

# Strategies to Prevent Acute Diarrhea and Upper Respiratory Tract Infection among Disaster Relief Workers

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**Background:** Sickness among field relief workers prompted us to develop strategies for preventing manpower loss. Most studies have focused on the preparedness and safety of medical responders in the prepared phase, but those parameters are lacking in the response phase. This study attempted to identify effective ways to prevent medical team members from acquiring acute diarrhea and upper respiratory tract infection (URI) based on our field reports.

**Methods:** This was a retrospective cohort study. The 56 team members were from eight missions in total, including medial disaster relief and international humanitarian assistance, deployed between June 2007 and February 2010. The demographics of the participating members and their actions were examined for association with acute diarrhea and upper respiratory tract infection episodes using a mixed-effect logistic regression model.

**Results:** One member (7.0%) with acute diarrhea and 11 (26.1%) members without acute diarrhea took doxycycline. The relationship between doxycycline and acute diarrhea episodes was not statistically significant. However, while 6 of 14 team members (42.9%) with acute diarrhea used hand sanitizer, 35 of 42 team members (83.3%) without diarrhea used hand sanitizer. Only hand sanitizer use was statistically related to the prevention of acute diarrhea and URI ( $p$  value = 0.021, 0.032).

**Conclusion:** Hand sanitizer is suggested to protect medical teams from acute diarrhea and URI in such challenging environments. Chemoprophylaxis for malaria remains dependent on the area of deployment.

**Key words:** *disaster; international humanitarian assistance; hand sanitizer*

## Background

In the past few decades, disasters have become more common due to climate change and terrorism. Taiwan developed its National Disaster Medical Assistant Team (NDMAT) to cope with emergency medical relief after the Ji-Ji earthquake in 2000.<sup>1</sup> More comprehensive disaster networks, such as the Hazardous Materials and Radiation Incident Emergency

Response Coordination Center, have been introduced since 2002 to manage chemical and radiation hazardous disasters for the purposes of preparedness and education. Emergency Operation Centers (EOCs) were established to coordinate and mobilize medical operations in mass casualty incidents and new emerging infectious disease outbreaks after the SARS (severe acute respiratory syndrome) epidemic in 2004.

NDMAT in Taiwan has participated in several

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medical relief efforts for disaster and international humanitarian assistance since 2004. Sickness among field relief workers prompted us to develop strategies for preventing manpower loss. Most references have focused on the preparedness and safety of medical responders in the prepared phase, but these factors are lacking during the response phase.<sup>2-4</sup> For our team members, we reported that the primary illness in the field was acute diarrhea (21.4%) followed by upper respiratory tract infection (10.7%); single episodes of malaria and dysentery were also identified. Based on our field reports, this study attempted to identify effective ways of protecting medical team members from acute diarrhea and upper respiratory tract infection.

## Methods

This was a retrospective cohort study. There were eight missions in total, including medial disaster relief and international humanitarian assistance, deployed between June 2007 and February 2010. Features including mission time span, sites of deployment, size of team, and protecting devices and drugs used were included in our analysis. All team members were instructed on personal safety and preparedness before each mission took place and were included in this study. They had cooked food and mineral water in each mission. Episodes of acute diarrhea (passage of three or more loose stools in a 24-hour period) and symptoms of upper respiratory tract infection (cough, sore throat, runny nose, nasal congestion, headache, low-grade fever, facial pressure and sneezing) among team members were recorded during and one week after the missions.

Participating member demographics (age, gender, experience, character or work, mask or hand sanitizer (ethyl alcohol, produced by CCPG®) use, and anti-malaria drug use) and actions (country, international, emergency, and visiting place for medical service) were examined for association with acute diarrhea and upper respiratory tract infection episodes using a logistic regression of a mixed effect model. A standard statistical software package (SAS version 9.2, SAS Institute, Cary, NC) was used. Data are presented as numbers and standard deviations. Statistical significance was designated at the  $p < 0.05$  level.

## Results

This study included the following missions:

medical assistance in Malawi 2007, emergency medical relief of the Myanmar Nargis cyclone 2008, India/Tibetan regions 2009, post-cyclone restoration in Myanmar 2009, Nepal/Tibetan medical services in 2009, Typhoon Morakot in Taiwan 2009 (Namasha village and Alishan Mountain), and the Haiti earthquake in 2010 (Table 1). Four missions were fixed medical posts, while the remaining four were mobile according to the best service delivered. The study consisted of 56 team members, with a male/female ratio of 5:3. The median age was 36. Thirty (53.6%) team members did not have prior medical relief or assistance experience. There were 24 physicians (42.9%), 18 registered nurses (32.1%), 9 pharmacists (16.1%) and 5 supporting staff (8.9%). Although many team members took malaria prevention drugs, including doxycycline (21.4%), mefloquine (17.9%), malarone (14.3%), and chloroquine (1.8%), 25 (44.6%) took no medication.

Preventive measures included hand sanitizers (73.2%) and masks (96.4%). Acute diarrhea and upper respiratory tract infection occurred in 21.4% and 10.7% of team members, respectively.

