Original Research Article

Tailored Communications via Social Media in Tackling Zika and Dengue Infections: Findings from a Cross-Sectional Study Among General Public Attending a Public Hospital in Malaysia

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ABSTRACT

Introduction: Over the last few decades, several studies have analyzed and described knowledge, attitudes, and practices (KAP) of populations regarding *Aedes* mosquitoes. However, few studies have described the possibilities of utilizing social media in instilling positive attitudes and practices in curbing Aedes mosquitos' infections.

Methods: A cross-sectional study was conducted among voluntary participation of 400 respondents attending Penang General Hospital, Malaysia. The targeted respondents were mobile phone users. Those whom agreed to participate in this survey were provided with self-administered questionnaires.

Results: From this study, it can be established that majority of the respondents own smart-phone-tablets (88%) and uses social media (87%) which is pivotal for communication. Most commonly used social media types are WhatsApp (82%) and Facebook (78%) applications. Furthermore, owners of smartphone/tablet were keen to obtain information on *Aedes* mosquitoes (p<0.001) and have indicated their preference to be alerted via social media applications (p<0.001). As to conclude, social media will be an important tool in eradication of the Aedes mosquitoes.

Conclusion: Continuous and repetitive information dissemination utilizing social media applications on information, implications, effects, and ways to curb *Aedes* infections may help in instilling positive attitudes and practices among the public.

Key Words: Aedes mosquitoes; Zika; Dengue; Smartphones; Social media; Repetitive information

INTRODUCTION

Zika virus and dengue virus which belong to the Flaviviridae are found in its vector mosquitoes *Aedes aegypti* and *Aedes albopictus*. The manifestations of zika virus are similar as of dengue with additional symptoms in unborn foetuses and infants such as microcephaly, deficits in eye and hearing, impaired growth and Guillain-Barré syndrome. [1] The severe form of the dengue virus infection results in dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS). The fatality rate is approximately 3.6% in Malaysia. The fatality rate in Malaysia is much higher than the fatality rate in neighbouring Singapore (0.003%). [2] Zika and dengue virus can cause recurring and debilitating infections and without adequate treatment, it increases vulnerability to other diseases, affects educational performance of children, and reduces labour market productivity of adults. [1-3]

The health costs associated with dengue are estimated to be US$950 million per year, and the disease burden (based on disability-adjusted life years) is greater when associated with other conditions such as Japanese encephalitis, upper respiratory infections and hepatitis B in the regions of Southeast Asia. [4]

To date, there is neither specific antiviral medicine nor vaccine against zika and dengue virus thus forcing the policy makers implementing prevention policies. The prevention policies include the elimination of adult mosquitoes through fogging or residual sprays, eradication of larvae breeding sites and usage of self-protective items like mosquito treated nets. [5,6]

In Malaysia, identifying and destroying larval breeding sites plus insecticide fogging to destroy adult mosquitoes is the core *Aedes* mosquitoes control activities carried out by the Ministry of Health. Locations, where mosquito's infections were prominent, are known as the dengue hotspots whereby the continuous monitoring and implementation of the above activities are done vigorously. [7] In addition, community-based activity known as Communication-for-Behavioural-Impact (COMBI) has been established in many towns in Malaysia as a platform for community involvement in combating dengue. The COMBI activities involve organizing awareness campaigns, neighbourhood clean-up programs (locally known as 'gotong-royong') and household visits to demonstrate on steps of eliminating mosquito larvae from premises [7] However, study done by Azmawati et al (2013) on COMBI programme, reported that the program had failed to produce desired behavioural impact expected in the community. [8] Moreover, limitation arises in the implementation of the programmes due to the lack of support and involvement from the community. [9]

In several published papers, it was reported that the awareness of the respondents on dengue infection is high in Malaysia. [9-12] However, Danial et al. (2016) reported on low levels of practice to eliminate mosquito larvae and its breeding sites which resulted in the awareness that does not translate into practice among the public. [9]

In recent years, mobile phone services have become the most rapidly adopted technology in developing countries, as the costs of installing mobile phone towers are relatively lower than landlines. [13] Mobile phones play a pivotal role in everyday life for most people mainly for communication or getting information. Thus, the mobile phone services can be a tool for tailored communication and spread of knowledge and practices with lower transaction costs thus improving the delivery of public services. [14,15] This platform can be positively engaged in disseminating information to curb *Aedes* mosquitoes that spread zika and dengue viruses.

