JISTaP http://www.jistap.org
Journal of Information Science Theory and Practice
eISSN : 2287-4577 pISSN : 2287-9099

Research Paper
J Inf Sci Theory Pract 7(1): 17-28, 2019
https://doi.org/10.1633/JISTaP.2019.7.1.2

Dengue-related Information Needs and Seeking Behavior of the General Public in Singapore

Shaheen Majid*
Nanyang Technological University, Singapore
E-mail: asmajid@ntu.edu.sg

Hu Ye
Nanyang Technological University, Singapore
E-mail: huye0001@e.ntu.edu.sg

Hui Yik Tan
Nanyang Technological University, Singapore
E-mail: huiy0005@e.ntu.edu.sg

Lin Xinying
Nanyang Technological University, Singapore
E-mail: xlin013@e.ntu.edu.sg

ABSTRACT
Dengue infection is becoming a serious global health threat. Public awareness is a pre-requisite for the successful implementation of dengue prevention programs. The main purpose of this study was to investigate dengue-related information needs and seeking behavior of the general public in Singapore. Some areas covered by this study were: importance of dengue-related information needs, preferred channels for seeking information, and respondents' perceptions of using dengue-related information. A questionnaire was used for data collection and 152 individuals participated in this study. Data analysis showed that the most sought after information concerned: dengue-related medicines, primary symptoms of dengue infection, and different possible treatments. The popular channels for seeking information were: websites of hospitals and other health agencies, the social media, television, and newspapers. Medical staff, such as doctors and nurses, were trusted for providing accurate information. Although credibility of social media was considered low, respondents were using it due to its easy accessibility. The findings of this study will be useful to government health departments in Singapore as well as in other countries suffering from dengue, hospitals, and public welfare agencies involved in public health awareness campaigns.

Keywords: dengue fever, information needs, information seeking, information quality, communication channels, Singapore

Open Access

Accepted date: March 08, 2019
Received date: January 27, 2019

***Corresponding Author:** Shaheen Majid
Associate Professor
Wee Kim Wee School of Communication and Information, Nanyang Technological University, 31 Nanyang Link, Singapore 637718
E-mail: asmajid@ntu.edu.sg

1. INTRODUCTION

In recent years, dengue has become a widespread worldwide health threat, particularly in Southeast Asia and Latin American countries. The estimated numbers of global annual dengue infections have reached 390 million. According to the World Health Organization, dengue is a mosquito-borne viral infection causing a severe flu-like illness, sometimes leading to potentially lethal complications (World Health Organization, 2019a). The incidence of dengue has increased 30-fold over the last 50 years. Up to 50 to 100 million infections are now estimated to occur annually in over 100 countries, putting almost one-half of the world's population at risk (World Health Organization, 2019b). However, it mostly affects Asian and Latin American countries and has become a major cause of hospitalization and deaths among children and adults. The dengue virus is transmitted through the female *Aedes aegypti* mosquito which acts as a vector (or transmitter). The dengue virus is passed on to humans through the bites of infective female *Aedes* mosquitos, which mainly acquire this virus from the blood of infected persons.

In spite of concerted efforts by multiple agencies, Singapore is still unable to completely wipe out dengue infections. It could partially be due to the reason that Singapore is a popular business and tourism destination and millions of travelers visit Singapore every year, some of whom may be carrying the dengue virus. In addition, hot and humid weather provides good breeding grounds for mosquitos. According to the National Environment Agency, 1,183 dengue infection cases were recorded in Singapore during the last three months of 2018, an increase of 63.6% as compared to the previous quarter (July to September 2018) (National Environment Agency, 2018).

Different government agencies in Singapore use a variety of methods to create awareness about dengue infection through posters, handouts, newspaper articles and advertisements, radio and television interviews, talks and documentaries, public seminars, and various other community awareness programs. However, these efforts could be more fruitful if information dissemination to members of the general public were based on their information needs and information seeking behavior. The main objective of this study was to investigate dengue-related information needs of the general public, their preferred information seeking channels, and their perceptions of the information quality disseminated through different communication channels.

2. LITERATURE REVIEW

Dengue is one of the most rapidly spreading mosquito-borne diseases in the world. It is transmitted by the *Aedes* mosquitoes and mainly found in tropical and semi-tropical urban areas of the world (Boonchutima, Kachentawa, Limpavithayakul, & Prachansri, 2017; Elsinga et al., 2018). The major reasons for its speedy spread are dense human populations, frequent international travelers, and poor vector control (Bhatt et al., 2013). The dengue infection may result in a series of clinical symptoms usually appearing 4 to 7 days after the mosquito bite, which include fever, skin rashes, intense headache, vomiting, and bleeding from nose or gums (Singapore Ministry of Health, 2018). In severe cases, dengue can potentially trigger lethal complications such as plasma leakage, hemorrhagic manifestations, organ impairment and shock, and even death (Singapore Ministry of Health, 2018; World Health Organization, 2019a).

