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Managing Dengue Disaster: Uncovering Paramount Community Elements for DNA Sensory Tool Accessibility in Malaysia

(Menangani Bencana Denggi: Mengenal Pasti Kepentingan Unsur Komuniti untuk Alat Mengakses Sensori DNA di Malaysia)

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ABSTRACT

In this study, communities' psychosocial judgements (relationship, awareness, responsibility, and attitude) were evaluated in relation to DNA-based dengue kit accessibility. It was carried out by handing out 100 structured questionnaires (Kajang Housing (KjH): 40, Kajang Industrial (KjI): 40, Kuala Selangor (KuS): 20). From our descriptive analyses, KuS respondents exhibited a closer relationship with their neighbours (100%) compared to other respondents. KjH, KjI and KuS respondents know very little about dengue vector species. While KjH is leading the other two study areas, KjI and KuS in terms of knowing all symptoms associated with dengue fever (DF), KuS shows more interest to participate in dengue campaigns and/or prevention and control programs compared to KjH and KjI. Not more than 25% of total respondents are willing to offer transportation or nurturing their neighbours back to health. While KjI is more confident to use DNA biosensor when outside of their community, not more than 35% of total respondents are confident enough to use it within their neighbourhood. All communities, especially the affected ones, should take a proactive step by making use of DNA biosensor as an early warning tool, in conjunction with good psychosocial behaviours towards dengue, to achieve sustainable health promotion in managing dengue disaster.

Keywords: Community-based health promotion; dengue disaster; dengue kit; psychosocial evaluation

ABSTRAK

Dalam kajian ini, pertimbangan psikososial komuniti (perhubungan, kesedaran, tanggungjawab dan sikap) berhubung dengan kebolehcapaian kit denggi berasaskan DNA dinilai. Ia dijalankan dengan mengedar 100 keping soal selidik (Perumahan Kajang (KjH): 40, Perindustrian Kajang (KjI): 40, Kuala Selangor (KuS): 20). Daripada analisis huraian kami, responden KuS menunjukkan hubungan kejiranan yang lebih rapat (100%) berbanding dengan responden lain. Sangat sedikit responden KjH, KjI dan KuS yang tahu tentang spesies vektor denggi. Meskipun KjH mendahului dua kawasan kajian lain, KjI dan KuS dengan mengetahui kesemua simptom yang berkaitan dengan demam denggi (DF), KuS menampakkan minat yang lebih untuk menyertai kempen dan/atau program pencegahan dan kawalan denggi berbanding KjH dan KjI. Tidak lebih daripada 25% responden sanggup menawarkan pengangkutan atau menjaga jiran sehingga kembali sihat. Meskipun KjI lebih yakin menggunakan biosensor DNA apabila berada di luar komuniti mereka, tidak lebih 35% daripada jumlah responden cukup yakin menggunakannya dalam kejiranan. Kesemua komuniti, terutamanya yang terjejas, seharusnya mengambil langkah proaktif dengan menggunakan sepenuhnya biosensor DNA sebagai alat amaran awal, seiring dengan tingkah laku psikososial yang bagus terhadap denggi, bagi mencapai promosi kesihatan yang mampan dalam menangani bencana denggi.

Kata kunci:Bencana denggi; kit denggi; penilaian psikososial; promosi kesihatan berasaskan komuniti

INTRODUCTION

Emergence/re-emergence of vector-borne diseases such as dengue, malaria, and many more is a very complex process which involves numerous parameters. The transmission process of these maladies involves a cycle between infected humans to non-infected female mosquitoes (*Aedes aegypti* and *Aedes albopictus*) and subsequently infected female mosquitoes to healthy humans (Gubler 1998). Innumerous dengue occurrences since World War II, attributed by mobilisation of troops, civilians and equipment, had only proven that transmission of dengue is boundless, currently affecting more than 100 countries from only 9 countries back in 1970. The heavily affected regions include the Eastern Mediterranean, America, Africa with Western Pacific and Southeast Asia (SEA) (World Health Organization 2017). Malaysia which belongs to South-eastern sub-region of Asia continent had faced an endless cycle of dengue threats over the past several decades. In the year 1902, Penang recorded the first-ever dengue case in

Malaysia (Mohd-Zaki et al. 2014). Since then, 2 outbreaks had occurred, firstly in Penang in year of 1902 (41 cases, 5 deaths) and secondly in Selangor in year of 1974 (969 cases, 54 deaths). In 2010, a total of 46,171 cases had been reported with 134 deaths and then illustrated a rather increasing trend of million-digit cases up until the recent year of 2017 (Ab-Fatah et al. 2015; Ishak et al. 2015). In Malaysia, townspeople were more susceptible to dengue which comprises about 70% - 80% of the reported cases in total. It is no secret that Aedes mosquitoes are more likely to concentrate in town areas having a higher density of population and rapid development progress (more urbanised) (Sahani et al. 2012). In addition, it was reported that the highest dengue occurrence in Malaysia was among those of workers and students, with a greater prevalence of dengue fever (DF) compared to DHF incidents (16-25:1) (Abdullah 2005).

