



Medical Assistance Services in Emergency Situation Including Coordination Constraints

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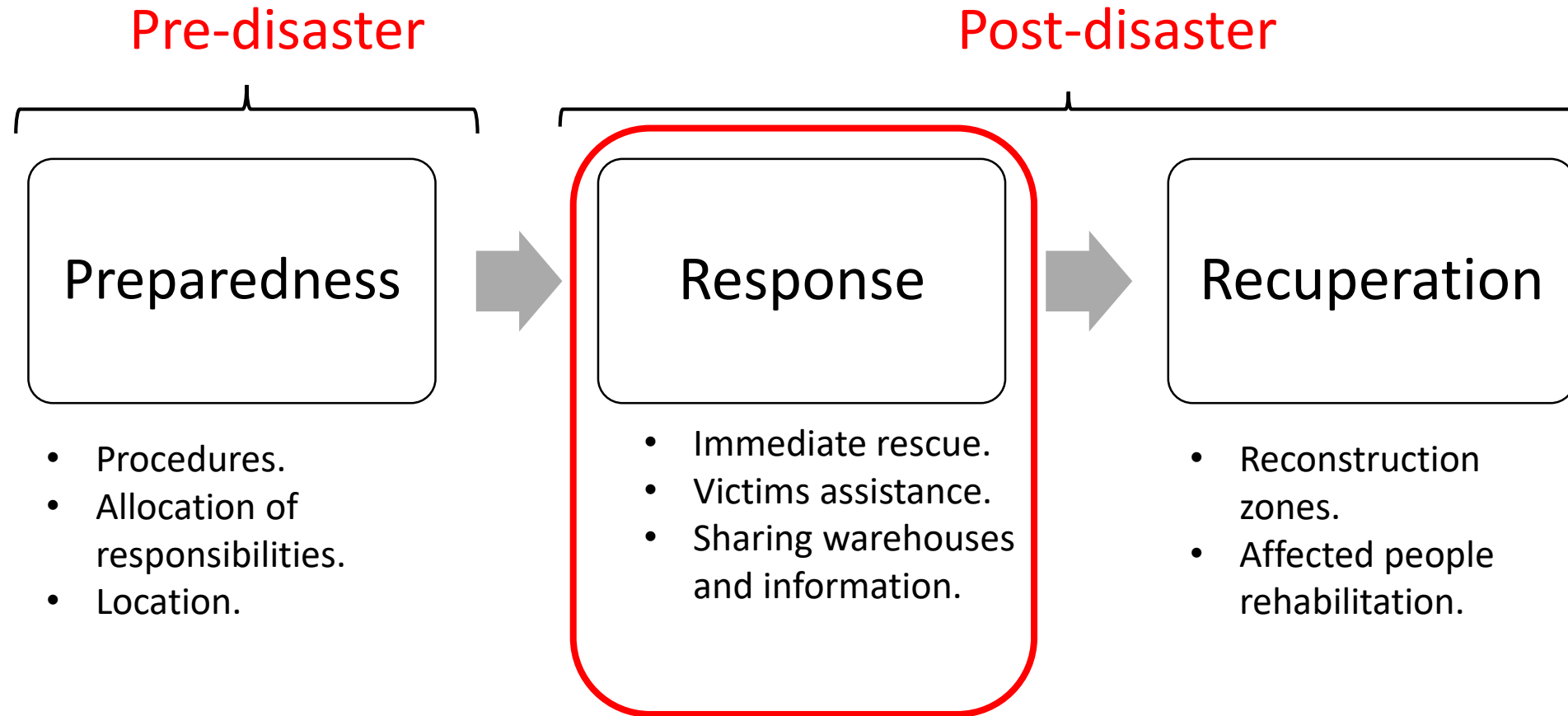
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Overview

- Introduction
- Horizontal collaboration importance contribution for humanitarian Logistics
- Problem description
- Model
- Conclusion

Humanitarian Logistics



Horizontal Collaboration

Horizontal Collaboration: refers to relationships among actors that belong to the same level in the supply chain, who are capable to supplant or complement their operations, in order to achieve a common goal.

