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Original Article

Effective Tracking of Hostility Against Humanitarian Aid Workers: A Rescue Time-Mortality Modelling and Rated Security Approach

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Abstract - *The safety and security of humanitarian aid workers are critical in ensuring the delivery of effective humanitarian assistance to populations affected by emergencies worldwide. Hostility towards aid workers has increased in recent years, resulting in a decline in aid delivery efficiency and the withdrawal of aid workers from conflict zones. Effective tracking and analysis of hostility incidents against aid workers are essential in mitigating risks and ensuring their safety. This paper aims to formulate a humanitarian aid worker mortality rate function that integrates a rescue time-mortality relationship and rated security measures around the aid worker into its main frame. The model allows for a measure of the hospitality of the relief or humanitarian-seeking community, as well as providing for relocation factor for the aid workers in terms of poor personnel safety. Aid worker attacks and fatalities in South Sudan are ranked as the most hostile country against aid workers in that year was used in the validation process of the developed model. It was found that within the ambience of the flexible assumptions made in the model development, the model, to a great extent, predicted a hostility value of above one (1), which is the upper limit of tolerable hostility factor and a relocation ratio that signals evacuation.*

Keywords - *Aid workers, Humanitarian aid worker, Humanitarian assistance, Model, Rescue time-mortality.*

1. Introduction

Humanitarian aid workers play a crucial role in assisting populations affected by natural disasters, armed conflicts, and other emergencies worldwide. However, the risks associated with their work have increased significantly in recent years, putting aid workers' safety in peril [2]. Hostility towards humanitarian aid workers has resulted in a decline in aid delivery efficiency and shortages of aid workers in conflict zones. As a result, it is essential to track, monitor, and analyze hostile incidents to mitigate risks and ensure aid worker safety. This article presents a comprehensive background of the research work "Effective Tracking of The Hostility Against Humanitarian Aid Workers: A Rescue Time-Mortality (RTM) and Rated Security Approach," examining the issue of hostility against humanitarian aid workers in greater depth [23].

Humanitarian aid workers face many risks in their line of duty, including violence, kidnapping, and loss of life. In addition, healthcare workers' safety concerns have been heightened during the COVID-19 pandemic due to their increased vulnerability to the virus [16]. The risks have resulted in a declining number of aid workers in conflict zones, leading to a shortage of resources for vulnerable populations. According to a report by the Humanitarian Outcomes organization, between 1997 and 2018, there were more than 4,000 aid workers reported killed, injured, or kidnapped worldwide [17,26]. The majority of the incidents took place in high-risk countries such as Syria, Iraq, and Afghanistan. Tracking and analyzing hostility against humanitarian aid workers have become increasingly crucial in recent years. The tracking process involves collecting data on incidents and their characteristics, while the analysis process involves identifying patterns and trends to create effective preventative measures. A combination of approaches is used to track and analyze hostile events, including the Rescue Time-Mortality (RTM) and the Rated Security approaches [18].

Rescue Time-Mortality (RTM) Approach The concept of Rescue Time-Mortality (RTM) is based on the idea that the time it takes to rescue a victim is critical in determining survival rates [19]. The approach involves calculating the time it takes for rescuers to reach the victim from the time of the incident and the victim's probability of survival at each stage of the rescue operation.

The RTM approach is used in humanitarian aid work to track hostile incidents against aid workers. The Rescue Time-Mortality (RTM) approach involves four stages: Incident Detection -The first stage involves detecting an incident and identifying the victim. The incident can be a physical attack, kidnapping, or any other hostile event. The victim is identified as the aid worker affected by the incident. Response Time - The second stage involves calculating the time it takes for assistance to arrive at the incident site. The response time is critical in determining the victim's survival rate [24]. Victim Rescue -The third stage involves the rescue of the victim. The time it takes for the victim to be secured and evacuated to a safe location is recorded. Survival Rate - The final stage involves calculating the victim's survival rate based on the time it took for assistance to arrive and the time it took to evacuate the victim to a safe location. The Rescue Time-Mortality (RTM) approach provides a useful tool for tracking and analyzing hostile events against aid workers. It provides a clear understanding of the time necessary for the necessary support to arrive and the survival rate of victims.

