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Research Article

Adaptive Capacity of Health Care System to Tsunami Disaster Impact Reduction in Sundanese Strait, Indonesia

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Abstract

The Tsunami disaster in 2018 was the first and the biggest disaster in Banten Province, but preparedness in the response to the health crisis was still lacking, even though in an emergency response situation the disaster management carried out was quite good. The method of research for the study was based on data reports that include quantitative and qualitative methods. Analyzing health facilities and the impacts that occurred in the field during the tsunami period is the basis for this article followed by discussion of describing problems that can be anticipated in the future.

Keywords

Adaptive capacity, health care system, Tsunami, Impact reduction, Sundanese Strat

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Introduction

Almost every year, based on observations by the Center for Volcanology and Geological Disaster Mitigation, there are volcanoes that blow volcanic material with different types of eruptions. Likewise, with the threat it creates between one mountain and another mountain. This is very much influenced by the type of eruption and the level of population density living near the location of the volcano. After several decades since the eruption of Mount Krakatau which disappeared from the geological map of Indonesia, in 1927 a new active mountain emerged between Panjang Island, Sertung Island and Rakata Island (the volcanic complex of Mount Krakatau) which later was named Mount Anak Krakatau. Its location is between Banten Province at the end of Java Island and Lampung Province at the eastern of Sumatra Island. The appearance of Mount Anak Krakatau, which has a height of 338 m, has shown its activity in recent years, with incandescent lava bursts, and the peak of this activity occurred on December 21, 2018. This activity has the potential to pose a very large risk to the two provinces.

Tsunami risk is characterized by three elements: danger, vulnerability and capacity (EM-DAT, 2020; UNISDR, 2009). Vulnerability analysis was determined by two variables: social and physical. Physical vulnerability has a strong impact on both monetary and social losses through the measurement of physical damage resulting from a given ground motion intensity level (FEMA, 2008). Measures that could be used to reduce the consequences of a tsunami are divided into two groups: structural and non-structural. Various strategies can increase the extent of tsunami awareness. These strategies include government policy, infrastructure, education and training, and awareness campaigns (Esteban et al., 2013). According to Courtney et al. (2007) the eight fundamental approaches towards coastal community resilience to tsunamis to reduce risk and adapt to change are governance, society and economy, coastal resources management, land use and structural design, risk knowledge, warning and evacuation, emergency response, and disaster recovery.

By analyzing previous disaster, lesson learnt could be used for future emergencies to facilitate response. Nic Lochlainn et al. (2018) Disasters almost always have significant impacts on the public health and well-being of affected populations. One of the reasons for reducing disaster casualties are health facilities, as they are vital assets for communities in daily basis and when disaster strikes. Dogra, Kakde, and Taneja (2019) suggesting that older people in good health may contribute positively to building community resiliency for crisis (Cohen et al., 2016). Natural disaster is causing not only physical but also mental health and psychosocial problems (Kujawa et al., 2016; Lee et al., 2018). Possible implications and chances for the optimization of psychosocial services are discussed (Dückers, Witteveen, Bisson, & Olff, 2017). Tsunamis caused heavy damage to human lives, environment, infrastructures, economies and health care systems. The Indian Ocean tsunami provides a valuable case study of disaster management issues in the new millennium. With a death toll of 227 thousand and 1.8 million displaced people spread over a dozen countries, it is by far the worst natural disaster of its kind in recorded human history (Athukorala & Resosudarmo, 2005). In Indonesia, the most severely hit of the countries, the Tsunami destroyed 30 health clinics out of 240, seriously damaged 77, and caused minor damage to an additional 40 (PACIFIC DISASTER MANAGEMENT INFORMATION NETWORK PDMIN, 2005).

To assess the human health risks associated with disasters, impact and vulnerability assessments must address adaptation. Adaptive capacity is the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences of hazards (IPCC, 2014). In fact, the IPCC identified rebuilding public health infrastructure as "the most important, cost-effective and urgently needed" adaptation strategy. A resilient healthcare defines as a new approach based on understanding and increasing adaptive capacity that may inform quality improvement efforts, but there is a need to develop a knowledge base of how it can be used and its effectiveness (Anderson, Ross, Macrae, & Wiig, 2020). This paper is intended to present the resilience at the health care systems and tsunami disaster impact in Sundanese strait.