- Maximizing deliveries in the most critical periods.
- Generating significant savings.
- Reducing assistance efforts.
- Good performance in coverage and connectedness.

Horizontal Collaboration Barriers

Some similarities with commercial logistics:

- Different missions, response capability and logistic experience.
- Barriers related to communication and alignment.
- Coordination required among stakeholders, resources, leadership, decision-making.

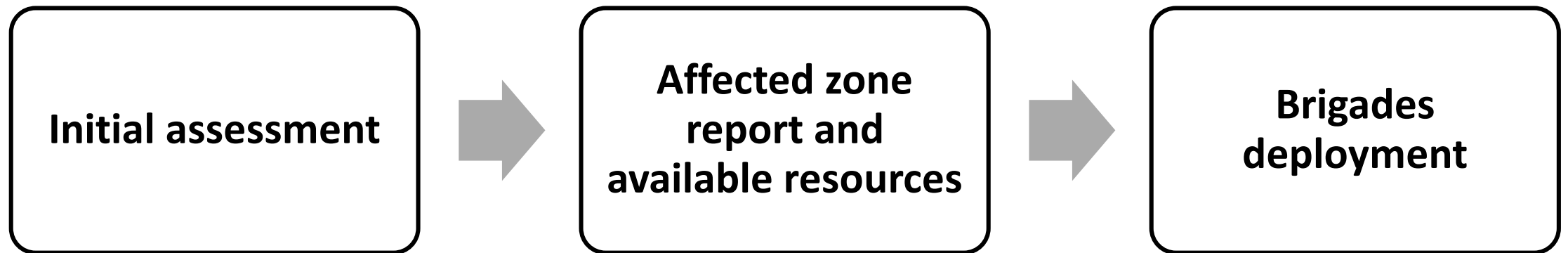
Other barriers:

- Culture.
- Language.
- Organizations legitimacy.

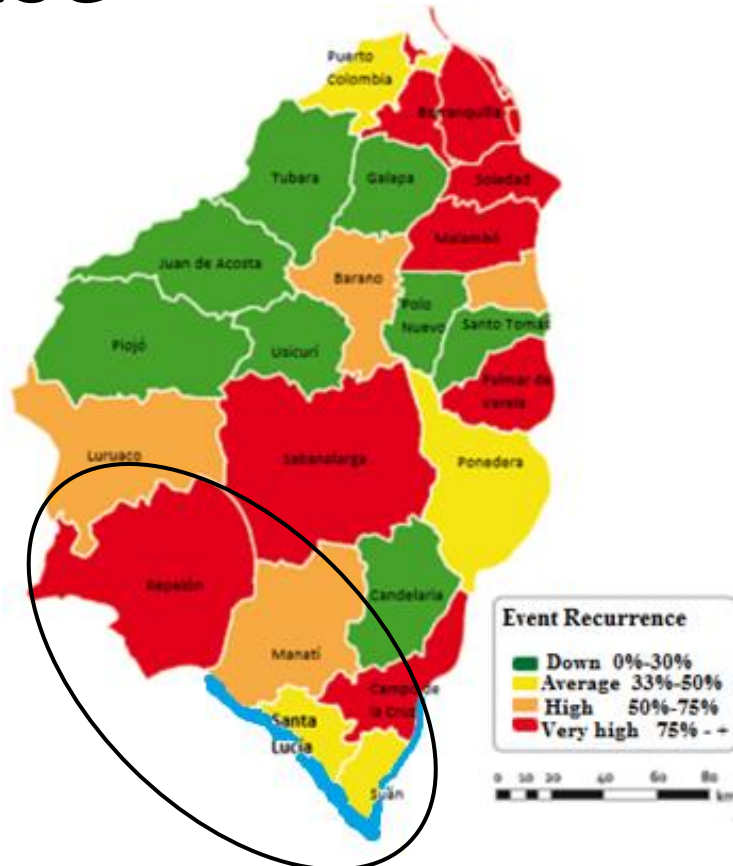
Problem Description

- High instability in the affected area.
- Lack of collaboration among humanitarian aid organizations.
- Spread of the health problems.
- Loss of human lives.