Even so, the Aedes persistency nature resulted from adaptation to uncontrollable climates and mutated genes due to fogging, has rendered humans constantly vulnerable to dengue infection throughout their lifetime (Indra & Chong 1982). Change in human activities, particularly when settlement and environmental cleanliness is not consistently being well-maintained, can significantly affect Aedes vectors by generating more oviposition grounds (Awang 2010; Ghafar & Shah 2017; Mondini & Chiaravalloti Neto 2007). For example, the uncontrolled urbanisation especially during times when Malaysia's industrialisation and economy were growing rapidly led to water and waste mismanagement. The non-biodegradable containers i.e. polystyrenes and plastic bags are one of many things that can store clean stagnant water which is preferable by Aedes to lay their eggs. The ever-growing human population size, on the other hand, also increased the number of susceptible hosts. Even worse, in concomitant with noticeable urbanisation growth of Malaysia, increasing migration rate had severely increased the unhindered factor of dengue transmission as well. Not only that, air travelling helps in expedite dengue transmission as well, either by human carriers or the vectors itself, especially when Malaysia is already well-known for its many tourist attractions (Gibbons & Vaughn 2002).

As one bite from infective female Aedes mosquitoes may be enough to cause infection in humans, all sub-regions of Malaysia (East and Peninsular Malaysia) are influenced similarly by different dengue serotypes. It is believed that primary infection with one of DEN serotypes (DEN-1, DEN-2, DEN-3 or DEN-4) will provide a lifelong shield towards that serotype, but sequential exposures to three other serotypes can lead to human life-threatening of DHF or DSS (Weppelmann et al. 2017). Nevertheless, the associated symptoms triggered in humans remained clinically indistinguishable between dengue virus serotypes (Innis et al. 1989). Considering the hyperendemicity nature of DEN serotypes in Malaysia, Dengvaxia® vaccine has not been implemented in Malaysia's National Immunisation Programme (NIS) for full-scale Malaysian population due to its unavoidable limitations (Chew et al. 2012; Sanofi Pasteur 2016). The commercially available test kits are still unable to give accurate dengue confirmation in the earlier stage, owing to their protein-based design which has lower sensitivity (requires a certain level of antibodies which means more days of waiting) and specificity (vulnerable to cross-contamination between flaviviruses) (The Star Online 2015). This is why the advancement in biosensor technology to employ DNA material can deal with the issues of sensitivity and specificity that arise from the laborious dengue determination techniques and prolonged confirmation of dengue severity conditions (Parab et al. 2010). The DNA biosensor technology is very much applicable in various fields such as for agriculture enhancement, drug development, food analysis, forensic recognition, genetic disorder, pathological uncovering, clinical monitoring and environmental inspection (Liu et al. 2000; Tam et al. 2009; Zhang et al. 2007). In terms of diagnostic applications, it can be further extended into emergency room diagnosis, real-time in vivo checking setup, on-site surveillance and home self-monitoring (i.e. by the community themselves) (Malhotra et al. 2005). Due to these reasons, we had also come up with an optical DNA biosensor in hope to relieve the burden of dengue in sustaining public health and significant results have been published elsewhere, just recently, of which rapid dengue detection (30-min response) with the simplest method of detection (observable colour changes) had been achieved (Mazlan et al. 2017).Zn).

STUDY PURPOSE: WHY COMMUNITY ENGAGEMENT MATTERS IN DENGUE TOOL INTEGRATION?

Apart from the widely preferable vector eradication approach and better clinical management of patients, early detection measure also plays an important role in the health sector to reduce the morbidity and mortality cases associated with dengue. The integration of these actions altogether is a determining factor for survivability out of dengue illness due to the short duration between the appearance of haemorrhage and death (dengue haemorrhagic fever (DHF) or dengue shock syndrome (DSS) which surely require immediate medical intervention (Guha-Sapir & Schimmer 2005). In this paper, we are highlighting on the need for DNA-based dengue tool to be accessible at the community level, not just by the clinicians only, to holistically reduce the public health suffering against dengue epidemic in Malaysia. To achieve this, this study aims to evaluate communities based on social perspective (i.e. psychosocial behaviours) to further empower health promotion in practicing dengue DNA sensory tool in Malaysia. This is due to the fact that health promotion, as defined by WHO (World Health Organization 2018) is "…the process of enabling people to increase control over, and to improve, their health."