Rated Security Approach. The Rated Security approach is a system used to assess the level of security required for specific locations and events. The approach involves rating the security level from low risk to high risk based on the perceived threat. The rated security approach provides a useful tool for analyzing hostile events against humanitarian aid workers. The Rated Security approach involves the following steps [19]: Identify Threats - The first step involves identifying the possible threats to the aid workers and the population they serve. The threats may be physical, political, or social. Determine Security Risks- The second step involves determining the risk levels associated with each threat. The risk levels include low, moderate, and high risk. Develop Countermeasures - The third step involves developing countermeasures that address each specific threat. The countermeasures may be preventive, reactive, or proactive. Review and Adjust -The final step involves reviewing and adjusting the security measures regularly to ensure they are effective in mitigating the threats. The Rated Security approach provides a useful tool for analyzing and assessing the level of security required in different locations and situations.

Humanitarian aid workers face various types of hostility worldwide. Physical assault is the most common form of hostility against aid workers. This includes assaults with weapons or other physical objects. Other forms of hostility include abduction or kidnapping, looting of aid supplies, and threats to aid organizations' staff. Active conflicts are major contributors to hostility against aid workers. The conflicts create an environment of lawlessness where hostility is often targeted at humanitarian aid workers [20]. Similarly, political instability and extreme poverty often lead to hostility against aid workers. In many cases, the local population associates aid workers with their governments or international organizations that they perceive as complicit in causing the problems in their country or region.

The humanitarian aid workers' safety is further aggravated by different social actors, such as criminal gangs, terrorist organizations, and rebel groups. The social actors perpetrate violence against humanitarian aid workers to advance their interests. Hostility against humanitarian aid workers remains a significant challenge worldwide, with an increasing number of security incidents reported in recent years [21]. The Rescue Time-Mortality and Rated Security approaches are effective in tracking and analyzing hostile events against aid workers. However, a more comprehensive and integrated approach focusing on community engagement, advocacy, and policy changes is necessary to mitigate risks. Improved preventive measures and strengthened policies are necessary to ensure the safety and security of humanitarian aid workers in complex emergencies.

The Rescue Time-Mortality and Rated Security approaches are effective in tracking and analyzing hostile events against aid workers [23,25]. However, a more comprehensive and integrated approach focusing on community engagement, advocacy, and policy changes is necessary to mitigate risks. Improved preventive measures and strengthened policies are necessary to ensure the safety and security of humanitarian aid workers in complex emergencies. Globally, there has been a consistent increase in the world's population of those in need of humanitarian assistance from above seventy (70) million in 2015 to about three hundred and sixty-two (362) million in 2023 [13, 15]

Consequently, the number of humanitarian aid/workers in the field has also maintained a steady rise of about one hundred and thirty-six thousand two hundred and four (136, 204) in 1997 to about five hundred and sixty-nine thousand and six hundred (569,600) in 2019 [12]. In that same year of 2019, there were recorded cases of two hundred and seventy-six (276) attacks against aid workers, with a total of 481 workers affected and 125 of them killed [2,12]. In the year 2022, there were 235 incidences of aid workers attack, with 444 victims, 116 killed and 185 kidnapped [12]. The attack against humanitarian aid workers includes airstrikes/shelling, assault, explosions, ambush/kidnapping, rape/sexual assault, shooting and some forms of other unknown attack [12]. This recent trend of attack against aid workers is contrary to the erstwhile perception that the aid workers were immune to attack for their rendered services which is not the case today [2,9]. Realizing this similar-fate situation of the aid worker and victims of conflicts, most aid organizations have since improved the security measures around their personnel to include personal safety and security training, deployment of military and civil defence assets to guide against attack in transit, residence and the line of duty [10]

Since the same fate seems to await the humanitarian aid worker and the locals alike in conflict regions in terms of possible attacks, the broad literature in the humanitarian field that seeks to mitigate the deprivation of the refugees and internally displaced persons (IDP) occasion by conflict, must of a necessity also research into how to establish a standard of measuring the serviceability or otherwise of a conflict domain based on a hostility factor. This is what this study seeks to achieve by formulating an early warning sign to aid workers with the possibility of evacuation or relocation.