Singapore, with a tropical rainforest forest climate, provides a conducive environment for the spread of all four serotypes of dengue virus (i.e., DEN-1, DEN-2, DEN-3, and DEN-4) and out of these DEN-2 and DEN-3 are considered more dangerous as they can cause secondary dengue infections (Singapore Ministry of Health, 2018). The lack of distinctive seasons, heavy and frequent rainfall, and a highly urbanized environment provide ideal conditions for *Aedes* mosquito habitation in Singapore (Lee et al., 2012; Seltenrich, 2016). Every year, the highest number of dengue cases in Singapore are recorded during July and August months due to high mean temperature (Viennet, Ritchie, Williams, Faddy, & Harley, 2016).

In 2013, there was a record 22,248 reported dengue cases in Singapore, with 842 cases in a single week. In 2016, a total of 13,115 dengue cases was reported in Singapore and 9 of these resulted in deaths. Comparatively, 2018 was a better year as there were a total of 1,282 dengue infection cases with only 5 deaths (Singapore Ministry of Health, 2018). In addition to other factors, lack of adequate dengue prevention awareness and insufficient public engagement were the reasons for the resurgence of dengue infections in Singapore (Viennet et al., 2016). It is in spite of the fact that several government agencies actively participate in the dengue prevention awareness campaigns and use a variety of communication channels to spread the message to different segments of society (Rajarethinam et al., 2018).

For implementing an effective disease awareness program, it is desirable to first adequately understand the knowledge level, information needs, and information seeking behavior of the general public. Firdous et al. (2017) stressed that more

practical health education programs were needed to create awareness and a positive attitude among the community members for effectively preventing and controlling dengue infections. A study by Elsinga et al. (2018) in Venezuela found that preventive practices were associated with better knowledge of dengue symptoms and transmission routes. It was also revealed that dengue-related knowledge was associated with exposure to various information sources. A study in Lima, Peru revealed that low knowledge among the respondents was mainly due to lack of access to appropriate information about dengue virus transmission modes, and the desired measures for its control (Cabrera et al., 2016).

Children are usually more vulnerable to dengue infection, and therefore they need to be knowledgeable about the symptoms and preventative measures. A study involving 601 school students in Islamabad, Pakistan investigated dengue-related knowledge of students exposed to different dengue awareness campaigns. It was found that two-thirds of the students had poor knowledge about dengue, particularly about the spread of its virus (Javed, Ghazanfar, & Naseem, 2018). A majority of the students (72.9%) reported acquiring dengue-related information from television and radio. In addition, 44.6% of the students also acquired this knowledge through the dengue awareness campaigns run by their respective schools. A study of 362 students in Makkah, Saudi Arabia concluded that school-based awareness campaigns and social mobilization can help raise awareness about dengue infection and this knowledge can be translated into sound preventative practices (Alhazmi et al., 2016). Siriwardana and Samarasinghe (2018) suggest that school teachers in Sri Lanka can play a vital role in transferring dengue-related knowledge to students in particular and the community in general. Their findings, based on focus groups and semi-structured interviews, revealed that school teachers possess good knowledge about the spread and symptoms of dengue infection. It was concluded that school teachers, due to their positive attitude, knowledge of dengue infection, and social status in the society, can be used for preventing the spread of this disease.

Basically the spread of dengue virus can be prevented through controlling the population of *Aedes* mosquitoes. Community education, awareness, and cooperation can help reduce the spread of this disease (Harish et al., 2018). In order to successfully reduce dengue infection cases, a comprehensive citizen education and awareness program could be useful (Majid & Rahmat, 2013). Such awareness programs and campaigns can help the general public to remain vigilant and take the necessary precautions to protect themselves from dengue infections. Ooi, Goh, and Gubler (2006) reported that the perceived severity and community awareness of dengue infection can influence the effectiveness of disease prevention and control measures. A study investigating the impact of information, education, and communication on dengue awareness in India showed a significant improvement in dengue-related knowledge of urban households (Nivedita, 2016). Similarly, in Thailand it was found that although information from awareness campaigns regarding malaria and dengue were reaching the target population, certain specific knowledge gaps still exist (Brusich et al., 2015).