Thus, to boost management of dengue disaster, there is no doubt that the development of biosensor technology (i.e. DNA biosensor) has given communities the platform to take advantage upon (Malhotra et al. 2005). Nonetheless, it would all be for nothing if community role is not being integrated into the public health regime, utilizing these DNA biosensors. In another word, the community should be given the option to buy and use the kit themselves whenever needed. Despite that, if accessibility were to be authorised by the government, the psychosocial behaviours of communities should be working in parallel with medical practitioners, to solidify health promotion in battling dengue towards improving community health significantly (Abdullah et al. 2013; Azfar et al. 2012). Therefore, if communities' closeness, awareness, responsibility, and attitude (psychosocial judgements) did not align with public health system which aims for early detection approach to allow early response to dengue outbreaks, this would regrettably hinder effective dengue prevention and control measures (Ferreira 2012; Leslie et al. 2017). Our findings provide a novel strategy for holistic management of global dengue disaster utilizing DNA-based early warning system tools.

Materials and Methods

Study areas and reasons for selection

Between January 2017 and October 2017, Selangor reported the highest number of dengue cases (39,158 cases with 59 deaths) which exceeded 50% from total dengue cases in Malaysia (71,892 cases). Totalling up cases from all Federal Territories of Malaysia (Kuala Lumpur, Putrajaya and Labuan) only makes up to 6,785 dengue cases, followed by Johor (6,511 cases) and Perak (4,896 cases). Deputy Health Minister Datuk Seri Dr Hilmi Yahaya said that the high occurrences of dengue cases in Selangor are probably due to mishandling of waste collection system where it can lead to dengue outbreaks. This is as expected since Selangor is an urban state with many development sectors such as construction sites (Bernama 2017) which can serve as Aedes breeding ground. Not to mention that Selangor has occupied the first-tier place with its 6% growth rate (based on the year 1991-2000 data) outranking other Malaysia's states (Hezri & Hasan 2004; Masron et al. 2012).

Hulu Langat District is one of 9 districts under Selangor which has recorded 5,300 cases (16 deaths) as of 21st May 2017, displaying an additional 373 cases (2 deaths) within 8-days gap from 13th May 2017 (4,927 cases, 14 deaths). Within this district area, there are 7 other sub-districts or municipals (*mukim*), defined as the smallest local governing unit (Ampang I, Ampang II, Semenyih, Hulu Langat, Cheras, Beranang, and Kajang) (Pejabat Daerah/Tanah Hulu Langat 2018). All *mukim* other than Ampang (Semenyih, Hulu Langat, Cheras, Beranang, and Kajang) which are governed by *Majlis Perbandaran Kajang (MPKj)* had been identified as dengue hotspots with a total of 3,886 cases (8 deaths). For this study, we have chosen Kajang municipal as our active study area with dengue waves already hitting 132 localities with 27 hotspots (as of 13th May 2017) (Er et al. 2010; The Star Online 2017a). As for the control study area, we have selected Kuala Selangor *mukim* which falls under the jurisdiction of Kuala Selangor District. This is because this rural district experienced only 209 dengue cases in May compared to Hulu Langat District (about 23.5-times difference) (The Star Online 2017b).

Questionnaire design

All data were gathered using questionnaire method, where 100 total surveys were constructed in structural design and prepared in two languages: Bahasa Malaysia (Malaysia's national language) and English. These questionnaires were developed based on advice from faculty members and input from a substantial literature review. Then, all items incorporated for this structural design were pre-tested prior to data gathering step. The survey consists of 4 domains, each pertaining to 1) community relationship (1 question); 2) community awareness (6 questions); 3) community responsibility (2 questions); and lastly 4) community attitude (2 questions). In the first section, it is based on a 3-point scale option (YES, NO or DON'T KNOW) and a fill-in-the-blank question (fill in a number figure). On the other hand, only multiple-choice questions were employed for the second and fourth domain. As in the third section, a 2-point scale option (YES or NO) and multiple-choice questions were applied here.

Data collection and analysis

Random distributions of questionnaires to both local and foreign citizens of Kajang and Kuala Selangor were conducted from February 2017 until April 2017. A total of 80 forms were distributed equally between housing and industrial areas of Kajang (40 forms each), and the rest were distributed in Kuala Selangor (20 forms). This study targeted the head of households or housewives due to their authoritative role in ensuring and sustaining the well-being of their household members.

Descriptive analyses were done on all acquired data and illustrated in more informative presentations (i.e. bar graph, cylinder chart & table). All data were displayed in percentage (%) where the values were obtained by dividing total respondents bearing similar answer, with total respondents from selected study areas (Kajang Housing Area (KjH), 40; Kajang Industrial Area (KjI), 40; and Kuala Selangor Area (KuS), 20), and multiplied by 100.

In the first domain, we determined the communities' knowledge of their neighbours' wellbeing based on the three options given: YES, NO, and DON'T KNOW. 'YES'

(there were neighbours who suffered from dengue in the past 5 years) and 'NO' (there were no neighbours who suffered from dengue in the past 5 years) means they can confirm their neighbours' status, while 'DON'T KNOW' means they do not know or just do not care about their neighbours' dengue history. Data on respondents' knowledge of dengue-infected neighbours were gathered from those who answered 'YES' or 'NO' as they were required to write the value in the questionnaire. In the second domain, knowledge related to dengue vector and its species, symptoms, causes, transmission cycle and preference for oviposition sites were being determined. For the third domain, their interest in joining dengue awareness campaigns and/or prevention and control programs, and also their action(s) when someone close to them or familiar is suspected of DF were being evaluated. The same goes to the fourth domain, where we evaluated their confidence in handling dengue kit (i.e. DNA biosensor) on their own, outside or within their communities (among friends, community leaders and capable people).