Table 2 shows the correlation between acute diarrhea and member characteristics by logistic regression analysis with a mixed effect model. Comparing the groups with and without acute diarrhea, members who had experience with medical relief or assistance were not significantly protected from diarrhea; the experienced members comprised 50% of the acute diarrhea cases and 45.2% of the non-diarrhea cases. Characteristics of the work or the places in which patients were visited (fixed or rotated) were not statistically correlated with acute diarrhea episodes. Only 1 member (7.0%) who had acute diarrhea took doxycycline compared to 11 (26.1%) members without acute diarrhea, but this difference was not statistically significant. All of the team members without acute diarrhea and 14 of 16 team members with acute diarrhea wore a mask not significant. However, while 6 of 14 team members (42.9%) with acute diarrhea used hand sanitizer, 35 of 42 team members (83.3%) without diarrhea used hand sanitizer. Hand sanitizer use was the only significant correlate of protection against diarrhea ( $p$  value = 0.021).

Table 3 shows the correlation between URI and member characteristics by logistic regression analysis with a mixed effect model. The results were similar to those seen in the acute diarrhea analysis. Only hand

**Table 1.** Demographics of actions and members

Variable	Value
Places	times (year)
Malawi	1 (2007)
Myanmar	2 (2008, 2009)
India	1 (2009)
Nepal	1 (2009)
Haiti	1 (2010)
Taiwan	2 (2010)
International:domestic	6:2
Emergency relief	
Yes	4 (50.0%)
No	4 (50.0%)
Visiting places	
Fixed	4 (50.0%)
Rotated	4 (50.0%)
Gender	
Male	35 (62.5%)
Female	21 (37.5%)
Age: median (range) [years]	36 (25~65)
Work	
Doctors	24 (42.9%)
Nurses	18 (32.1%)
Pharmacists	9 (16.1%)
Support	5 (8.9%)
Prior experience	
Yes	26 (46.4%)
No	30 (53.6%)
Visiting patients	
Yes	45 (80.4%)
No	11 (19.6%)
Hand sanitizer use	
Yes	41 (73.2%)
No	15 (26.8%)
Mask use	
Yes	54 (96.4%)
No	2(3.6%)
Antimalaria drug use	
Doxycycline	12 (21.4%)
Mefloquine	0 (17.9%)
Malarone	8 (14.3%)
Chloroquine	1 (1.8%)
No	25 (44.6%)
Acute diarrhea	
Yes	14 (21.4%)
No	42 (78.6%)
Upper airway infection	
Yes	6 (10.7%)
No	50 (89.3%)
Malaria	1 (1.8%)
Dysentery	1 (1.8%)

sanitizer use was significantly correlated with protection against URI ( $p$  value = 0.032).

Figs. 1 and 2 demonstrate that hand sanitizer use had a significant effect on the prevention of acute diarrhea and URI among relief workers.

## Discussion

Without proper education and training, hospital staff may not be effective at a disaster site.<sup>5-7</sup> However, field experience in disaster response may be relatively limited.<sup>8</sup> We postulate that international humanitarian missions can be utilized to simulate real disasters. These missions serve as a window of opportunity for simulation (working in an austere environment) to tackle real disasters.<sup>9</sup>

When visiting patients, we prepared hand sanitizers and masks for medical team member use. In this study, we found that hand sanitizer use was significantly correlated with the prevention of acute diarrhea and URI. Because most team members used masks (96.4%), their use was not significantly correlated with morbidity prevention in this study. Using hand sanitizer has been reported to be an effective method of infection control in acute care facilities, intensive care units, and extended care facilities.<sup>10-13</sup> We believe that this is the first report demonstrating that hand sanitizer can be useful in protecting disaster relief and international humanitarian assistance team members from infection.

Due to the high incidence rate of acute diarrhea for our medical teams, we attempted to identify prophylactic antibiotic drugs to improve this problem. Many references have indicated that doxycycline is used for prophylaxis of *E. coli*-induced travelers' diarrhea.<sup>14-16</sup> Our hypothesis was that relief workers using doxycycline for prophylaxis of malaria would have a lower likelihood of contracting an acute malaria infection. Different anti-malaria drugs were suggested for use during the missions in various countries: mefloquine in Africa, chloroquine in Central America, and doxycycline in drug-resistant areas, such as Myanmar. If doxycycline treatment was significantly correlated with protection against both malaria and diarrhea, it would be easier to prevent these illnesses using doxycycline alone. During these missions, food and beverage selection was safely considered; therefore, more effective strategies are needed to prevent acute diarrhea. In our study, chemoprophylaxis with doxycycline for acute diarrhea did not significantly cor-

**Table 2.** Mixed-effect logistic regression model of risk factors for acute diarrhea

Factor	acute diarrhea	nondiarrhea	<i>p</i> value
Age (mean ± SD)	33.9 ± 7.6	38.8 ± 9.6	NS
Gender			NS
Male	10	25	
Female	4	17	
Experienced: yes:no	7:7	19:23	NS
Work: doctors:nurses:pharmacists:support	7:5:2:0	17:13:7:5	NS
Visiting patients: yes:no	12:2	33:9	NS
Visiting locations: fixed:rotated	12:2	22:20	NS
Doxycycline use:yes:no	1:13	11:31	NS
Mask use: yes:no	12:2	42:0	NS
Hand sanitizer use: yes:no	6:8	35:7	0.021

NS: no statistical significance.