Aedes mosquito eradication and elimination programs are better implemented if knowledge and vector control practices of the population are understood and implemented [9,16-18] The present study evaluates the possibilities of utilizing the mobile phone applications to enhance households' health preventive behaviour especially in areas with prevalent infections.

METHODS
Participants
This cross-sectional questionnaire-based survey was conducted among voluntary participation of 337 respondents at the Penang General Hospital, Malaysia. The target population for this study was probable users of mobile applications, with access to smart phones and internet connectivity. In this study, convenience sampling approach was adopted. Participation in this study was from five districts in Penang, Malaysia namely North Seberang Perai (NSP), South Seberang Perai (SSP), Central Seberang Perai (CSP), South West (SW) and North East (NE).

Respondents aged 18 and above who were able to communicate in either Bahasa Malaysia or English were included in this study. Written informed consent was obtained and a brief respondent explanatory note was read out to the participants before distributing the survey. The informed consent process conformed to international standards where participants have learned their rights and had the freedom to stop answering the survey questions at any point. The whole study was conducted for the duration of 6 months and respondents' participation in the survey was about 15 minutes respectively.

The study was carried out after approval from the Malaysia Research Ethics Committee (MREC) (Approval number: NMRR-14-1496-22936(IIR) was obtained.

Validity and Reliability

The questionnaire-based survey was adopted with written permission from Sami et al (2013). [10] The Cronbach alpha of different sections of the questionnaire is between 0.681 to 0.954, indicating good reliability. For the current study, the questionnaire was pilot-tested on 20 voluntary participants to test the appropriateness of the questions and their comprehension. This pilot study revealed that the questions seemed to be readily understood by those who participated in the pilot.

Statistical methods

The data were entered and analysed using the Statistical Package for Social Sciences (SPSS) base version 21.0. The study included descriptive and bivariate analysis.

RESULTS

Survey data from 337 respondents who participated were included in the analysis (Table 1). From this study, it is eminent that most of the study respondents own smart-phone-tablets which is about 298 (88%) and uses social medias as one of the major tools for communication which is

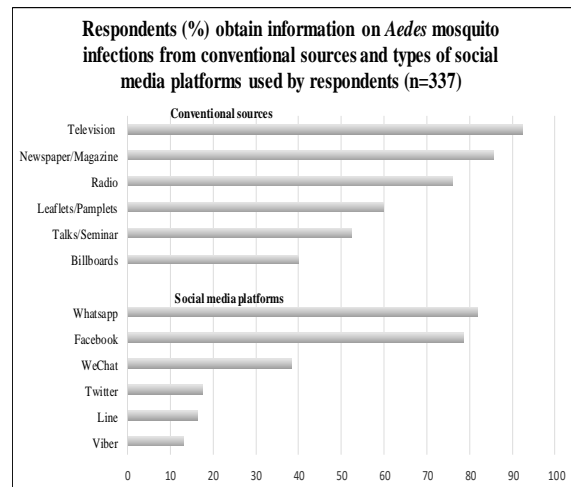about 292 (87%) of the total 337 total respondents.

Figure 1: Respondents (%) obtain Information on *Aedes* mosquito infections from Conventional Sources and types of Social Media Platforms used by the study respondents (n=337)

Table 1: Socio-demographics of the respondents (n=337)

Characteristics	No. (n)	Percentage (%)
Gender		
Male	79	23
Female	258	77
Age group (years)		
≤30	185	55
≥31	152	45
Ethnicity		
Malay	186	55
Indian	53	16
Chinese	88	26
Others	10	3
Marital Status		
Single	162	48
Married	175	52
Employment status		
Employed	214	64
Unemployed	123	37
Education		
Non tertiary	196	58
Tertiary level	141	42
Owns Smartphone/Tablet		
Yes	298	88
No	39	12
Uses Social Media		
Yes	292	87
No	45	13
Locality		
North Seberang Perai (NSP)	52	15
South Seberang Perai (SSP)	31	9
Central Seberang Perai (CSP)	23	7
North East (NE)	165	49
South West (SW)	66	20
Type of Residence		
Single storey terrace	42	13
Double storey terrace	55	16
Bungalow	9	3
Semi-detached	22	7
Apartment	94	28
Flat	75	22
Kampung	32	10
Student Hostel	8	2