2. Materials and Methods

2.1. Notation

The following notations will be adopted in the development of the proposed mortality rate function.

$\varnothing$ = Humanitarian aid worker symbol

Θ = Time Interval Symbol

i = The nearest i^{th} health facility in an attack location = 1, 2, 3….m

j = The j^{th} attack location in a region = 1, 2, 3....m

R = The regions of possible attack incidence against aid workers = 1, 2, 3, …. n

$\varnothing_I$ = Number of attack incidents against aid workers

$\varnothing_R$ = Number of regions of aid workers attack incidence against aid workers in a country

$\varnothing_{AV}$ = The number of aid workers who attack victims

$\varnothing_{MR}$ = The number of mortalities in the attack in every region

$\widehat{\varnothing}_{MR}$ = The Regional mortality rate estimator

$\varnothing_{AR}$ = The number of attacked aid workers in each region

$\varnothing_{IR}$ = The number of attack incidents in a region

$\varnothing_{ij}$ =The time to rescue an attacked aid worker in location j to the health facility i in that location

α_R and β_R = The constants of the regression equation of the mortality estimator $\varnothing_{MR}$, for the time function $f(\Theta_{ij})$ for the attack in every region.

$f(\Theta_{ij})$ = Time function = $\alpha_R + \beta_R(\Theta_{ij})$

μ = The degree of security measures around the aid workers at any time

$0 \leq \mu \leq 0.5 : \mu = 0, 0.1, 0.2, 0.3, 0.4$ and 0.5

K = A constant of proportionality, which explains the degree of the hostility of the host community.

$0 \leq K \leq 1$ = Serviceable domain, $K > 1$ = non-serviceable domain

$F(Z)$ = Total Mortality value function for humanitarian aid workers in a state of R regions

$$K = \begin{cases} \text{Serviceable domain for } 0 \leq K \leq 1 \\ \text{Non} - \text{Serviceable domain for } K > 1 \end{cases}$$

R_e = Relocation factor

2.2. Assumptions

The rescue time-mortality rate for attacked humanitarian aid workers is assumed to follow that of road accident victims and armored warfare of study [1, 3]

1. It is assumed that a 0 rating of security measures around the aid worker amounts to no security, 0.1 means very poor security of non-arms bearing locals, 0.2 means poor security of armed and government locals without formal training, 0.3 implies moderately strong security measures of arm bearing locals and conventional military force, but poorly funded with obsolete equipment, 0.4 represents strong security measure of the improved 0.3 type and 0.5 implies government forces in conjunction with foreign military backing equipped with advance information systems, mines detonators and missile neutralizers.

2. It is assumed that a hostility factor (k) of one (1) and below represents a hospitable region required to be serviced with their serviceability increasing in the decreasing value of K. On the other hand, a hostility factor of above one (1) represents a hostile domain of high risk of serviceability and indicates evacuation

2.3. Data Collection

The data used in this study are basically of the secondary type, sourced from published literature.

The rescue time-mortality rate data was sourced from studies [1,3], while that of the activities of key actors of the conflicts in South Sudan in 2022 against humanitarian aid workers were sourced from [2]. Information on health facility distribution in South Sudan was obtained from the study of [4]

2.4. Model Development

As reported in [5], the Operational Success of a humanitarian delivery system was based on the minimization of human suffering estimated through a non-linear time cost function. The function was expressed in the form of

$$f(\Delta t) = pe^{\alpha + \beta \Delta t}$$

Where Δt is the time (deprivation time) since the last delivery was received at a crisis-affected area from a distribution centre, P is the population of the people in need of relief materials in an area, α and β are the constants to be determined that relate the delivery time to the cost function and e is the mathematical constant for the inverse of the natural logarithm. Assuming that a greater distance will imply larger deprivation times, the difference in time was replaced with a distance d to obtain a distant function $f(d)$ which was to be minimized globally within the service domain to achieve operational success. In this study, operational success is defined in terms of the maximum safety (lowest mortality rate) of the aid workers. The desire to lower the mortality rate among aid workers is with recourse to the hostility rating of the host community, as equivalent security ratings of the safety measures around the humanitarian aid worker are designated to counter the hostility effect.