Research Method

For the development of the research, the type of descriptive, qualitative and quantitative study has been used, as such is based on an analysis of the community capacities and vulnerabilities. The data information was collected through Ministry of Health Report. It focuses on qualitative aspects related to how the health crisis task force's work system in tsunami management works.

Quantitative data is used to determine the level of strength and interest in responding to management of emergencies tsunami disaster. This study was carried out in Sundanese Strait In Banten and Lampung Provinces where the volcanoes have been active recently and the largest numbers of people in those two areas are vulnerable to tsunami events. This research analyses data regarding past impacts and projections for tsunami disaster risk. Systematic review from public reports and peer-reviewed journal articles, which were relevant to the research aims were used to identify the capacities and challenges of Tsunami healthcare management. It is mainly based on secondary data sources which are reported in the Ministry of Health Special Report 2019. The review of the data from the book report on the 2018 health crisis was used to strengthen the evidence of the analysis. For the purpose of this study, we used several data analysis such as peer-reviewed articles on morbidity, mortality, risk factors and levels of exposure with the data from health care systems following tsunami.

Results and Discussion

On Friday, December 21, 2018, the Geological Agency of the Ministry of Energy and Mineral Resources (ESDM) and the Center for Volcanology and Geological Disaster Mitigation (PVMBG) detected eruptive activity of Mount Anak Krakatau Lampung. The National Disaster Management Agency (BNPB) had provided an early warning of high waves which was valid from December 22, 2018 at 07.00 Western Indonesia Time (WIB) to December 25 2018 at 07.00 WIB in the water territory of Sunda Strait with a height of 1.5 - 2.5 meters. Then on Saturday, December 22, 2018, at 20.56 WIB, Mount Anak Krakatau erupted which triggered a landslide on the slopes of Mount Anak Krakatau covering an area of 64 hectares. Viewed from the results of the BIG marigram tide gauge records, it is believed that this is a tsunami wave. Furthermore, at 22.30 WIB, BMKG immediately issued a press release that a tsunami had hit Banten and Lampung which was not triggered by a tectonic earthquake. On Sunday, December 23 2018? at 14:40 WIB BMKG confirmed that the center of vibration was on Mount Anak Krakatau, 115.46 East Longitude - 6.10 South Latitude, 1 km depth, equivalent to a magnitude of 3,4.

Analysis of population affected

Based on the 2016 SUSENAS(Survei Sosial Ekonomi Nasional), the national poverty rate in September 2016 was measured at 10.70% in the Sunda Strait. In September 2018 (Central Bureau of Statistics, 2021), estimated the national poverty rate at 9.66%. The population lives below a specified poverty line (USD 1.90 per day per capita). The vulnerability line is equal to 1.5 times the national poverty line. Healthcares are influenced by the education and income levels, precisely affected the capacity of community to access on healthcare. The relation between education and health care is that poor education is associated with poor health care due to income. Berkman, Sheridan, Donahue, Halpern, and Crotty (2011) stated that individuals with low health literacy had poorer health-related knowledge and comprehension, ability to demonstrate taking medications properly, and ability to interpret medication labels and health messages. They also had increased hospitalizations and emergency care, decreased preventive care and among the elderly. Education is therefore considered an important social determinant of health in Banten and Lampung Provinces. The gender profile and density of the population affected in facing tsunami disaster are respectively presented in Tables 1 and 2 below.

Analysis of vulnerabilities

The frequency of the tsunami hazard occurrences and the number of vulnerable persons is related. The more often a hazard occurs generally the more prepared people are, and the more used to coping they are. Since tsunamis are relatively infrequent, it is more difficult to sustain awareness and preparation. However, past experience can increase the preparedness to a tsunami since it influences people to gather more information about the severity of the hazards. Preparation can help rapid recovery and also reduce the negative impact on the safety of the communities. For example, coastal communities frequently experience or continuously exposed tsunamis perceive their risks to be high and tend to have a depth understanding of risks they encored. They are better prepared for the tsunami threat compared to those who live in safe area.

