 288 lives and left approximately 900 individuals injured.

- More than 350,000 people have been killed after 10 years of war in Syria

- The Russian-Ukrainian war has so far caused nearly half a million military casualties.

Mass casualty incidents(MCI) include natural disasters and man-made incident

1 Background

The frequency and intensity of disaster continue to rise：

China's average annual loss due to disasters is **373.2 billion yuan, 75,000 people died**. The annual death caused by disasters has ranked fourth among the world's population causes of death, and the death caused by disasters among young people under the age of 36 has accounted for the first

The disaster rescue site environment is complex：

Buildings collapsed, infrastructure was disrupted and secondary disasters continued. Nearly **80%** of those seriously injured died at the site

Requires：

1. **Quick access to disaster casualty information**
2. **Improve the level of accurate on-site treatment**
3. **Front and rear coordinated treatment**

Technology:

- **Casualty assessment** and **rapid deployment** of rescue resources technology
- Fast and accurate on-site **triage** technology

2 Triage Research Status

Fast and accurate on-site triage technology

Difficulties

Understaffing

Uneven abilities

Lack of materials

Limited transportation

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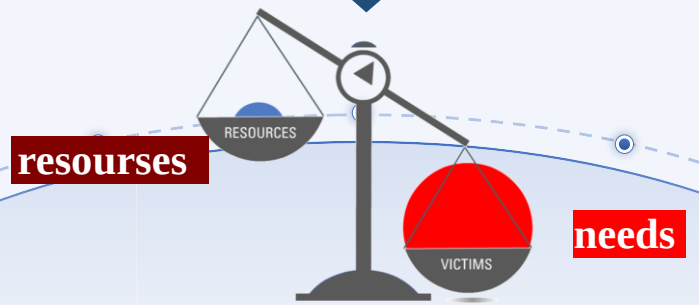
large number of casualties

Lack of equipment and personnel

Multiple types of injuries



Mass Casualty Incidents

Needs

"101"strategy

10 **Platinum** ten minutes

- About 67% of deaths occurred within 10 minutes of injury[1]

1 **Golden** hour

- 90% of deaths due to injuries occur within one hour before reaching a medical facility

[1]Tropeano AM,Pugh WM,Review of the Naval Health Research Cen- ter's development of medical information systems for far-forward ech- elons of care,1983 to 1997[J].Military Medicine,2001,166(7):656.
[2]Daban J,Falzone E,Boutonnet M,et al.Wounded in action:the plati- num ten minutes and the golden hour[J].Soins 2014,59(788):14.

2 Triage Research Status

Fast and accurate on-site triage technology

- MCI rescue strategy：Focus primarily on patients who need immediate treatment and are expected to have a significant effect

Triage

RED： First priority, critical injury

YELLOW： Second priority, serious injury

GREEN： Third priority, minor injuries

BLACK： Death, fatal injury

Efficient triage is the primary task of MIC rescue

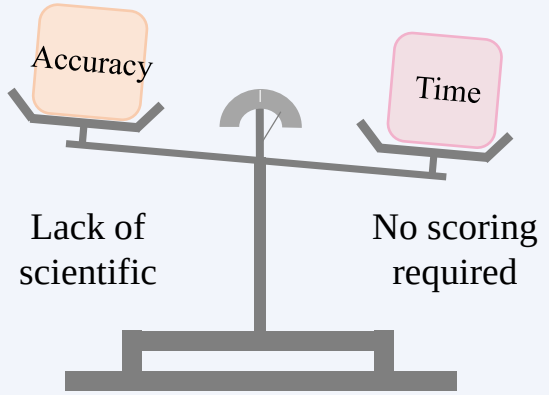
- The limited aid resources will be given priority to ensure the rescue of the seriously injured
- Avoid dying on the spot due to lack of timely treatment；
- Helps guide disaster relief decisions；
- Improve the overall treatment rate and cure rate。

Triage is the premise of timely treatment and the key link of MCI rescue

2 Triage Research Status

Fast and Accurate On-site Triage Technology

Qualitative Method



START method
SALT method
ABCD method
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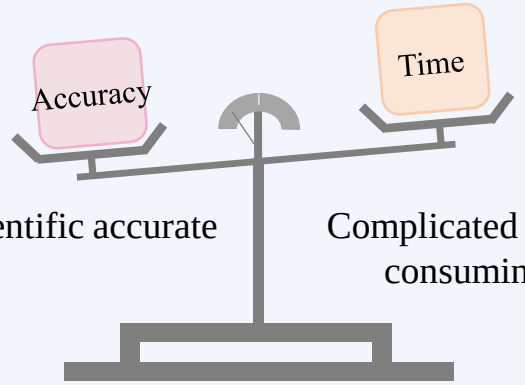
➢ Triage method at rescue site

Quantitative Method



APACHE-II (Acute Physiology and Chronic Health Evaluation-II) method
ISS (Injury Severity Score)
PHI （Prehospital Index) method
……