Results

COMMUNITY CLOSENESS

Results show that Kuala Selangor respondents (control area) are closer and paid more attention to the wellness of their neighbours (n=20, 100.0%) compared to Kajang respondents (study area), where n(%) was only 17(42.5%) for KjH and 19(47.5%) for KjI, respectively. Total dengue-infected neighbours known by respondents are n=26 for KjH, n=18 for KjI, and n=48 for KuS, respectively (Table 1).

TABLE 1. Community alertness within neighbourhood towards dengue infected neighbours (N=100)

Area	Answer option	Total, n	Total respondents with knowledge, n(%)	Total respondents without knowledge, n (%)	Total neighbors known, n
Kajang Housing Area (KjH), n=40	Yes	6	17(42.5)	-	26
	No	11			
	Don't know	23	-	23(57.5)	-
Kajang Industrial Area (KjI), n=40	Yes	4	19(47.5)	-	18
	No	15			
	Don't know	21	-	21(52.5)	-
Kuala Selangor Area (KuS), n=20	Yes	14	20(100.00)	-	48
	No	6			
	Don't know	0	-	0(0.0)	-

COMMUNITY AWARENESS

As summarised in Table 2, all respondents (100.0%) from respective areas know that mosquito is the dengue vector with 27.5% (KjH,n=7), 12.5% (KjI,n=5) and 15% (KuS,n=3) of them thought that both *A. aegypti* and *A. albopictus* are responsible in transmitting dengue. KjH respondents (n=18,45.0%) are more knowledgeable on all symptoms related to DF compared to KjI (n=14,35.0%) and KuS (n=2,10.0%) respondents. Only 12.5% (KjH,n=5), 12.5% (KjI,n=5) and 5% (KuS,n=1) of respondents from respective areas know that all DEN serotypes are equally responsible in causing dengue. Majority of the respondents are knowledgeable on how dengue is transmitted (KjH: n=30(75.0%); KjI: n=33(82.5%); and KuS: n=16(80.0%)). Upon further questioning on typical Aedes oviposition grounds, more than 50% of KuS respondents answered correctly (n=13,65.0%), which is then followed by KjH: n=19(47.5%) and KjI: n=13(32.5%).

TABLE 2. Community knowledge on dengue infection (N=100)

Community Awareness	Kajang Housing Area (KjH), n(%)	Kajang Industrial Area (KjI), n(%)	Kuala Selangor Area (KuS), n(%)
What animal (vector) that causes dengue?			
Rodent	0(0.0)	0(0.0)	0(0.0)
Mosquito	40(100.0)	40(100.0)	20(100.0)
Spider	0(0.0)	0(0.0)	0(0.0)
Cat	0(0.0)	0(0.0)	0(0.0)
Dog	0(0.0)	0(0.0)	0(0.0)
What are the responsible species of dengue vector in Malaysia?			
A. aegypti	1(2.5)	2(5.0)	4(20.0)
A. albopictus	1(2.5)	2(5.0)	0(0.0)
All	11(27.5)	5(12.5)	3(15.0)
Don't know	27(67.5)	31(77.5)	13(65.0)
What are the symptoms associated with DF?			
High fever	18(45.0)	23(57.5)	16(80.0)
Fatigue	11(27.5)	16(40.0)	17(85.0)
Nausea	8(20.0)	14(35.0)	11(55.0)
Vomiting	13(32.5)	15(37.5)	16(80.0)
Severe headache	12(30.0)	13(32.5)	9(45.0)
Pain behind the eyes	6(15.0)	6(15.0)	5(25.0)
Severe joint and muscle pain	15(37.5)	21(52.5)	13(65.0)
Skin rash	11(27.5)	15(37.5)	7(35.0)
Mild bleeding	1(2.5)	4(10.0)	3(15.0)
All	18(45.0)	14(35.0)	2(10.0)
Don't know	0(0.0)	1(2.5)	0(0.0)
What causes DF?			
Dengue virus serotype 1 (DEN-1)	1(2.5)	0(0.0)	0(0.0)
Dengue virus serotype 2 (DEN-2)	0(0.0)	0(0.0)	1(5.0)
Dengue virus serotype 3 (DEN-3)	0(0.0)	0(0.0)	1(5.0)
Dengue virus serotype 4 (DEN-4)	0(0.0)	0(0.0)	0(0.0)
All	5(12.5)	5(12.5)	1(5.0)
Don't know	34(85.0)	34(85.0)	17(85.0)
How DF is transmitted?			
Female Aedes mosquito bites a healthy person in few days after biting a DF patient	30(75.0)	33(82.5)	16(80.0)
Male Aedes mosquito bites a healthy person in few days after biting a DF patient	6(15.0)	2(5.0)	10(50.0)
Female Aedes mosquito bites a healthy person in few days after touching the skin of a DF patient	1(2.5)	1(2.5)	3(15.0)
Male Aedes mosquito bites a healthy person in few days after touching the skin of a DF patient	1(2.5)	0(0.0)	0(0.0)
Not sure	3(7.5)	4(10.0)	0(0.0)
Where Aedes mosquito breed?			
In container containing clean, stagnant water, inside and outside of house	19(47.5)	13(32.5)	13(65.0)
In container containing dirty, stagnant water, inside and outside of house	27(67.5)	24(60.0)	14(70.0)
In container containing clean, stagnant water, inside of house only	2(5.0)	5(12.5)	8(40.0)
In container containing dirty, stagnant water, inside of house only	2(5.0)	6(15.0)	8(40.0)
In container containing clean, stagnant water, outside of house only	3(7.5)	3(7.5)	8(40.0)
In container containing dirty, stagnant water, outside of house only	2(5.0)	4(10.0)	7(35.0)
Not sure	0(0.0)	1(2.5)	0(0.0)