The majority of the respondents were females about 77% out of 337 respondents. About 50% of respondents who were below 30 years old and married status participated in this study. Age group was categorized into ≤30 and ≥31 years old as to minimize the number of categories and unnecessary detailing. [19] Ethnic group participations in descending manner were Malay (55%), Chinese (26%), Indian (16%) and others (3%). Others ethnic group included those who are from Sabah and Sarawak states in West Malaysia. They have either lived or worked in Penang and took part in this study. Most of the respondents (58%) received non-tertiary level education (diploma level and below) and were employed (64%).

Demographics based on locality participation in descending manner were North East (NE) (49%), South West (SW) (20%), North Seberang Perai (NSP) (15%), South Seberang Perai (SPS) (9%) and Central Seberang Perai (CSP) (7%). The largest group of respondents were staying in high rise building like apartments (28%) and flats (22%). Percentage of respondents residing in other types of residential types are 16% double story terrace, 13% single story terrace, 10% 'kampung' or village houses, 7% semi-detached, 3% bungalow and 2% student hostel respectively. The socio-demographic results were similar with our previously published data. [9]

Table 2: Knowledge, Attitudes And Practices In Curbing *Aedes* Mosquitoes Infections (n=337)

2.1 Knowledge on Aedes Mosquitoes	No. of Respondents whom Correctly Answered n (%)
Aedes borne disease presentations are chills and high fever, intense headache, muscle and joint pains	332 (99%)
Aedes mosquitoes viruses infects all age group	330 (98%)
Aedes mosquitoes causes vector borne disease	327 (97%)
Aedes mosquitoes breed in stagnant water	316 (94%)
Aedes infection can be inhibited by eliminating its breeding sites	298 (88%)
Aedes mosquitoes larvae can be eliminated with the use of Abate	268 (80%)
Aedes mosquitoes infection bites at all times	258 (77%)
Aedes mosquitoes life span is one week	256 (76%)
Aedes infection can be eliminated by the current vaccine	250 (74%)
Aedes mosquitoes transmission cycle is 'Man-Mosquito-Man'	235 (70%)
Aedes mosquitoes viruses infection in the past among family members worries me	231 (69%)
Aedes infection manifestations can be treated by the uptake of Paracetamol	191 (57%)
Aedes borne disease manifestations are flu-like illness	177 (53%)
Aedes borne disease epidemics is not specific to hot weather	142 (42%)
Aedes borne diseases are transmitted thru direct blood contact	87 (26%)
2.2 Attitudes in Curbing Aedes Mosquitoes Infections	**No. of Respondents whom Agreed n (%)**
Role of the public is most important in curbing Aedes mosquitoes infections	312 (93%)
Seeking treatment is unnessary as there is no cure for Aedes mosquitoes infections	287 (85%)
Thought of risk of being infected Aedes mosquitoes worrying	287 (85%)
Curbing Aedes mosquitoes is the sole responsibility of the local government and public health staffs	223 (66%)
Curbing Aedes mosquitoes infections thru fogging by local municipilaties are adequet	163 (48%)
Agree if weekly fogging done with minimal fee	162 (48%)
Preventing Aedes mosquitoes infections is possible by sleeping under bed-net	93 (28%)
Aedes mosquitoes larvae breeding site elimination is waste of time	49 (15%)
Curbing Aedesmosquitoes by elimination of stagnant water is most essential	50 (15%)
Aedes mosquitoes infections will not happen in a person infected before	32 (10%)
Aedes mosquitoes infect unhealthy individuals	20 (6%)
2.3 Practices in Curbing Aedes Mosquitoes Infections	**No. of Respondents whom Agreed n (%)**
Ensures the water jar is covered	280 (83%)
Ensures the water tank is covered	252 (75%)
Inspects potential indoor and outdoor larvae breeding sites	220 (65%)
Inspects discarded materials that can potentially hold water in the surrounding	204 (61%)
Participates in communal clean-up 'gotong-royong'	201 (60%)
Uses temephos (Abate®) for elimination of mosquito larvae	61 (18%)