Table 1:
Total population and its density in the districts/cities affected by the Sunda Strait tsunami

No	Districts/Cities	Total population			
		Total men	Total women	Total populations	Population density Hab/km²
Banten Province					
1	Serang District	757,089	1,493,591	2,250,680	861
2	Pandeglang District	615,297	1,205,203	1,820,500	439
Average Population Density of Banten Province (Hab/ km²)					1288
Lampung Province					
3	South Lampung District	504,498	478,387	982,885	490
4	Tanggamus District	302,474	277,909	580,383	192
5	Pesawaran District	219,587	219 587	439,174	191
Average Population Density of Lampung Province (Hab/ km²)					234

Source: BPS Lampung and Banten Provinces 2017

Table 2:
Total of vulnerable populations in districts/cities affected by the Sunda Strait Tsunami in Banten and Lampung provinces

No	Districts/Cities	Vulnerable groups				
		Baby	Toddler	Pregnant women	Elderly	Proportion of vulnerable Groups
Banten Province						
1	Serang District	26,926	147,942	29,618	284,890	21.74%
2	Pandeglang District	23,266	51,012	25,028	81,349	9.92%
Lampung Province						
3	South Lampung District	10,875	45,370	12,394	22,467	9.27%
4	Tanggamus District	19,038	79,167	21,640	69,252	32.58%
5	Pesawaran District	7,816	33,320	9,065	29,640	18.18%

Source: Profiles of Lampung and Banten Provinces in 2015

It isnot possible to predict exactly when a tsunami may strike a coastal area, but there are clues that can save lives. For the case of tsunami risk in Indonesia, the government has chosen to rather establish an early warning system as a priority then promoting long-term exposure reduction. This is due to low tsunami occurrence probability at a specific coastal area and roughly high exposure levels, where long-term exposure reduction. The disaster risk assessment portal of the National Disaster Management Agency (UNDRR, 2019) reported that all affected districts/cities are considered at high-risk areas, except for Tanggamus district which is at moderate risk. Based on health profile data, population density in the 3 affected districts, namely Serang, Pandeglang and South Lampung, are classified as very dense.

Serang and Tanggamus districts have a high proportion of vulnerable groups. All affected districts have not met the minimum standard for availability of health facilities. Those affected districts have met the minimum requirement for the number of Community health center except Serang district and for the needs of hospitals, South Lampung and Pesawaran districts have met the minimum standards while the 3 affected districts / cities in Banten Province have not met the minimum standard. The number of health workers (specialist doctors, general practitioners, nurses and midwives) in all districts / cities has not met the minimum requirement for public health services. Two districts have an upper middle Human Development Index (IPM), namely Serang and South Lampung, while the other 3 affected districts have a lower middle IPM.