COMMUNITY RESPONSIBILITY

Almost all respondents are interested to join any campaigns and/or prevention and control programs held by our government in near future with Kuala Selangor respondents being the most interested (n=18, 90.0%), and then followed by Kajang respondents (KjH: n=31(77.5%) and KjI: n=32(80.0%)) (Figure 1).

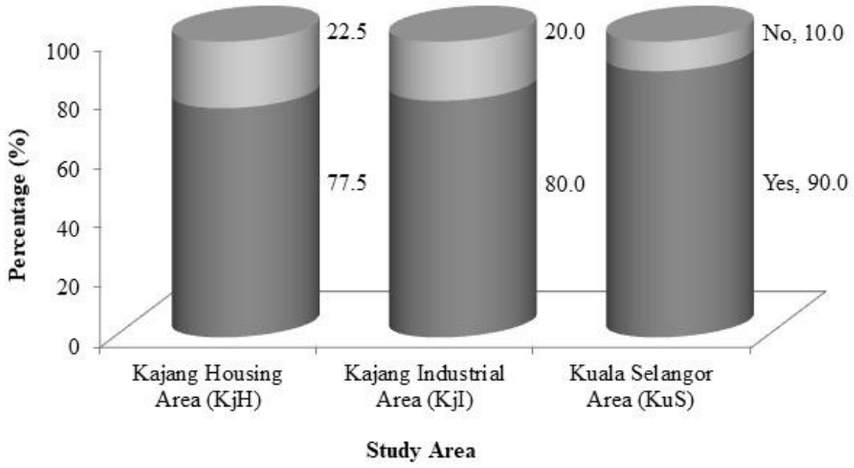

FIGURE 1. Stacked cylinder bar charts showing the communities' interest in joining campaign and/or prevention & control program of dengue