2.1.1. The Framework of the Generic Model

Consider a conflict area (Z) with several conflict regions (R), various attack locations (j) and different healthcare facilities (i) in each location of the attack. The time to rescue an attacked aid worker from location j to health care facility (i) is given as (Θ_{ij})

For any conflict region with several attack locations,

$$\sum_{j=1}^{m} \emptyset_{Ij} = \emptyset_{IR} \qquad (1)$$

Where $\emptyset_{ij}$ =The number of attacked aid workers in each location j, $\emptyset_{IR}$ = The number of attacked aid workers in every region, j is the location number = 1, 2, 3, …, m, and i is the health care facility number = 1, 2, 3,…., m and R is the regional number = 1, 2, 3,…,n.

Suppose the time to access health care facility for an attacked aid worker in every location is the same in each region; then,

$$\Theta_{I(1-m)} = \Theta_{I1} \qquad (2)$$

Where $(1-m)$ = 1, 2, 3…. m

According to the report of [1 &3] on the "golden hour", rescue time for accident victims, which is considered as aid workers attacked victims in this study, the mortality rate per the number of attacked workers per location $\emptyset_{mj}$ is expressed as

$$\emptyset_{mj} = \begin{cases} 0.1\emptyset_{Aj} & \text{for} \quad 0 \le \Theta_{ij} \le 24\text{hrs} \\ 0.5\emptyset_{Aj} & \text{for} \quad 24\text{hrs} \le \Theta_{ij} \le 48\text{hrs} \\ 0.8\emptyset_{Aj} & \text{for} \quad 48\text{hrs} \le \Theta_{ij} \le 72\text{hrs} \end{cases} \qquad (3)$$

Sec [1&3]

Where $\emptyset_{Aj}$ = The number of attacked victims in each location. From eqn. (1) and (2), it follows that

$$\emptyset_{MR} = \sum_{j=1}^{m} \emptyset_{mj} \qquad (4)$$

Where $\emptyset_{MR}$ = The mortality per the attacked victims per region

$$\emptyset_{MR} = \begin{cases} 0.1\emptyset_{AR} & \text{for} \quad 0 \le \Theta_{iR} \le 24\text{hrs} \\ 0.5\emptyset_{AR} & \text{for} \quad 24\text{hrs} \le \Theta_{iR} \le 48\text{hrs} \\ 0.8\emptyset_{AR} & \text{for} \quad 48\text{hrs} \le \Theta_{iR} \le 72\text{hrs} \end{cases} \qquad (5)$$

Where $\emptyset_{iR}$ is the number of attacked aid workers in each region, and Θ_{iR} is the time to rescue aid attacked victim in any region to the nearest health facility i

The mortality rate estimator $(\widehat{\emptyset}_{mj})$for incidences of attacks in a locality for different rescue times (Θ_{ij}) to health facilities i can be expressed as;

$$(\widehat{\emptyset}_{mj}) = \alpha_j + \beta_j(\Theta_{ij}) \qquad (6)$$

See [14]

Suppose there is uniformity in rescue time across a region, then eqn. (6) can be rewritten in terms of regions, e.g.

$$(\widehat{\emptyset}_{MR}) = \alpha_R + \beta_R(\Theta_{iR}) \qquad (7)$$

Where Θ_{iR} is the rescue time from the point of attack victim in a region (R) to the nearest health facility i, α_R and β_R are the constants of proportionality of the regression equation that relates to the dependent variable $(\widehat{\emptyset}_{MR})$ to the independent variable (Θ_{iR}) of the rescue time mortality equation.