Process Response



Study Case



Canal del Dique



Study Case

Affected Regions	Total Area (hectares)	Affected Area (hectares)	Affected Families	State
Campo de la cruz	1200	1200	106	Total flooding
Manatí	22000	22000	1861	Total flooding
Repelón	3400	2200	393	Partial flooding
Santa Lucía	1350	1350	302	Total flooding
Total	27950	26750	2662	

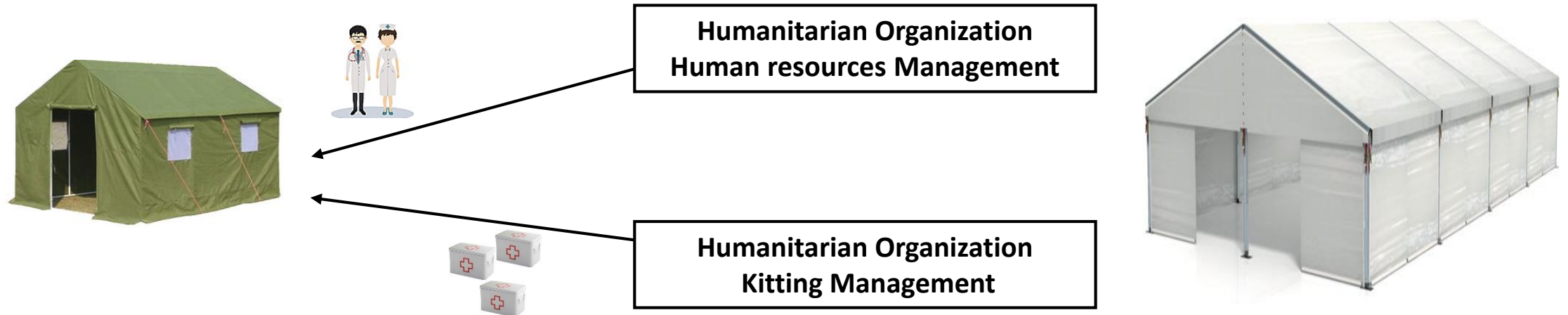
Calamities	Health problem	Incidence rate
Psychological disorder	Sleep disorder	27.1%
	Anxiety	21.3%
	Post-traumatic stress	39.5%
Fractures		11.7%
Crushing of limbs		11.7%
Minor injuries (blows, scratches, small cut)	Bumps, scrapes, minor cuts	90%
Acute diarrheal diseases	Vomit	4.3%
	Diarrhea	4.3%
	Cholera	2.0%
Respiratory infections	Cough	7.6%
	Rhinorrhea	9.9%
	Exanthema	3.5%
	Sore throat	3.5%
Vector-borne diseases	Malaria, dengue, others	30.0%



Information		Total	
Brigades	Doctors	5	19
	Nurses	5	
	Humanitarian aid kits	9	
Shelters	Sabanalarga	10	39
	Ponedera	18	
	Repelón	8	
	Candelaria	3	
Depot		1	

General Considerations

- Coordination among caregivers.
- Health cares victims' necessity.
- Single depot.
- 40 nodes and 19 brigades



Formulation

Sets

i	<i>Set of nodes (shelters and depot).</i>
j	<i>Copy of the set i.</i>
l	<i>Set of mobile units.</i>
m	<i>Set of calamities.</i>

Parameters

$TV_{i,j}$	<i>Travel time between i and j.</i>
$D_{j,m}$	<i>Number of families suffering from calamity type m in the shelter j.</i>
$TA_{l,m}$	<i>Attention time for the mobile unit l to meet the calamity type m.</i>
$Alivio_{l,m}$	<i>Relief percentage of mobile unit l when it meets the calamity m.</i>

Variables

$$X_i^{j,l} \begin{cases} 1, & \text{If the mobile unit } l \text{ goes from shelter or distribution point } i \text{ to shelter or} \\ & \text{depot } j \\ 0, & \text{Otherwise} \end{cases}$$