➢ Diagnosis method in hospital

2 Triage Research Status

【Qualitative method：START】

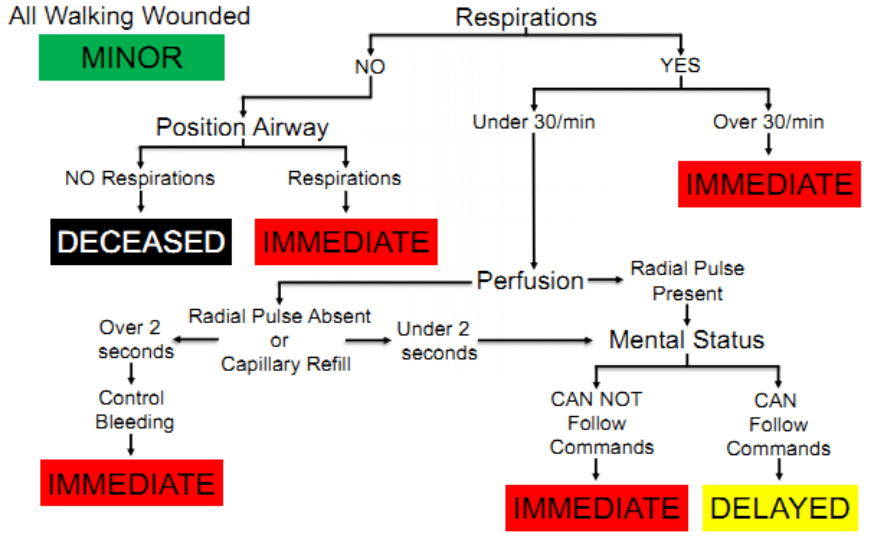
Simple Triage And Rapid Treatment (The most widely used method of injury rescure site triage method in the world)

fast

- Could be completed **within 5s-10s per patient。**

inaccurate

- The overall **accuracy** of START was **44.6%** and the **over-triage** rate was **53.4%**.



【Quantitative method：APACHEII socre method】 Acute Physiology And Chronic Health Evaluation (The most widely used method of diagnosis in hospitals)

accurate

- APACHE II is **positively correlated** with poor prognosis of acute and critical patients, and has significant diagnostic value

slow

- Blood pressure, sodium clearance, potassium and other indicators need to be obtained, so that the scoring process is **time-consuming.**

Physiologic Variable	High Abnormal Range					Low Abnormal Range			
	+4	+3	+2	+1	0	+1	+2	+3	+4
Rectal Temp (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
Mean Arterial Pressure (mmHg)	≥160	130-159	110-129		70-109		50-69		≤49
Heart Rate	≥100	140-179	110-139		70-109		50-69	40-54	≤39
Respiratory Rate	≥50	35-49		25-34	12-24	10-11	6-9		≤5
Oxygenation a) FIO_2≥0.5 record A-aDO_2 b) FIO_2<0.5 record PaO_2	≥500	350-499	200-349		<200 PO_2>70	PO_2 61-70		PO_2 55-60	PO_2<55
Arterial pH	≥7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
HCO_3 (mEq/l)	≥52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
K (mEq/l)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
Na (mEq/l)	≥100	160-179	155-159	150-154	130-149		120-129	111-119	≤110
S. Creat (mgm/dl)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit (%)	≥60		50-59.9	46-49.9	30-45.9		20-29.9		<20
TLC (10^3/cc)	≥40		20-39.9	15-19.9	3-14.9		1-2.9		<1
GCS									

3 Our Thinking

Fast and accurate on-site triage technology

Face video data

Videos

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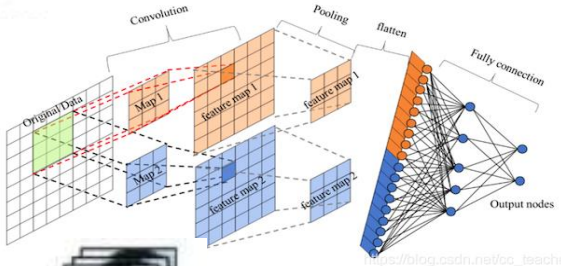
- Eye movement
- Mouth movement
- Head posture



Mental condition

Images

Computer vision

- blood loss
- age

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Voice data

audio

Speech recognition

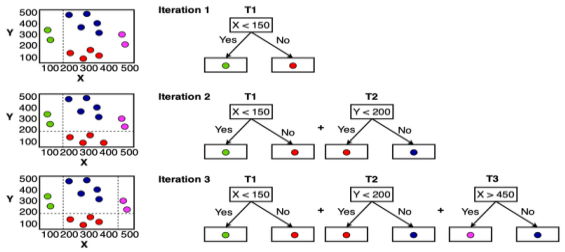
response of the wounded

mental condition

Acoustic parameter

Machine learning

Respiratory status



Physiological data

- ✓ Easy to collect
- ✓ Strong specificity

- heartbeat rate
- Blood pressure
- pulse rate
- Blood Sugar
- Blood lactic acid
- Blood oxygen