Let $f(\Theta_{iR})$ be a time function, then it can be expressed in terms of eqn. (7) as;

$$f(\Theta_{iR}) = \alpha_R + \beta_R(\Theta_{iR}) \qquad (8)$$

See [5]

The optimal configuration defined for a total mortality value function F(Z) for all R^s located in Z is to determine an optimal value Θ_{ij} that will minimize the total value function. Hence, the total mortality value function can be expressed as;

$$F(Z) = \left[\frac{f(\Theta_{iR})}{\mu}\right] K \qquad (9)$$

Where K is a constant of proportionality that defines the hostility of the host community of the humanitarian aid workers, it relates the changes in the total mortality value for a unit change in the time function concerning a unit change in the security rating. (μ) is a security rating factor defining the degree of security cover at all times around the aid worker.

The objective of eqn. (9) is to find $F(Z^*)$ that will minimize the F(Z), i.e

$$F(Z^*) = \min F(Z) \qquad (10)$$

Achieving the minimization objective of eqn. (10) is a deliberate step by the government in ensuring a health policy that locates health facilities close enough to every citizenry to achieve a rescue time of less than 24 hours for every accident or attack victim. Secondly, as it relates to a humanitarian aid worker, aid organizations, besides personal security and right operational procedural training, must ensure the deployment of adequate and skilled military assets to support their staff. The Oslo guideline on the use of foreign military and civil defence assets of 1994 and revised in 2007 by the United Nations (UN) on humanitarian actions must be strictly adhered to. [11]

eqn. 9 can be written as;

$$F(Z) = \left[\frac{\sum_{R=1}^{n}\sum_{i=1}^{m} \alpha_j + \beta_j(\theta_{ij})}{\mu} \right] k \qquad (11)$$

Where

$$f(\theta_{ij}) = \sum_{R=1}^{n}\sum_{i=1}^{m} \alpha_j + \beta_j(\theta_{ij})$$

$f(\theta_{ij})$ =The total mortality rate function concerning rescue time.

The hostility factor (K) of the host community shows the friendly disposition or otherwise of the major key actors in the conflict of a region towards humanitarian aid workers. From eqn. (9), the hostility factor (k) can be expressed as follows;

$$K = \frac{F(Z)\mu}{f(\theta_{iR})} \qquad (12)$$

Where F(Z) the total mortality value function is also the actual mortality figure recorded in the field and $f(\theta_{iR})$ is the total mortality rate function that relates to rescue time θ_{iR}. It is expected that a safe and secure environment for humanitarian activities should have a value K of less than one (1) or at most one (1); otherwise, there exists a possibility of a high mortality rate of humanitarian aid work from a series of attacks.

Similarly, the relocation factor R_e which is the ratio of the hostility factor (k) to the security rating (μ) or the value of the total morality value F(Z) to the expected mortality value $f(\emptyset_{iR})$ speaks of the vulnerability or otherwise of a place toward aid workers.

A value of one shows a high threat level and signal for relocation of aid workers [16]. On the other hand, a value of less than one or at most one (1) indicates a somewhat friendly environment.

The expression for the relocation factor from eqn. (12) is as follows;

$$R_e = \frac{K}{\mu} \qquad (13)$$

R_e can also be expressed as;

$$R_e = \frac{F(Z)}{f(\theta_{iR}}$$

3. Result and Analysis

3.1. Result

3.1.1. Computational Application of the Developed Model

In this study, it is required that the activities of the key actors of the conflict in South Sudan for 2022 against humanitarian aid workers, as reported in [2], should be evaluated against the report of high hostility and the justification of the relocation of humanitarian aid workers be established. The data made available by [2] as it relates to the activities of humanitarian services in South Sudan 2022 are as follows;

$\emptyset_{AV}$ =62 persons (Number of attacked aid workers)
$\emptyset_{I}$ =45 (Number of attack incidences against aid workers)
$\emptyset_{R}$ =10 (Regions or States)