$Y_{i,l}$ = Service starting time provided by the unit l at shelter i

Objective Function:

$$\text{MAX } Z = \sum_{\forall i} \sum_{\forall j} \sum_{\forall l} \sum_{\forall m} X_i^{j,l} A_{l,m} D_{j,m} \quad (1)$$

Constraints:

$$\sum_{\forall j \in J} X_0^{j,l} \leq 1,$$

$$\forall l \in L$$

$$\sum_{\forall i \in J} X_i^{0,l} \leq 1,$$

$$\forall l \in L, j$$

Start/end of the route

$$\sum_{\forall j} X_i^{j,l} = \sum_{\forall j} X_j^{i,l}$$

$$\forall i \setminus \{0\}; \forall l$$

Routes continuity

$$\sum_{\forall j \in J} X_i^{j,l} \leq 1,$$

$$\forall l \in L, i \in I$$

$$\sum_{\forall i \in J} X_i^{j,l} \leq 1,$$

$$\forall l \in L, j \in I$$

One origin and destination

$$\sum_{\forall i \in J} X_i^{j,l} \leq 1,$$

$$\forall l \in P, j \in I$$

Avoiding multiple deliveries

Constraints:

$$\sum_{\forall j \in I} \sum_{\forall l \in D} X_i^{j,l} + \sum_{\forall j \in I} \sum_{\forall l \in N} X_i^{j,l} = \sum_{\forall j \in I} \sum_{\forall l \in K} X_i^{j,l} \quad \forall i \in I \setminus \{0\} \quad \text{Brigades Coordination}$$

$$Y_{i,l} - Y_{i,f} \leq GAP \quad \forall i \in I \setminus \{0\}; \forall l \in D \cup N; \forall f \in K; \forall j$$

Time Coordination

$$Y_{i,l} - Y_{i,f} \geq -GAP \quad \forall i \in I \setminus \{0\}; \forall l \in D \cup N; \forall f \in K; \forall j$$