Table 3: Association between willingness to obtain information on *Aedes* mosquito from online platforms and socio-demographics variables

	Yes n(%)	OR	(95% CI)	p-value
Gender				0.343
Male	51(65%)	1.00(ref)		
Female	162(63%)	1.32	(0.74,2.34)	
Age group (years)				0.250
$\leq$30	122(66%)	1.00(ref)		
$\geq$31	91(60%)	0.77	(0.49,1.20)	
Ethnicity				0.056
Malay	129(69%)	1.00(ref)		
Indian	24(45%)	0.55	(0.11,2.80)	0.467
Chinese	52(59%)	0.24	(0.04, 1.28)	0.094
Others	8(80%)	0.36	(0.07, 1.88)	0.225
Marital Status				0.361
Single	108(67%)	1.00(ref)		
Married	105(60%)	1.32	(0.73,2.38)	
Owns Smartphone/Tablet				<0.001*
No	4(2%)	1.00(ref)		
Yes	209(98%)	20.55	(7.09,59.53)	
Uses Social Media				<0.001*
No	4(2%)	1.00(ref)		
Yes	209(98%)	25.81	(8.96,74.33)	
Locality				0.980
North Seberang Perai (NSP)	34(65%)	1.00(ref)		
South Seberang Perai (SSP)	20(65%)	1.12	(0.50,2.52)	0.783
Central Seberang Perai (CSP)	15(65%)	1.34	(0.51,3.48)	0.554
North East (NE)	105(64%)	1.22	(0.43,3.45)	0.711
South West (SW)	39(59%)	1.16	(0.62,2.14)	0.644
Residential area affected				0.408
Yes	105(63.6%)	1.00(ref)		
No	108(62.8%)	0.82	(0.51,1.32)	
Employment Status				0.984
Employed	136(64%)	1.00(ref)		
Unemployed	77(63%)	1.01	(0.60,1.68)	
Education				0.793
Non Tertiary	122(63%)	1.00(ref)		
Tertiary	91(65%)	0.93	(0.55,1.59)	
Type of Residence				0.898
Single storey terrace	27(13%)	1.00(ref)		
Double storey terrace	38(18%)	1.24	(0.53,2.91)	
Bungalow	5(2%)	0.69	(0.16,2.99)	
Semi-detached	12(6%)	0.67	(0.23,1.91)	
Apartment	56(26%)	0.82	(0.39,1.74)	
Flat	48(23%)	0.99	(0.45,2.17)	
Kampung	21(10%)	1.06	(0.40,2.78)	
Student Hostel	6(3%)	1.67	(0.29,9.31)	

*significance value (p<0.005)

Figure 1 demonstrates on the various platforms the respondents (%) obtain information on *Aedes* mosquitoes. Typically, respondents obtain information from conventional sources and social media platforms. Examples of the conventional platforms are like television, radio, newspaper where the community obtains information from relevant authority by the ordinary means. From this study, television was recorded as the most prominent source of information on *Aedes* mosquitoes which accounts for 92%. Subsequently, newspapers and magazine have also importantly contributed information on

Aedes mosquitoes to the public which accounted for 85%. Sixty percent (60%) of the participants obtain information from leaflets/pamphlets, 52% from talks/seminars and only 40% from billboards.

In this study, information on the types of the social media platforms that are commonly used by the study participants was also recorded. We discovered that social media platforms WhatsApp (82%) and Facebook (78%) were used extensively by the study respondents as their leading source of information sites. Furthermore, WeChat contributed about 38% on usage for obtaining information. Other social media

platforms such as Twitter, Line, and Viber recorded less than 20% of usage among the study participants.

Table 2 illustrates the knowledge, attitudes, and practices in curbing *Aedes* mosquito infections. More than 90% of knowledge were recorded for questions pertaining *Aedes*-borne disease presentations, infection of all age group, infection vector-borne disease and *Aedes* mosquitoes breeding sites (Section 2.1). More than 80% of respondents answered correctly on infection inhibition by elimination of mosquito breeding sites and *Aedes* mosquito's larvae elimination with Temephos (Abate®). However, only two questions gained the lowest percentages for correct answers which are "*Aedes*-borne disease epidemics is not specific to hot weather" and "*Aedes*-borne diseases are transmitted through direct blood contact" , 42% and 26% respectively.