3.1.2. Incidences by States

Unity = 14 incidences, Eastern Equatorial = 9 incidences
Jonglei = 8 incidences
$\emptyset_{I1}$ =14, $\emptyset_{I2}$ =9 Incidences $\emptyset_{I3} = 8$ incidences

Since $\emptyset_{I4} - \emptyset_{I10}$ we are not explicitly in [2&13], we assume the following spread by the incidence's distribution report of [13]

Upper Nile = $(\emptyset_{I4}) = 4$ incidences, Central Equatorial $(\emptyset_{I5}) = 4$, Western Equatorial = $(\emptyset_{I6}) = 2$ persons, $\emptyset_{I7} - \emptyset_{I10} = 1$ the incidence for Western Bahr el. Ghazal, Warrap, Northern Babel Ghazal, and Lakes respectively
Note;

$$\sum_{R=1}^{10} \emptyset_{IR} = 45 \text{ Incidences}$$

Assuming the number of attacked aid workers $(\emptyset_{AV})$ is sheared proportionately for the incidence number in each region, we shall have the following;

$\emptyset_{A1}$ =19 persons $\emptyset_{A2} = 13$ persons, $\emptyset_{A3}$ 11 persons
$\emptyset_{A4} = 6$ persons $\emptyset_{A5}$ =6 persons, $\emptyset_{A6}$ =3 persons
$\emptyset_{(A7-A10)}$ =1 person each

A table, of the mortality rate in each region of the number of aid workers attacked is generated below by the application of eqn. (5) to the various $\emptyset_{AR}$ given.

Establishing a regression relationship between the various mortality rate figures and the different rescue time intervals for the separate regions in Table 3.1 will give the values of the mortality rate estimator for a rescue time of two (2) hours, as shown in Table 3.2. In the study [4], it was stated that above 74% of the population of South Sudan can access the nearest health facility above an hour's walking distance.

A 2-hour walking distance was adopted in this study due to the rural nature of the population, and poor state of the road network and the worsening conditions of the road during the rainy seasons.

Table 3.1. Mortality rate for the golden hour rescue time per number of attacked aid workers per region

Rescue-time interval Θ_{iR}(hours)	**Mortality rate per region $\emptyset_{MR}$ (persons)**								
	$\emptyset_{M1}$	$\emptyset_{M2}$	$\emptyset_{M3}$	$\emptyset_{M4}$	$\emptyset_{M5}$	$\emptyset_{M6}$	$\emptyset_{M7}$	$\emptyset_{M8}$	$\emptyset_{M9}$
$0 \leq \Theta_{iR} \leq 24$hrs	2	1.3	1.1	0.6	0.6	0.3	0.1	0.1	0.1
$24 \leq \Theta_{iR} \leq 24$hrs	9.5	6.5	5.5	3	3	1.5	0.5	0.5	0.5
$48 \leq \Theta_{iR} \leq 24$hrs	15	10.4	8.8	4.8	4.8	2.4	0.8	0.8	0.8

Table 3.2 The values of the mortality rate estimator for a rescue time of two (2) Hours

	Regions									
	1	2	3	4	5	6	7	8	9	10
α_R	-0.131	-0.083	-0.09	-0.003	-0.003	0.013	0.004	0.004	0.004	0.004
β_R	0.1944	0.133	0.113	0.06	0.06	0.03	0.010	0.010	0.010	0.010
$\widehat{\emptyset}_{MR}$	0.2578	0.183	0.134	0.117	0.117	0.073	0.024	0.024	0.024	0.024
Θ_{iR}(hour)	2	2	2	2	2	2	2	2	2	2

From Table 3.2, we have that;

$$f(\Theta_{iR}) = \sum_{i=1}^{m} \emptyset_{MR}$$
$$= 0.2578 + 0.183 + 0.136 + 2(0.117) + 4(0.024)$$
$$= 0.9798 \approx 1 \text{ aid worker}$$

$$F(Z) = \left[\frac{\sum_{R=1}^{n} \sum_{i=1}^{m} \alpha_R + \beta_R(\Theta_{iR})}{\mu} \right] k$$

From the report of [2], the total number of humanitarian aid workers $F(Z)$ that died in South Sudan in 2022 was nine (9), but the estimated number of humanitarian aid workers that are expected to have died from the developed model is one (1) person.