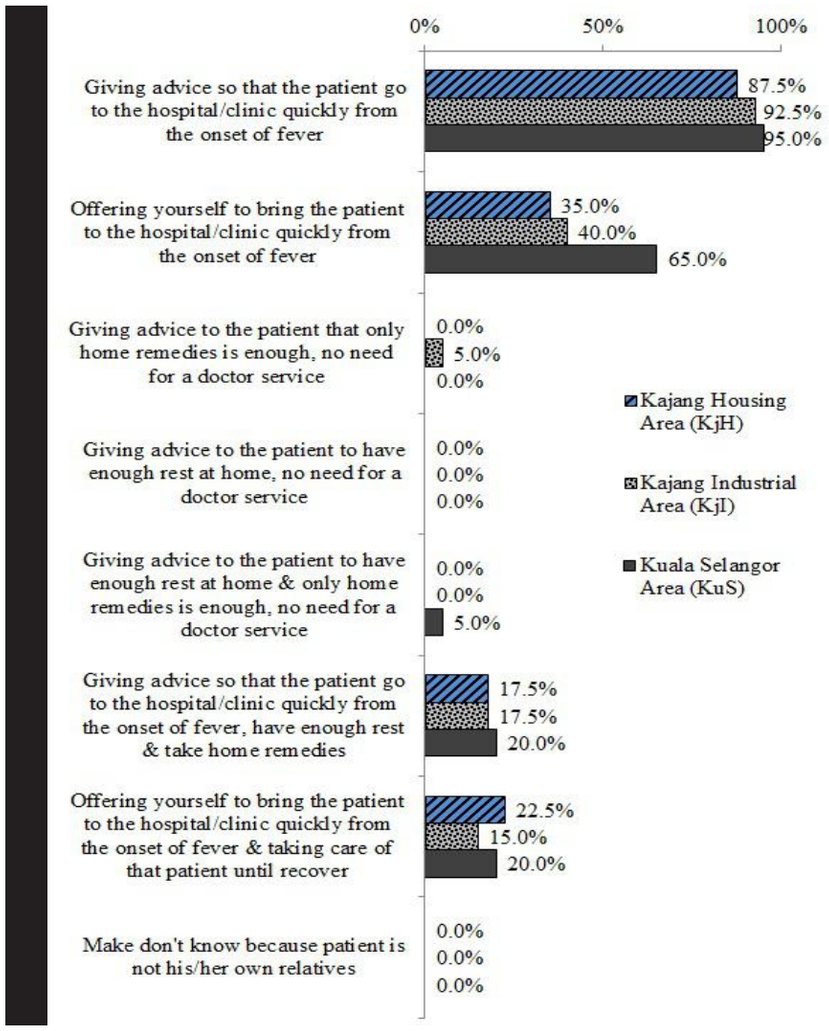

FIGURE 2. Clustered bar graphs representing the respondent's action when someone close to them is suspected of dengue fever (DF)

As depicted in Figure 2, almost all respondents from selected study areas preferred that their family go to the hospital or clinic immediately from the fever onset (KjH: 35(87.5%), KjI: 37(92.5%), KuS: 19(95.0%)). Respondents with more flexible approaches towards fever such as advising patient to go to the hospital or clinic immediately from the fever onset, or resting and taking home remedies are distributed (less than 25%) among the study areas (KjH: n=7(17.5%); KjI: n=7(17.5%); and KuS: n=4(20.0%)). Also, less than a quarter of total respondents in respective study areas are willing to offer themselves to bring the patient to the hospital or clinic quickly from the fever onset and to take care until patient return healthy, where n(%) were: KjH - 9(22.5%); KjI - 6(15.0%); and KuS - 4(20.0%).

COMMUNITY ATTITUDE

In terms of kit handling, KuS respondents displayed a higher level of dependency (n=18,90.0%) where they prefer the health department to help them use the kit rather than using it themselves compared to Kajang respondents with KjH (n=30,75.0%) and KjI with n(%) of 21(52.5%) (Figure 3).

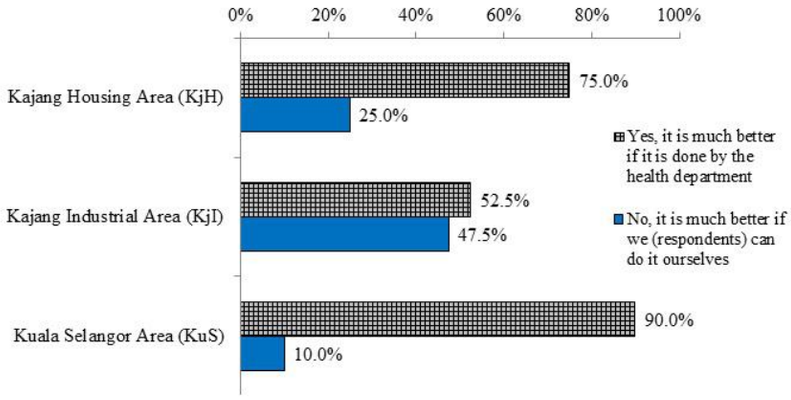

FIGURE 3. Clustered bar graphs portraying the communities' confidence when outside of their comfort zone (not within their community)

As illustrated in Figure 4, respondents of KjI (n=28,70.0%) show a slightly higher level of confidence when compared to respondents of KjH (n=27,67.5%). For KuS respondents, only n=7(35.0%) are brave enough to handle the dengue kit on their own.

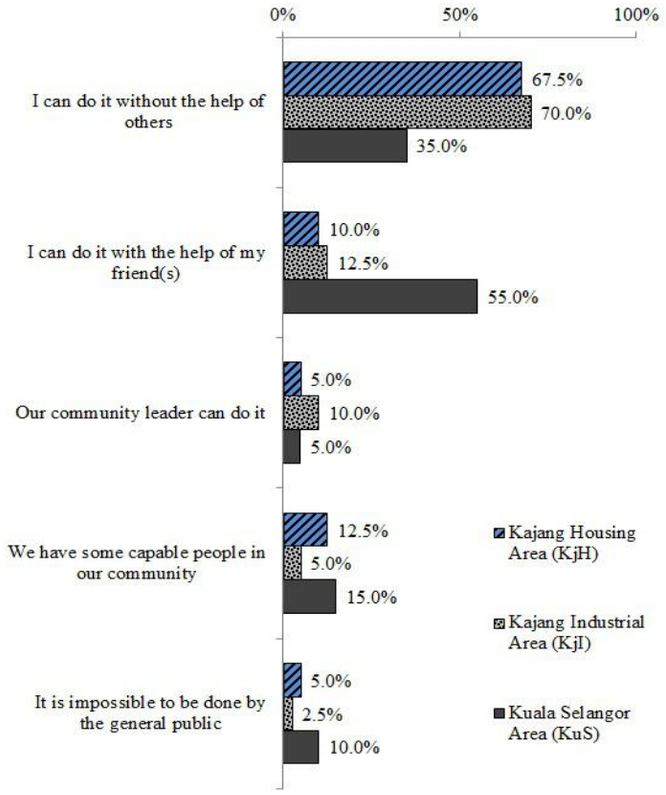

FIGURE 4. Clustered bar graphs depicting the communities' confidence in managing DNA-based dengue surveillance tool on their own, that is when within their community