Attitudes pertaining curbing *Aedes* mosquito infections were shown in Section 2.2. The majority of respondents agreed that public plays the pivotal role in curbing *Aedes* mosquitoes infections (93%); 66% admitted on curbing *Aedes* mosquitoes is the sole responsibility of the local government and public health staffs, and respondents agreed to pay a minimal fee for weekly fogging (48%). On contrary, 85% responded that seeking treatment is unnecessary as there is no cure for *Aedes* mosquito infections.

Practice associated with curbing *Aedes* mosquito infections were accessed and recorded in Section 2.3. Prevention of mosquito breeding was done by covering water jar (83%) and water tank (75%). Over 50% of the respondents inspect for potential indoor and outdoor larvae breeding sites inspects discarded materials that can potentially hold water in the surrounding and participates in communal clean-up 'gotong-royong'. Only about 18% of respondents add Temephos (Abate®), which is a mosquito larvicidal in their water storage containers.

Willingness to obtain information on *Aedes* mosquito from online platforms was associated with socio-demographics variables of the respondents using bivariate analysis (Table 3). Owners of smartphone/tablet (98%) were eager to obtain information on *Aedes* mosquito (p<0.001; OR: 20.55; 95% CI 7.09-59.53). In addition, they (98%) preferred to be alerted on *Aedes* mosquito via their social media applications (p<0.001; OR: 25.81; 95%CI 8.96-74.33).

In terms of demographics; Malay; single; female; age ≤ 30; employed; has a non-tertiary education; living in a high-rise building and affected residential area are keener in obtaining information and updates on *Aedes*. There are no many differences based on the responses from all localities in Penang. No association was found between gender, age, ethnicity, marital status, locality, residential area, employment status and education.

DISCUSSION

Interventions in health communication have been easier with the available smartphone applications which are now becoming progressively important, as means of formal information dispersion. This is because of its ability to penetrate the hard-to-reach populations and disseminate messaging using a variety of interactive and personal modes. [17,18] In this study, it is eminent that owners of smartphone/tablet were keen to obtain information on *Aedes* mosquitoes via their social media applications. Social media platforms are widely being used in countries like Peru, Mexico, Sri-Lanka, Brazil, Singapore and Africa [7,20-24] for dissemination of information in curbing and preventing mosquitoes' infections. However, as reported by Blaya et al (2010), mobile phone service has not yet been used extensively to advance preventive health care in developing countries [6] such as Malaysia.

Social media is an integrative system which incorporates multiple functionalities

in a single system and is easily accessible by anyone, anywhere and at anytime. [7] Social media platforms WhatsApp (82%) and Facebook (78%) are used extensively by the study respondents for information sourcing and the majorities have indicated their preference to receive information on *Aedes* mosquitoes via these applications. These findings have been supported by some published papers which reported the usage of social platforms like Twitter and Facebook during health emergencies and outbreaks to create awareness, tracking disease spread and also to ration popular sentiment. [25-27] In addition, the civic engagement component of the social media platforms is usually built on the concept of crowdsourcing. [7]

Females have more willingness (63%) in getting updates on *Aedes*. This may be due to the role of women who are mostly responsible for the activities related to *Aedes* mosquito prevention inside the house and the tendency to invest more in improving child's well-being and health. [28]

There was also more willingness to receive information and updates on *Aedes* mosquitos from the respondents who reside in residential areas with high mosquitos' infection rate (64%). Evidence suggests that households are more responsive to information on the health risks they face [7,29-31] Thus, more responsiveness may aid in information sharing, as people may share the information they got from the text messages or people who engaged in preventive behaviour may discuss the beneficial outcome with friends and family. [32]

The types of beneficial information for controlling the spread of the *Aedes* mosquito infections that can be disseminated to the public includes mosquito's life cycle, endemic conditions that allow disease spread and ways to curb infection. For effective dissemination of the messages, the messages can be tailored according to the locally used languages possibly with terms and local illness classifications. [7,33] In addition,

establishment and usage of social platforms have the potential to be a cost-effective health care intervention as treatment for a single case of dengue ranges from US$10 to US$2529. [7,33]