Social and Physical vulnerability to tsunami

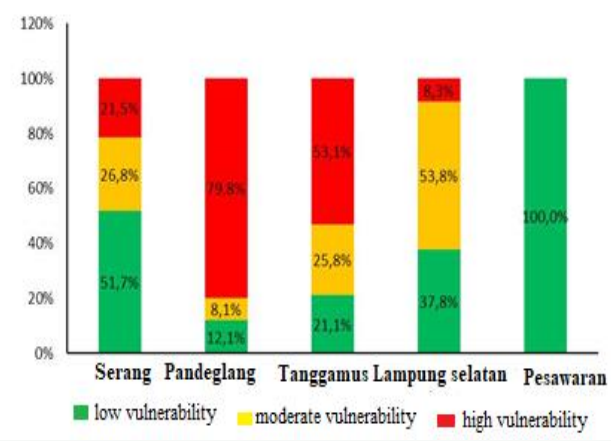

Figure1: Social vulnerability to tsunami

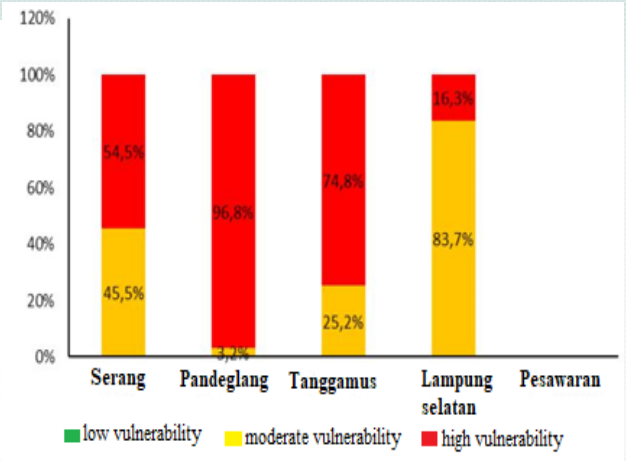

Figure 2: Physical vulnerability to tsunami

Physical vulnerability describes the ability of the built environment, including homes, roads, bridges, hospitals, schools, and government buildings, to withstand impacts. Generally, physical vulnerability is represented as the monetary value of physical assets in the hazardous zone (Henao-Sierra, Romero-Sáez, Gracia, Cacua, & Buitrago-Sierra, 2018). Social vulnerability as the limitation of a community to the impact of natural disasters that influence its ability or resilience in the effort to recover from the impacts (Cutter & Emrich, 2006). Social vulnerability is often closely linked to physical vulnerability. For example, if a component of social vulnerability is access to health care, one must consider the physical location of hospitals and health care providers, as well as the state of that infrastructure and quality of service. Damage to physical infrastructure will inevitably affect social functions (Romero Lankao & Qin, 2011). One widely known measure in quantifying the social aspects of vulnerability is social vulnerability index (SoVI) approach developed by Cutter, Boruff, and Shirley (2003). It can be used to identify location of socially vulnerable groups (Fekete, 2009). While for quantifying physical loss, such as the structural damage, the physical vulnerability of the elements at risk can be achieved by assessing the damage degree.

Figure 1 shows that the most vulnerable population to tsunamis is in Pandeglang district (high vulnerability: 79.8%), followed by Tanggamus district (high vulnerability: 51.1%), and South Lampung district (moderate vulnerability: 53.8%), while for Pesawaran district, the level of the population vulnerability to tsunami is low. Besides, Figure 2 shows that most of the buildings in Pandeglang and Tanggamus districts have a high physical vulnerability. Most of the buildings in South Lampung district have a moderate level of vulnerability, while Pesawaran district has no physical vulnerability to tsunami.

Analysis of health facilities

Analyzing the availability of health services is not only vital for understanding the capacities and weaknesses of disrupted health systems during disaster but also to prepare for future natural disasters. Table 3 and Table 4 show the health situation and number of healthcare personnel affected by the Sunda Strait Tsunami.

The minimum standard is the smallest or lowest measure of the necessities of life (clean water and sanitation, food supply, nutrition, shelter and health services) that must be fulfilled to disaster victims or refugees in order to live a healthy, decent and humane life (Law of The Republic of Indonesia Number 1357 Of 2001). Public health services for disaster victims are based on initial situation assessments and continuous health information data, with the function of preventing the increase or decrease in the death rate and the fall of victims due to disease through health services that are in accordance with the needs. The minimum standard for health facilities must be one (01) Health Center for 20,000 people and same as one (01) hospital for 20,000 people. All affected districts or cities have not met the minimum standard for the availability of health facilities. For the number of Community health center health, all affected districts have met the minimum requirement except for Serang district. For the needs of South Lampung and Pesawaran district hospitals, they have met the minimum standards while the 3 affected districts in Banten Province have not met the minimum standard. The number of health workers (specialist doctors, general practitioners, nurses and midwives) in all districts / cities has not met the minimum

requirement for public health services.

Table 3:
Total of health service facilities in districts / cities affected by the Sunda Strait Tsunami in Banten and Lampung Provinces
Other health facilities include research/educational hospitals, clinics, outpatient care centers and specialized care centers, such as birthing centers and psychiatric care centers.