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3 Our Thinking

Fast and accurate on-site triage technology

New Triage Method

Videos

audio

Physiological

- ✓ mental conditoin
- ✓ age
- ✓ Organ function
- ✓ Blood condition

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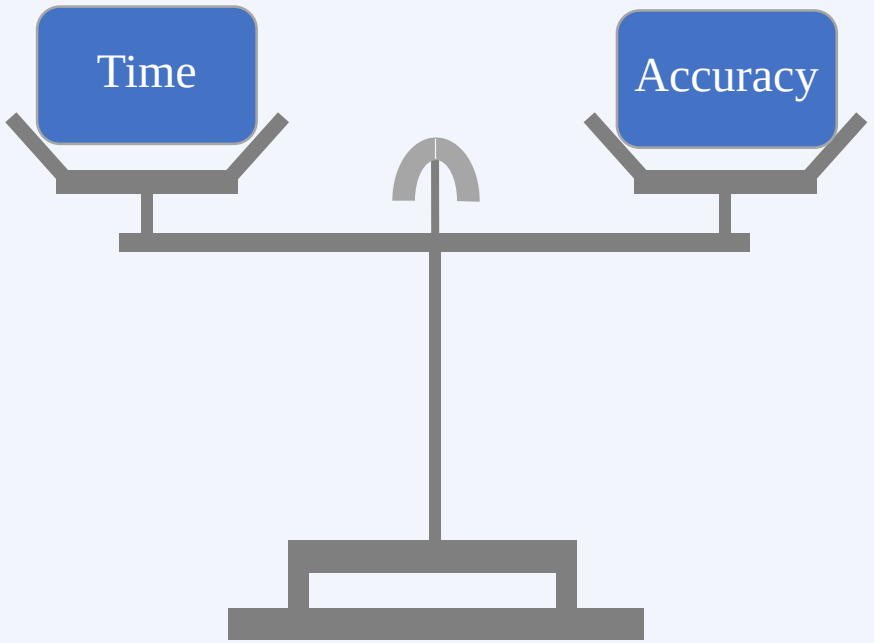
Socre evaluation

Level of injury

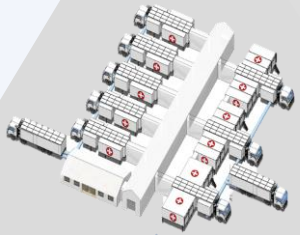
Machine learning



4 ICT in Emergency Rescue

Rapid, Accurate, and High-quality Emergency Medical Rescue

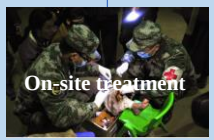
Mobile field hospitals



Casualty transport materials dispatch

3. An emergency medical rescue coordinated command system and mobile field hospitals.

On-site treatment



2. Disaster site diagnosis, treatment, and rescue techniques and equipment.

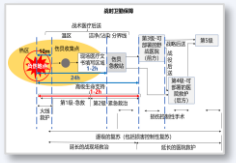
Scene Information Fusion

Casualty prediction

Rescue Resource Allocation

Rescue preparation

1. Rapid assessment of injuries and rapid allocation of rescue resources.

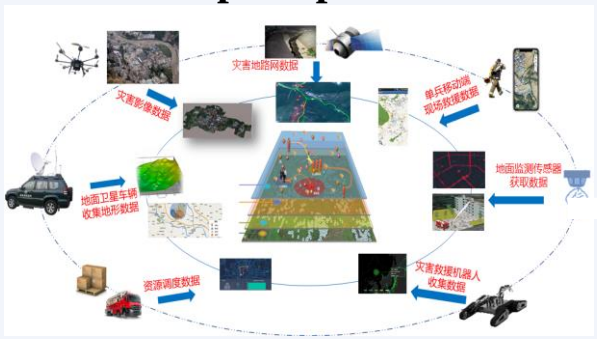


4 ICT in Emergency Rescue

Casualty assessment and rapid rescue resources deployment

Front → **Rear**

disaster on-site information perception



- Satellite map data
- Road network data and topographic data
- Sensor data and data collected by rescue workers
- Local resource reserve data

Emergency medical rescue data processing

- Analysis of medical rescue force around disaster
- Regional disaster vulnerability analysis

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Rescue data fusion and further planning

- Intelligent visualization of data
- Prediction of disaster intensity distribution
- Analysis of on-site rescue dispatching scheme

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4 ICT in Emergency Rescue

Emergency medical rescue coordination command system

Quick casualty assessment

Rapid resource deployment

- ✓ **casualty assessment error within 10%**
- ✓ **generating medical rescue plan within 30 minutes**
- ✓ **Minimize mortality and disability rate**

Traditional:
rely on expert experience

Intellegent:
predict based on data and model

Yushu earthquake

Medical rescue program

- Based on the casualty assessment results, appropriate rescue personnel (orthopedics, trauma surgery mainly) and materials and equipment (anti-high anti-drugs, anti-hypothermia medical treatment equipment) were dispatched to the scene at one time

Casualty rescue result

- ✓ Compared with the Wenchuan earthquake, the rescue response to the Yushu earthquake minimized the rate of death and disability, and created a record of zero deaths during transport

Please comment

Thank You