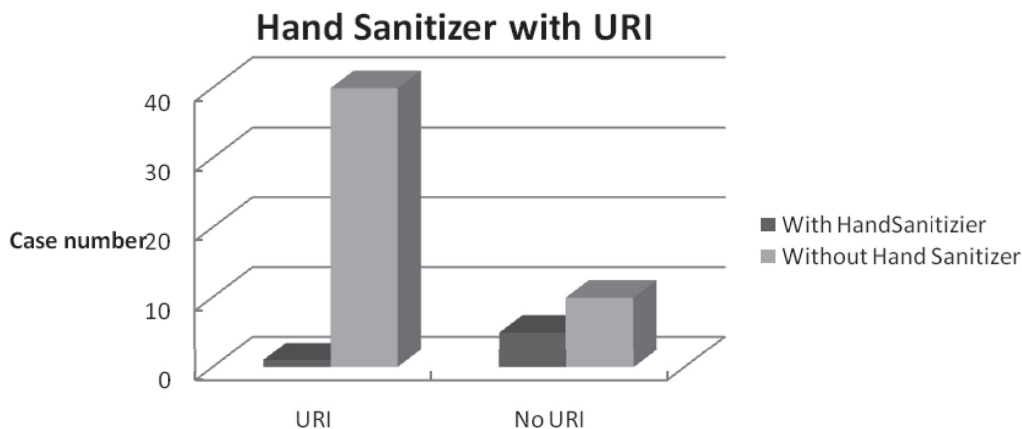
*p* value < 0.05 indicates statistical significance.

**Table 3.** Logistic regression analysis with mixed effect model of risk factors of URI

Factor	URI	non URI	<i>p</i> value
Age mean ± SD	33.5 ± 9.6	38.1 ± 9.3	NS
Gender: male:female	4:2	31:19	NS
Experienced: yes:no	3:3	23:27	NS
Work: doctors:nurses:pharmacists:supportive staffs	3:2:1:0	21:16:8:5	NS
Visiting patients: yes:no	5:1	40:10	NS
Visiting locations: fixed:rotated	5:1	29:21	NS
Doxycycline use: yes:no	0:6	12:38	NS
Mask use: yes:no	5:1	49:1	NS
Hand sanitizer use: yes:no	1:5	40:10	0.032

NS: no statistical significance.

*p* value < 0.05 indicates statistical significance.



**Fig. 1.** Hand sanitizer use and acute diarrhea incidence

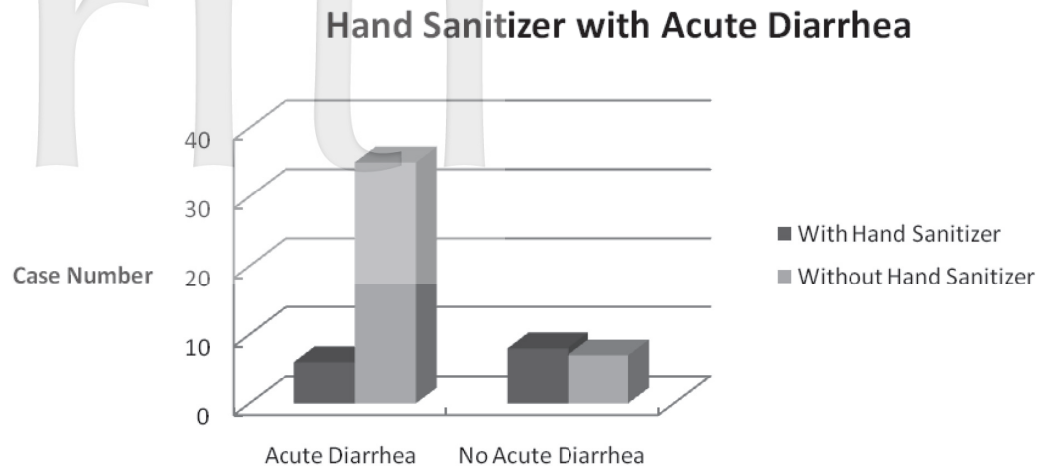


Fig. 2. Hand sanitizer use and URI incidence

relate with protection. The acute diarrhea may have been caused by pathogens in addition to *E. coli*, but this would need to be proven by specimen analysis. Our study does not indicate that chemoprophylaxis for malaria and acute diarrhea using only doxycycline would be effective.

In conclusion, hand sanitizer is suggested to protect medical teams from acute diarrhea and URI in challenging environments. The appropriate chemoprophylaxis for malaria is still dependent on the area of deployment.

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