No.	Districts/Cities	Community health center	Government hospital	Private hospital	Other health facilities	Total
Banten Province						
1	Serang District	31	1	1	17	50
2	Pandeglang District	36	1	1	20	58
Lampung Province						
1	Tanggamus District	23	1	1	1	26
2	South Lampung District	26	1	1	0	28
3	Pesawaran District	12	1	1	0	14

Source: Profiles of Lampung and Banten Provinces in 2015

Table 4:
Total of health workers in 5 districts / cities affected by the Sunda Strait Tsunami

No	District/Cities	Specialist Dr	General practitionner	Drg	Drg Specialist	Midwife	Nurse	Dentist	Pharmacy	Apt	Public health	Kesling	Nutritionist
Banten province													
1.	Serang District	86	62	6	1	478	209	12	3	0	33	16	8
2.		25	15	3	0	246	230	22	12	5	9	16	13
Total		111	77	9	1	724	439	34	15	5	42	32	21
Lampung province													
3.	Tanggamus District	6	33	3	0	351	31	24	18	0	9	18	14
4.	South Lampung District	0	42	10	0	382	267	21	20	5	30	26	17
5.	Pesawaran District	5	30	6	0	274	121	8	8	7	32	7	8
Total		11	105	19	0	1,007	419	53	46	12	71	51	39

Source: Profiles of Lampung and Banten Provinces in 2015

Table 5:
Health profiles in 4 districts / cities affected by the tsunami in Banten and Lampung provinces

No.	Districts/Cities	IPM	IPKM	AHH	AKI	AKB
Banten Province						
1	Serang District	70.44	0.5859	69.28	221	8.8
2	Pandeglang District	62.78	0.5503	66.28	199	3
Lampung Province						
1	Tanggamus District	64.41	0.6155	67.61	241	2,4
2	South Lampung District	66.19	0.6517	68.49	180	0.9
3	Pesawaran District	63.47	0.5913	68.05	128	0.8

Source: Health Profile. Banten and Lampung Provinces in 2015. Infant Mortality Rate(AKB); Maternal Mortality Rate (AKI); Life Expectancy Rate (AHH); Human Development Index (IPM);

Public Health Development Index (IPKM)

The infant mortality rate (AKB) is the probability of deaths of children under one year of age per 1000 live births. While, the maternal mortality ratio (AKI) is defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period. It depicts the risk of maternal death relative to the number of live births and essentially captures the risk of death in a single pregnancy or a single live birth (World Health Organization, 2015).
AKB= (Number of resident infant deaths/Number of resident live births) x 1000
AKI= (Number of resident maternal deaths / Number of resident live births) x100000
Life expectancy rate (AHH) is calculated as the number of years a person is expected to survive based on the statistical average. Life expectancies are calculated using (abridged) life tables presenting age specific mortality rates. Life expectancy tables are calculated based on death probabilities according to Farr's death rate method: qx = Mx / (Bx + (Mx/2)) where Mx = the number of deaths at the age of x to under x+1 year in the reported period; Bx = average population aged x to under x+1 in the base period; qx = death probability from age x to x+1. Farr's method of calculation of abridged life-tables assumes that there is a constant mortality within the age intervals and thus the years of life lived by a person dying in the interval is (on average) half of the length of the interval.
The Human Development Index (IPM) is a statistic composite index of life expectancy, education, and per capita income indicators, which are used to rank countries into four tiers of human development (UNDP, 2020).
IPM= $(I_{Health} \times I_{Education} \times I_{Income})^{1/3}$
The Public Health Development Index (IPKM) is a key indicator for seeing health development down to the district / city level. It was developed in 2009, and subsequently mandated in 2010 by national decree to be used to monitor development within and across districts through the analysis and interpretation of simple, easily measurable, credible, and timely indicators across a range of domains: public health infrastructure, services, behavioral risk factors and health outcomes (Ministry of Health Republic of Indonesia, 2010). The Public Health Development Index (IPKM) can be calculated after obtaining seven sub-index values or index group indicators, as follows:

Local Capacity

The data indicates that all affected districts have disaster management plan documents. Tanggamus District has good achievements in policy / regulatory indicators related to health /disasters crisis, early warning, mitigation and preparedness efforts. For Serang district, the early warning indicator (tsunami knowledge, tsunami monitoring and warning service, dissemination and communication, and response capability) has reached 100%, while other indicators are still below 40%. For Pandeglang district, the achievement of all indicators is still below 40%. Regarding to the community empowerment, all districts/cities have formed active, prepared and resilient villages to disaster proclaimed by the (UNDRR, 2019).