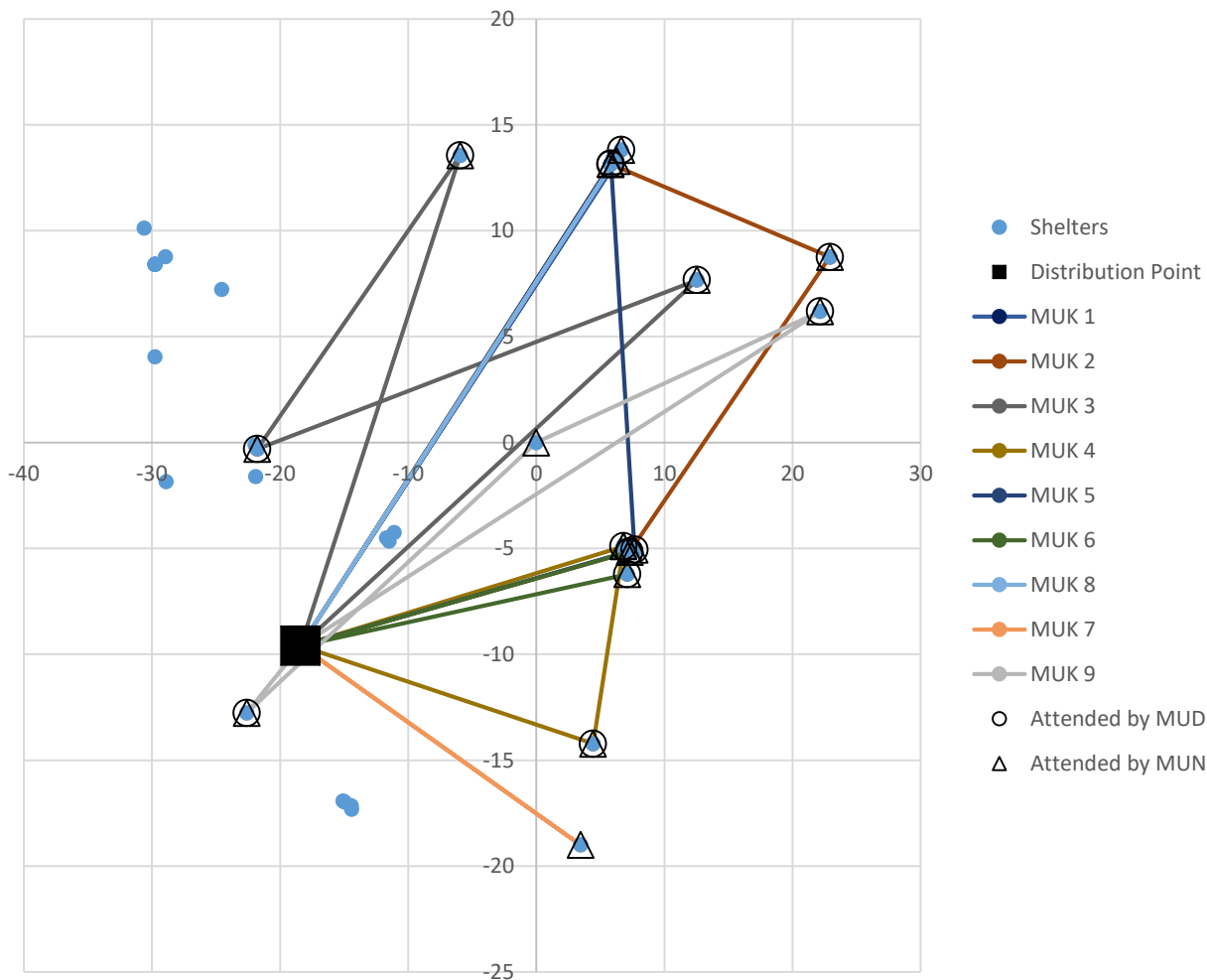
$$Y_{i,l} + TV_{i,j} + \sum_{\forall m} TA_{l,m} \leq Y_{j,l} + F(1 - X_j^{i,l}) \quad \forall i \in I \setminus \{0\}, \forall l, \forall j \quad \text{Sequence}$$

$$X_i^{j,l} \in \{0,1\}, \quad \forall j \in J, i \in I, l \in L$$

$$Y_{i,l} \geq 0, \quad \forall i; \forall l$$

Characterization

Results



Indicators (Period less than 72 hours)	
Operation Time (hours)	72
Coverage	51%
Attended shelters	20
Relief percentage	99%

Indicators (Without any time limit)	
Operation Time (days)	7
Coverage	100%
Attended shelters	40
Relief percentage	100%

Results

Indicators	Collaboration + Maximizing relief	Minimizing Distance
Operation Time	7 days	12 days
Coverage	100%	100%
Relief percentage	100%	60%
Shelters	40	40

Conclusions

- The structured tools can be reduced the response time up to 80%, because in average the disaster management can take from 1 day to 2 months.
- There are many studies in humanitarian logistics based on traditional economic interests neglecting the humanitarian factors.
- Traditional objectives of commercial logistics do not respond to humanitarian needs.
- Maximizing relief in a period less than 72 h generates significant savings in terms of loss of human lives.

Horizontal Collaboration

- Horizontal collaboration improves the connectedness and coverage when organizations work in cooperation.
- Horizontal collaboration is a strategy that contributes not only to affected people safety, but also the volunteers and employees safety who assist the affected zone.
- Horizontal collaboration generates knowledge transfer among organizations, which improves operation response.
- The culture problems can be solved by cooperation among local and international humanitarian organization.
- Horizontal collaboration avoids duplicating efforts by multiple deliveries to a small portion of affected people.

Future Research

- To consider disasters related to:
 - Toxic or radioactive materials.
 - Man-made disasters and conflict situations.
- To analyze city logistics emergency situations considering different risk factors.
- To develop an efficient solution method, generating a coordinated work to reduce the people suffering and the efforts of humanitarian aid organizations.

Thanks