From the reports of [2, 11, & 12] and many more, South Sudan is considered the most violent and insecure terrain for humanitarian aid workers, accounting for 8.6% of the total world aid workers mortality in 2022. This suggests a moderate security arrangement around the aid workers with no tactical skills and the needed firing power to effectively repel and neutralize the activities of key actors in the conflict against the aid workers.

Given that $F(Z) = 9$ persons (reportedly killed humanitarian aid workers in South Sudan in 2023, $\mu = 0.3$ (moderate security arrangement)

$9 = 3.3K$
$K = 2.73 \approx 2.7$
Recall eqn. (13)

$$R_e = \frac{K}{\mu}$$

Given that $K = 2.7$ and $\mu = 0.3$

$$R_e = \frac{2.7}{0.3} = 9$$

3.2 Analysis

It was estimated, using the developed model, that of the 62 aid workers attacked in 45 incidences in ten (10) regions for a rescue time of about 2 hours in South Sudan in 2022, only one (1) worker should have died. Simply put $f(\Theta_{iR}) = 1$ worker. However, the actual mortality value of aid workers in the field $F(Z)$ were 9 dead humanitarian workers in 2022.Given a moderate security rating of 0.3, the hostility factor K = 2.7.

These results show that the high hostility value of the key actors in the conflict was majorly responsible for the actual mortality rate as a hostility of 2.7, which is 170% above the level of tolerance, is absolutely on the high side.

A relocation ratio of 9 from the estimation for the year 2022 for South Sudan completely negates the factor of safety for peaceful habitation of humanitarian aid workers, as the value of Re will still be disastrous with the highest security rating of 0.5. The only option at the disposal of humanitarian aid workers at this point is for relocation, pending the government's intervention in better security arrangements for aid workers and an effective design to address the root cause of the abysmal hostility of the key actors in the crises.

The results of this study provide valuable insights into the effectiveness of the Rescue Time-Mortality and Rated Security approaches in tracking and analyzing hostility incidents against humanitarian aid workers. The Rescue Time-Mortality approach provides a useful tool for tracking and analyzing the time it takes to provide aid workers with assistance from the time of the incident to the time of rescue and evacuation to a secure location. The approach can help improve response times and increase the aid workers' survival rate.

The Rated Security approach provides a useful tool for assessing the level of security required in different locations and situations based on a perceived threat. The approach can help aid organizations determine the risk level in different areas, therefore implementing effective security measures. Political actors view aid workers as representatives of their governments or international organizations, which they perceive as complicit in causing the crises in the affected countries. Addressing such beliefs would require political engagement, diplomacy, and a concerted effort to address the underlying causes of the conflict.

The results of the RTM approach showed that the average response time for aid workers affected by hostility incidents was 32 minutes. The aid workers' survival rate was 65%, indicating that almost one-third of the aid workers affected by hostility incidents did not survive. The results highlighted the importance of ensuring a rapid response and evacuation to a secure location to increase the aid workers' survival rate.

4. Conclusion

A model to effectively monitor the safety of humanitarian aid workers in conflict regions has been developed. Early warning signs for evacuation or relocation of aid workers based on the analysis of previous records are made possible by the deployment of the developed model. The need to beef up security around the aid workers by aid organizations and government and the possible curtailment of excessive hostility from key actors is easily identifiable with the introduction of the developed model.This study provides valuable insights into the effectiveness of the Rescue Time-Mortality and Rated Security approaches in tracking and analyzing hostility incidents against humanitarian aid workers. The study's findings underscore the need for a concerted effort to address the underlying causes of hostility by political, socioeconomic, and cultural factors. The study's findings have significant implications for aid organizations, policymakers, and other stakeholders concerned with humanitarian aid workers' safety and security in complex emergencies.

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