IPKM = (Reproductive and maternal health sub-index + New-born and child health sub-index + Infectious Diseases sub-index + Environmental health sub-index + Non-communicable diseases sub-index + Health risk behaviour sub-index + Health services provision sub-index)/7

Health problems

Earthquake, tsunami and liquefaction disasters cause health problems due to serious and minor injury, and also missing and loss of victims as shown in the Table 6&7 below.
Pandeglang and South Lampung districts are the worst affected areas with the highest number of victims and refugees. The highest number of deaths, seriously injured, minor injuries, missing and refugees' victims was in Pandeglang district, while minimal number in Pesawaran district. The number of Community health center affected is only one with moderate level of damage and no hospital was affected by the tsunami. The Community health center affected are in South Lampung district. Two sub-health centers and Village health posts affected by moderate damage are also found in South Lampung district.

Table 6:
Total of tsunami victims in Banten and Lampung provinces

No	Districts/Cities	Death	Serious injury hospitalization	Minor injury /outpatient care	Missing	Refugees
1	Serang District	21	122	3,184	0	1,227
2	Pandeglang District	296	766	15,946	3	7,972
1	Tanggamus District	1	0	92	0	0
2	South Lampung District	118	483	11,402	7	6,999
3	Pesawaran District	1	2	21	0	0
Total		437	1,373	30,645	10	16,198

Source: Health Crisis Center, 2018

Table 7:
Total of health care facilities damaged by the tsunami

No	Districts /Cities	Community health center				Hospital				Sub-health center				Village maternity clinic / Village Health post			
		RR	RS	RB	Total	RR	RS	RB	Total	RR	RS	RB	Total	RR	RS	RB	Total
Banten Province																	
1	Serang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Pandeglang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		RR	RS	RB	Total	RR	RS	RB	Total	RR	RS	RB	Total	RR	RS	RB	Total
Lampung province																	
3	Tanggamus	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	South Lampung	0	1	0	1	0	0	0	0	0	2	0	2	0	2	0	2
5	Pesawaran	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	1	0	1	0	0	0	0	0	2	0	2	0	2	0	2

Source: Health Crisis Center, 2018. Severely damaged (RB), Moderately damaged (RS) ,Slightly damaged (RR)

Efforts

The Health Sub-Cluster Efforts: in the effort to overcome health problems caused by the Sunda Strait tsunami, it is carried out in accordance with existing health problems, the efforts made by the health program. Efforts made across sectors include: operational funding support during the emergency response period from APBD, Koperasi KPRI Bhakti Husada and Community Assistance. Operations during the disaster response period have been proposed to BNPB through ready-to-use funds.

Challenges

Table 8:
Challenges to health disaster responses

	Challenges
Resources	- The basic sanitation is very limited at the shelter. - The roads in some evacuation locations are difficult for 4 wheeled vehicles to access. - There are limited medical supplies and consumables, especially for handling wounds and are also limited health service tents (health facilities called Posyankes) especially in in Sebesi and Sebuku islands. - Relocation of health facilities are constrained by land availability and most people in the red zone are still reluctant to be relocated. - The number of evacuation points that spread out caused uneven health services.
Data and Information	- The health information system has not been developed. - There is no early warning system for a tsunami event. - Communication was hampered at the Cugung Posyankes evacuation site due to signal constraints.
Health crisis management	-The coordination function does not work, never conducts regular cluster / sub-cluster coordination meetings. - There is no policy regulating disaster management at the district / city level and a lack of regional preparedness in overcoming health crises. - The analysis of existing risk assessments is not used by both the local government and the community including health agencies with many settlements and health service facilities in the tsunami red zone. - The coordination during the first day until the issuance of the emergency response decree has not yet been carried out due to the absence of an Incident Commander (IC). -There was no follow-up to the RHA results from across sectors and the role of other clusters is less than optimal in supporting the health cluster.
Financing	-The need for health care costs for disaster victims during the emergency response period using ready-to-use funds (DSP) is difficult to obtain because applications are limited by time, while health services for victims cannot be limited by time, so the required documents for administrative completeness of DSP applications cannot be fulfilled.
Health Promotion	-There is no study and risk analysis regarding local diseases, so that refugees are affected by snake bites.