Discussion

As summarised in Table 1, if more than 50% of these Kajang respondents are concerned enough to know about their neighbourhood severity of dengue, they will instinctively feel cautious to take care of their neighbourhood for the sake of their own family and themselves, and then it would be easier for health officials to do inspections and fogging from time to time. Premises inspection is important in identifying Aedes larvae sites for destruction using temephos (Abate®) while fogging is more for eradicating this vector population in its adult stage (Chen et al. 2005; Teng & Singh 2001). From a study done in Federal Territory of Putrajaya, via semi-structured interviews, health officials stated that there is lesser cooperation from the upper-class neighbourhood as they hardly allow the officials to enter their premises for inspection, and thus bringing about a longer infestation of dengue in that area. Not only that, the wealthy people complained that the fogging activities will surely affect the value of their properties since this technique gives off an unpleasant smell and oily debris. Due to this reason, the officials are targeting more on low- and middle-income neighbourhoods for fogging (Mulligan et al. 2012). Moreover, as we can see in Table 1, KuS respondents exhibited familiarity with their neighbours, knowing as much as 48 people (total) from their neighbourhood, who had suffered from dengue before. This is obviously way more than Kajang respondents.

With regards to dengue awareness, as simplified in Table 2, it is good that all respondents involved are knowledgeable on which vector responsible for dengue disease. This is even better than research done in the southern district of Tamil Nadu, South India where as much as 81% from total respondents associate the mosquito-borne disease with dengue only (Nelson et al. 2017). Sadly, more than half of total respondents (KjH: 27(67.5%), KjI: 31(77.5%), KuS: 13(65.0%)) do not know that both *A. aegypti* and *A. albopictus* are the species that specifically transmitted dengue in Malaysia. Hence, they are not aware of the behaviour associated with these species that make them capable of being dengue vectors. For examples, Aedes anthropophilic nature (prefers human blood), multiple biting habits, biting time (day or night time or certain hours) and frequency (peak times) (Santya et al. 2017). Moreover, only 45% (KjH: n=18), 35% (KjI: n=14) and 10% (KuS: n=2) of total respondents from each respective study areas know all symptoms associated with DF. In comparison with other study involving 300 total Malaysian citizens (urban, semi-urban and rural areas), they reported a higher percentage (95%) of people knowing the DF symptoms (Al-Dubai et al. 2013). Additionally, a total of 45%(n=18), 57.5%(n=23) and 80%(n=16) respondents from respective KjH, KjI and KuS areas associated DF with high fever. Normally, DF-infected patients are distinguished from non-infected ones based on the high fever of more than 37 ºC (up to 40 ºC or higher) with at least 2 other accompanying symptoms (either fatigue, nausea, vomiting, severe headache, pain behind the eyes, severe joint and muscle pain, skin rash or mild bleeding). Various studies have reported that dengue infections did inflict atypical or few symptoms, ranging between 14% to 87% cases (Jacobs et al. 2007; Jelinek 2000). Here, it also means that there are also cases where patients coming to the hospitals/clinics assuming of having fever only or having an illness with no indication of dengue-related symptoms whatsoever, but later found positive of dengue (i.e. undifferentiated fever).

Besides that, without dengue-related information, they will have a tendency to take lightly on precautions needed to prevent skin contact or biting from these species. For instance, *A. aegypti* is regarded as primary vector because they preferred to live and breed around the house (inside and outside) and hence higher chances of contact with humans, compared to *A. albopictus*, the secondary vector which preferred to live and breed in the bushes or garden and thus lesser contact with humans (Chadee 2013; Koenraadt et al. 2006). Our findings showed that only about 25% (KjH: n=10), 22.5% (KjI: n=9) and 20% (KuS: n=4) of respective study areas know that clean, stagnant water is essential for female Aedes to lay eggs, be it inside or outside of human's settlement. This is quite disappointing when compared to a much higher result of 88.5% (n=177 out of 200 respondents) reported for Kuala Kangsar district of Perak (Hairi et al. 2003). The knowledge of Aedes preference sites is particularly important for identifying and destroying Aedes larvae as severe dengue infection could bring fatality to their household members (Mohamad et al. 2014). On top of that, spreading dengue awareness among students by school teachers is considered crucial in the effort to fend off against dengue threat, as children in their delicate stage of development is easier to be reformed to produce a more informed future generation with better behaviour in practicing dengue precautions (Bhatnagar et al. 2016).