Exposure to repeated health preventive information can affect the households health behaviour. [21] A study conducted by Dupas et al (2009) utilizing Breteau Index (dengue risk transmission index) shows that households exposed to preventive information experienced a decrease in the number of water containers per household with positive testing for dengue. This has been explained by changes in household behaviour since there are statistically significant increases in the probability of covering water reservoirs, cleaning of water reservoirs, consumption of safe water and the use of screens in windows or mosquito bed nets. [34] In addition, there were other studies that find positive effects on public behaviour by providing repetitive information over many months. [30,35-37]

In Malaysia, Artificial Intelligence in Medical Epidemiology (AIME) was developed by a group of researchers led by Dr Dhesi. It is a mobile platform that predicts arthropod disease and it is able to warn the public before the onset of dengue and zika. [38] Mo-Buzz (developed by Nanyang Technological University, Singapore) is a social media-based system that can predict dengue outbreak. The social media based systems are able to tap into historical data about weather and dengue incidents and swiftly reports by the public on mosquito bites and breeding sites via smart phones and tablets. These reports can be geographically tagged to the user location via Google Maps. Thus, real-time information can boost the authorities efforts to keep a constant eye on the spread of dengue and more importantly, help in using resources more accurately and in a more targeted manner. [23]

In this study, it was evident that conventional platforms are still being the most imminent information source for the

Aedes mosquito with television (92%), newspapers/magazine (85%) and leaflets/ pamphlets (60%) among the respondents. Dammert et al (2014) reported that in Malaysia, media such as flyers, billboards, and radio advertisements are used to disseminate information on dengue to residents with the key message of '10 minutes a week,' which was to remind residents to check for and remove breeding sites from their homes on weekly basis. [7] In a country like Malaysia that supports increasing rates of internet and cellular service penetration, [39,40] community education and outreach about *Aedes* mosquito infections continues to be executed using outdated media channels like pamphlets and brochures. This therefore, limits the capacity of public health institutions to persuade the public to practice healthy behaviours in curbing dengue is limited. [21] Information dissemination efforts can be strengthened through digital interventions.

Sixty percent (60%) of the study participants participate in communal clean-up 'gotong-royong' and only about 18% of respondents use Temephos (Abate®) for the elimination of mosquito larvae. In a qualitative study conducted by Dickin et al (2014) among the reasons informed by the participants of not adequately involving in communal clean-up ('gotong-royong') are lack of time and it is adequate to keep only the internal part of the residence clean compared to the external area of their residence. [9] One sentiment expressed strongly across all communities was the conflicting attitudes of 'tidak apa' which means 'don't bother' or 'it's nothing,' which are common Malay expressions when not involving in the communal clean-up. [41]

It is not uncommon that several states in Malaysia face water disruption frequently; this thus causes water to be stored for future uses by the residents. This, in turn, becomes a good breeding site for *Aedes* mosquitoes. Therefore, it has been shown that one of the most effective ways to control the mosquito breeding is to provide

households repetitive access to information for knowledge improvement of preventive practices, so that elimination of its breeding places can be done through house maintenance and disposal of unused tires and plastics thus reducing dengue infestation risk. [7,42] Reminders in form of repetitive information can diminish attentional failure. [43]

CONCLUSION

In this study, it was evident that the respondents have high levels of knowledge on *Aedes* mosquito breeding, spread, infection and its complication. However, translating the knowledge to attitude and practice among the public will be a challenging process. Continuous information exposure to the implications, effects and ways to curb *Aedes* infections may help in instilling positive attitudes and practices among the public. Bridging knowledge into attitude and practice can be done via social media applications. Employing social media platforms to disseminate repetitive information could be the key in curbing the *Aedes* mosquito-borne infections. However, one must be aware of the dangers of misleading information that may spread swiftly through social media that could potentially cause public anxiety and worry. Although this study was a step forward in evaluating the potential uses of social media platform in disseminating information and instilling positive behaviour in curbing the *Aedes* mosquito infection, further evaluation studies are needed.

Study Limitations and Future Recommendations

The results in this study were discussed with the acknowledgement of certain study limitations. One major study limitation would be the method of the sampling where convenience sampling method approach was adopted. In addition, this is a single site study. Therefore, the study might be performed in many other

sites for better generalizability for the Malaysian population.

DECLARATIONS

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