Challenges beyond the health care system for health workers

Health workers providing health care during disaster face a wide range of challenges in providing care within a rapidly changing work environment. First, health workers or volunteers who come to help in the disaster area are not optimal in providing assistance to the community. Second, health workers or volunteers do not report and register to the health office which make it difficult to control and coordinate. Other issues include a shortage or poor availability of engaged healthcare workers to deliver services leads to reduced access to healthcare and adverse outcomes in disaster victim's health. Additional problem is a lack of qualified health personnel, due to the lack of appropriate disaster education and training programs, the emergency staff or doctor delayed to do their work properly. There are another several challenges that hinder effective health disaster responses (Table 8).

Conclusion

The 2018 tsunami disaster is the first and the biggest disaster in Banten Province, but the preparedness in the response to the health crisis is still lacking, even though in an emergency response situation the execution of disaster management has been quite good; and regulations governing disaster management have not been established, including health clusters, SOPs regulating health crisis management during the emergency response period. The availability of facilities and medicines in the regions has not been planned for a disaster, even though the support for the facilities and medicines to deal with the impact of the tsunami is fulfilled. Disaster management financing does not take advantage of the existing unexpected costs (BTT), due to a complicated accountability process. The mobilization of health personnel is still spontaneous. There is no specific policy that regulates team mobilization during the emergency response. The Information systems that have not been centralized, causing the difference in information. In conclusion, the comprehensive qualitative analysis of the health disaster preparedness and response in Sundanese Tsunami 2018 indicate some issues and challenges to be addressed further for improved disaster management in the future

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References

Anderson, J. E., Ross, A. J., Macrae, C., & Wiig, S. (2020). Defining adaptive capacity in healthcare: A new framework for researching resilient performance. Applied Ergonomics, 87, 103111. doi: https://doi.org/10.1016/j.apergo.2020.103111

Athukorala, P.-c., & Resosudarmo, B. P. (2005). The Indian Ocean Tsunami: Economic Impact, Disaster Management, and Lessons. Asian Economic Papers, 4(1), 1-39. doi: 10.1162/asep.2005.4.1.1

Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low Health Literacy and Health Outcomes: An Updated Systematic Review. Annals of Internal Medicine, 155(2), 97-107. doi: 10.7326/0003-4819-155-2-201107190-00005

Central Bureau of Statistics, B. (2021). Statistics Indonesia. from https://www.bps.go.id/

Cohen, O., Geva, D., Lahad, M., Bolotin, A., Leykin, D., Goldberg, A., & Aharonson-Daniel, L. (2016). Community Resilience throughout the Lifespan – The Potential Contribution of Healthy Elders. PloS One, 11(2), e0148125. doi: 10.1371/journal.pone.0148125

Courtney, C., Jackson, R., Stein, A., White, A., Ahmed, A., Rubinoff, P., . . . McKinnie, D. (2007). How Resilient is Your Coastal Community? A Guide for Evaluating Coastal Community Resilience to Tsunamis and Other Coastal Hazards (U. S. IOTWS Ed.). Bangkok, Thailand: U.S. Indian Ocean Tsunami Warning System Program supported by the USAID.