Some researchers had reported that knowledge of dengue was related with greater employment of preventive actions and decrease in oviposition sites of Aedes larvae (Chiaravalloti Neto et al. 2003; Swaddiwudhipong et al. 1992; Van Benthem et al. 2002). Additionally, a notable diminution in *A. aegypti* spreading rate was also observed in various studies following the community-based dengue prevention campaigns (Sanchez et al. 2005). Which is why, community participation in campaign and/or prevention and control program of dengue is very important to deliver crucial dengue messages across all groups of communities (i.e. age, gender & races), not just through a short commercial on television or radio. Yet, the remaining 10% (KuS,n=2), 22.5% (KjH,n=9) and 20% (KjI,n=8) of total respondents from respective areas show lack of responsibility by refusing to join any dengue campaigns or programs, probably because they thought that dengue-related information can be easily acquired through television or radio (Figure 1). A study done among a suburban community of Sepang,

Selangor showed that as much as 90.5% (n=276) of total respondents get their knowledge of DF from television or radio (Nur Ain et al. 2017). This is also supported by Al-Dubai et al. (2013) in which they reported that the common source of DF information was obtained through television (97%).

From the results obtained, only 22.5% (n=9), 15% (n=6) and 20% (n=4) of KjH, KjI and KuS total respondents are willing to volunteer in bringing the patient to hospital or clinic immediately from the fever onset and to take care of the patients until full recovery (Figure 2). It is in the communities' best interest to practice the same theme of community-mindedness whenever there are neighbours who are suspected with DF, not just in communal work activities (New Straits Times 2017). Other members of the community should be more proactive and show more concern to their community's health status by offering more helps such as transportation or caring until patient return healthy, not just by giving some generic suggestions. Moreover, there are as little as 5% of total respondents of KjI and KuS areas that are still delusional in thinking that there is no need for doctor service because home remedies and/or sufficient rest is enough to return patients' back to health.

Nonetheless, despite having successful novel technologies developed to detect dengue, the community should also take half of the clinicians' responsibility in fighting dengue menace by not being too dependent on them (New Straits Times 2017; Parks & Lloyd 2004). Meaning that they should learn and be able to independently to handle the DNA biosensor or dengue kit by themselves in the absence of medical practitioners, community leader, friends and other capable people. For example, if 75%, 52.5% and 90% of respectively KjH, KjI and KuS total respondents know how to handle dengue biosensor on their own, then they could easily satisfy their curiosity without having to wait for cumbersome medical check-ups solely to be tested of dengue (Figure 3).

Even though Kuala Selangor district is less affected by dengue compared to Kajang district, but Kuala Selangor is still one of many districts or areas under Selangor, an urbanised state, in which dengue can certainly become a risk to anyone living within this area, anywhere and anytime (Shekhar & Huat 1992). Hence, from Figure 4, the other 65% of total respondents from KuS should be confident in handling dengue kit by themselves without the help from their friends, community leader or capable people within their community environment, when needed, especially concerning someone in their household. Of course, the same goes for the other 32.5% and 30% of total KjH and KjI respondents, respectively.

Discussion

In a nutshell, aside from poverty, ignorance is deemed to be responsible as well in promoting multiple dengue outbreaks (Suárez et al. 2009). Through dengue-related knowledge and awareness, not only that it can give a sense of preparedness to the community, but they would also easily accept on whatever means necessary (i.e. early warning system tools) especially something that is able to give on-the-spot confirmation of dengue. Furthermore, despite the increasing level of knowledge and awareness on dengue diseases (DF, DHF, DSS), there are still many people that are not willing to act on their own because it conflicted with their own self-interest (Parks & Lloyd 2004). The post-World War II events have led to increasing interest towards reliance on hospital and illness management (Young & Hayes 2008). Given by dengue hyperendemicity in tropical zones (i.e. Malaysia), this has posed quite a challenge to public health officers in holding down the fort to battle dengue epidemics. On the bright side, if communities are skillful enough to manage dengue kit when needed or in times of emergency, then they could bypass transportation costs, medicine and consultation fees from time-consuming clinical diagnostics. In real clinical practice, the doctors can only provide side treatments (paracetamol for fever, adequate fluid intake, platelet check, and blood glucose level) owing to unavailability of a specific cure for dengue (World Health Organization 2009). Following this, it clearly explained the reason behind communities' dependency on 'old folk remedies' such as papaya leaf juice, bitter gourd, and *tawa-tawa* leaves brew (Pang & Loh 2016).

Therefore, we concluded from our descriptive studies that there is a dying need for holistic integrated approaches of curative (dengue case management), proactive (relationship, knowledge, awareness, indoor and outdoor precautions, campaigns and programs, and DNA-based dengue tool) and reactive (fogging and larvacide). To achieve this, community along with their psychosocial judgements must be regarded as an important element to link this integrated approach between one and another, not just by the medical practitioners and government only, for the sake of healthier future generation and much more sustainable health promotion intervention in Malaysia. Overall, our findings have future implications for improving public health and the betterment of health policy through the empowerment of community-based dengue tool utilisation.

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