Planned Actors Matter in an Emergency Response Network?

2015 MERS-CoV Response in South Korea

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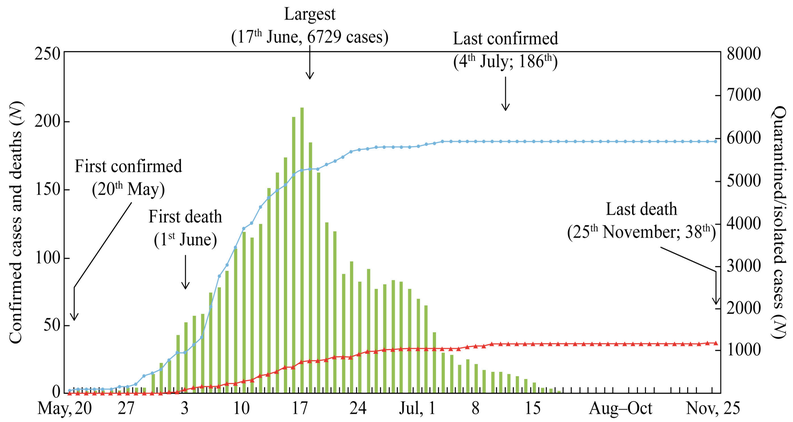
Background

- Middle East Respiratory Syndrome Coronavirus (MERS-CoV) is a global pandemic threat that first attacked Saudi Arabia in September 2012.
- South Korea remains the country with the second largest number of confirmed MERS-CoV cases after Saudi Arabia (WHO, n.d.).



Source: Kim, Tandi, Choi, Moon, & Kim (2017)

- The country's health authorities made great efforts to prepare and respond to MERS outbreak.

(a) On June 15, MERS death toll rises to 16 in South Korea as total cases hits 150 (***source***: www.independent.co.uk).

(b) On June 17, 2015, Seoul Mayor Park Won-soon checks the temperature of a pupil at an elementary school in Seoul, South Korea (***source***: www.prokerala.com).

- The widespread outbreak and the high mortality in the country are attributed to the inadequate response and policy failures rather than biological factors.
- To understand the way the Korean government's efforts ended with unwanted outcomes, we ask how the planned efforts to coordinate key stakeholder organizations change during the actual response.

Research Questions

1. What are the characteristics of the MERS response network?
2. What is the effect of planned actors on the structure of the response network?
3. Will planned actors predict tie formation in the response network?

Data and Methods

Data

- Data Sources:
  - News article between May 20, 2015 and December 31, 2015
  - 2015 MERS Whitepaper by the Korean Government (2016)
- Network Data:
  - Actors: Group of organizations (e.g., hospitals, local polices, local fires)
  - Edges: Response operations (e.g., reporting, patient management, epidemic investigation, lab testing, and other supporting activities)
- Dataset
  - 38 actors (16 planned actors + 22 unplanned actors)
  - 4716 edges among the 38 actors

Network Statistics

- Information flow efficiency (Latora and Marchiori, 2001)

$$E_{global}(G) = \frac{1}{N(N-1)} \sum_{i \neq j \in G} \frac{1}{d_{ij}}$$

- Hierarchy (Krackhardt, 1994)

$$H = 1 - \left[\frac{V}{Max\ V}\right]$$

Exponential Random Graph Models (ERGM)

$$Pr(X = x|\theta) \equiv \frac{1}{k(\theta)} exp\{\theta_1 z_1(x) + \theta_2 z_2(x) + \cdots + \theta_l z_l(x)\}$$

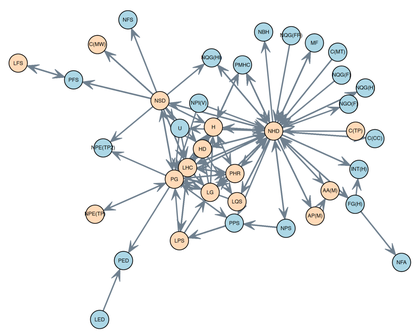
$Pr(X = x|\theta)$ is the probability distribution of the network given all of the smaller configurations described in the equation; $\frac{1}{k(\theta)}$ is the normalizing constant that ensures the sum of the probability remains within 0 to 1; θ_l is the coefficient of the network statistics of interest, and $z_k(x)$is the counts of configurations that include statistics k.

Results

Finding 1.

The MERS response network was not dense, but efficiently structured and less hierarchical at this actor level.

- The actor who consists of central government health authorities (NHD) was at the center of the response network.
- A significant number of unplanned actors directly interacted with NHD.



Density	3.35
Transitivity	0.29
Efficiency	0.95
Hierarchy	0.06

Note:
yellow nodes – planned actors,
blue nodes – unplanned actors

Finding 2.

NHD was the most influential planned actor in the MERS response network.

- NHD decreases information flow efficiency, but increases hierarchy in all epidemic stages.

Stages	Impact	Efficiency	Hierarchy
Early	Positive	LHC (0.01) PG (0.01)	**NHD (0.02)**
	Negative	**NHD (-0.02)** NSD (-0.01)	
Peak	Positive	H(0.01) PG (0.01)	LFS (0.01) **NHD (0.03)**
	Negative	LHC (0.01) **NHD (-0.08)**	
Waning	Positive	All	
	Negative		All

Finding 3.

Planned actors were more likely to build a tie with other actors in the response network.

- Full model did a better job in capturing the data characteristics compared to the null model.
- Governmental actors were more likely to built a tie with other actors than non-governmental actors.
- Health actors were more likely to built a tie with other actors than non-health actors.
- Provincial actors were more likely to build a tie with other actors than local actors.

	Null model	Full Model
Estimates	-2.55	-8.10
(SE)	(0.10) ***	(0.69)
Plan		1.78
		(0.23) ***
Govt.		1.29
		(0.22) ***
Health		1.30
		(0.20) ***
Scope		
Provincial		0.70
		(0.25) **
National		0.29
		(0.21)
Foreign		-0.15
		(0.49)
AIC	733.6	548.3
Logit	0.07	0.05

*** p<0.01 ** p<0.05 * p<0.1

Conclusion

- Planned actors play a significant role in the response network by two ways:
  1. The central health authority actor influenced information flow efficiency as well as hierarchical structure of the network.
  2. Planned actors predict tie formation in the response network.
- This study contributes to the emergency response literature by empirically analyzing the role of planned actors in the actual response network.

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