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social Vulnerability to Environmental Hazards. Social Science Quarterly, 84(2), 242-261. doi: https://doi.org/10.1111/1540-6237.8402002

Cutter, S. L., & Emrich, C. T. (2006). Moral Hazard, Social Catastrophe: The Changing Face of Vulnerability along the Hurricane Coasts. The ANNALS of the American Academy of Political and Social Science, 604(1), 102-112. doi: 10.1177/0002716205285515

Dogra, N., Kakde, V., & Taneja, P. (2019). Decision tool for climate disasters and infectious disease at sub-national level in India: Ensuring a paradigm shift in health planning from prevalence to vulnerability. Acta Tropica,191, 60-68. doi: https://doi.org/10.1016/j.actatropica.2018.12.006

Dückers, M. L. A., Witteveen, A. B., Bisson, J. I., & Olff, M. (2017). The Association Between Disaster Vulnerability and Post-disaster Psychosocial Service Delivery Across Europe. Administration and Policy in Mental Health and Mental Health Services Research, 44(4), 470-479. doi: 10.1007/s10488-015-0671-8

EM-DAT. (2020). The international disasters database. from https://www.emdat.be/

Esteban, M., Tsimopoulou, V., Mikami, T., Yun, N. Y., Suppasri, A., & Shibayama, T. (2013). Recent tsunamis events and preparedness: Development of tsunami awareness in Indonesia,

Chile and Japan. International Journal of Disaster Risk Reduction, 5, 84-97. doi: https://doi.org/10.1016/j.ijdrr.2013.07.002
Fekete, A. (2009). Validation of a social vulnerability index in context to river-floods in Germany. Nat. Hazards Earth Syst. Sci., 9(2), 393-403. doi: 10.5194/nhess-9-393-2009
FEMA. (2008). HAZUS MH Estimated Annualized Earthquake Losses for the United States,FEMA 366 CreateSpace Independent Publishing Platform
Henao-Sierra, W., Romero-Sáez, M., Gracia, F., Cacua, K., & Buitrago-Sierra, R. (2018). Water vapor adsorption performance of Ag and Ni modified 5A zeolite. Microporous and Mesoporous Materials, 265, 250-257. doi: https://doi.org/10.1016/j.micromeso.2018.02.036
IPCC. (2014). Climate Change: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
Kujawa, A., Hajcak, G., Danzig, A. P., Black, S. R., Bromet, E. J., Carlson, G. A., . . . Klein, D. N. (2016). Neural Reactivity to Emotional Stimuli Prospectively Predicts the Impact of a Natural Disaster on Psychiatric Symptoms in Children. Biological Psychiatry, 80(5), 381-389. doi: 10.1016/j.biopsych.2015.09.008
Lee, M.-S., Hwang, J.-W., Lee, C.-S., Kim, J.-Y., Lee, J.-H., Kim, E., . . . Bhang, S.-Y. (2018). Development of post-disaster psychosocial evaluation and intervention for children: Results of a South Korean delphi panel survey. PloS One, 13(3), e0195235. doi: 10.1371/journal.pone.0195235
Ministry of Health Republic of Indonesia. (2010). Decree of the Minister of Health Number 1798/Menkes/SK/XII/2010 concerning Guidelines for the Implementation of the Public Health Development Index., from https://www.kemkes.go.id/
Nic Lochlainn, L. M., Gayton, I., Theocharopoulos, G., Edwards, R., Danis, K., Kremer, R., . . . Jimissa, A. (2018). Improving mapping for Ebola response through mobilising a local community with self-owned smartphones: Tonkolili District, Sierra Leone, January 2015. PloS One, 13(1), e0189959. doi: https://doi.org/10.1371/journal.pone.0189959
PACIFIC DISASTER MANAGEMENT INFORMATION NETWORK PDMIN. (2005). Indian Ocean Earthquake & Tsunami Emergency Update: Center of Excellence in Disaster Management and Humanitarian Assistance.
Romero Lankao, P., & Qin, H. (2011). Conceptualizing urban vulnerability to global climate and environmental change. Current Opinion in Environmental Sustainability, 3(3), 142-149. doi: https://doi.org/10.1016/j.cosust.2010.12.016
UNDRR. (2019). National Agency for Disaster Management (BNPB). from http://www.bnpb.go.id/
UNISDR. (2009). Terminology on Disaster Risk Reduction. from https://www.undrr.org/
World Health Organization. (2015). World health statistics World Health Organization.