A study in Bangladesh by Chowdhury, Haque, and Meyur (2013) found that a close coordination between dengue patients and primary healthcare providers was useful in successfully implementing dengue control measures. A telephone survey of 1,050 individuals in Malaysia showed that, during the H1N1 outbreak, a majority of the people wanted to receive information about virus prevention and treatment through health authorities and mass media (Wong & Sam, 2010). A study by Majid and Rahmat (2013) during the H1N1 outbreak in Singapore found that the most sought after information concerned the disease symptoms, causes of the infection, preventative measures, and possible treatments. During the outbreak of H7N9 virus in Guangzhou, China people were generally more interested in receiving information about disease prevention (75.31%), the current epidemic situation (71.86%), and vaccination availability (63.10%) (Li et al., 2014). On the whole, it appeared that during epidemics a considerable proportion of the general public usually prefer receiving information about the disease symptoms, preventive measures, current rate of infections, and possible treatments.

In addition to understanding the information needs of the general public for epidemic diseases, it is equally important to know about their preferences for different information sources as well as their information seeking behavior. Voeten et al. (2009) reported that disease-related information seeking behavior may determine people's knowledge of diseases, which in turn might influence their health beliefs and precautionary actions. Some other studies also suggest that identification of the information seeking behavior of the general public towards certain diseases is essential for developing customized information distribution strategies to better cater to their information needs (Li et al., 2014; Wong & Sam, 2010). Harish et al. (2018) interviewed 195 parents in Bangalore, India whose children were hospitalized for dengue infection, to assess their knowledge regarding dengue fever, its transmission, possible infection complications, and the desired preventive measures. It was found that television, followed by radio and newspapers, were the popular channels for getting dengue-related information. They concluded that improved knowledge about dengue preventive measures can

ultimately help reduce the transmission of dengue virus in a community.

A study by Wong and Sam (2010) found that visual media, such as television, are more powerful in promoting disease awareness than written media because visual media are more understandable to many people. In Pakistan, Siddiqui, Ghazal, Bibi, Ahmed, and Sajjad (2016) also found that television served as a better communication channel in disseminating dengue-related information than radio and newspapers due to its popularity across different socioeconomic groups in the country. Another study in Pakistan by Hassan, Khail, Waris, Alam, and Marwat (2017) revealed that television and radio were the most preferred sources for seeking dengue-related information. Similar conclusions were also drawn by Yboa and Labrague (2013), who investigated the preferred resources for dengue information among rural population in the Philippines. A study involving 7,772 individuals from 25 provinces of Thailand stressed the role of media in educating and reminding Thai people about the prevention and control of dengue infection (Boonchutima et al., 2017). Studies in certain other countries, such as Malaysia (Hanim et al., 2017), Singapore (Majid & Rahmat, 2013), China (Li et al., 2014), and Brazil (Alves et al., 2016) have also reported the vital role played by mass media and online sources in creating awareness about dengue and other mosquito borne diseases. On the whole, it appeared that for dengue-related information, a majority of individuals preferred receiving information through mass media channels.

The literature review revealed that a majority of the previous studies have mainly focused on the knowledge, attitudes, and practices aspect of dengue infections. Only a limited number of studies are available on dengue-related information needs and information seeking behavior. The purpose of this study was to bridge this knowledge gap and investigate the dengue-related information needs of the general public in Singapore and their preference for different information sources and communication channels. Some areas covered by this study were: frequently sought after dengue-related information, preferred information sources, use of different communication channels, quality of information accessible through different channels, and respondents' perceptions of utilizing dengue-related information. The findings of this study will be useful to health information communicators, hospitals, government health departments, social welfare departments, and other agencies involved in public health and safety in Singapore as well as in other countries. They can also use these findings to assess the effectiveness of their existing dengue awareness campaigns as well as use this knowledge for developing future health awareness strategies.

3. METHOD

This study used a quantitative approach of a questionnaire survey for data collection. Initially content analysis of dengue-related brochures, posters, and other sources was conducted to understand the type of information usually disseminated to the general public. This information was used for designing the survey instrument. The questionnaires of some previous studies on similar topics were also consulted to learn about the type of questions asked and the measurements used by them (Majid & Rahmat, 2013; Li et al., 2014; Wong & Sam, 2010).

The survey questionnaire consisted of four sections and the first section asked respondents about the importance of different dengue-related information needs. A 5-point Likert scale was used to record their responses, where 1 represented the "least important" and 5 the "most important." The next question in this section asked the respondents about the information and communication channels used by them for meeting these information needs. The purpose was to map the information needs of the respondents with their preferred information sources and channels. The information sources/channels included in the questionnaire were: mass media channels (i.e., television, radio, newspapers), Internet sources (i.e., websites of hospitals and other health agencies, social media, general websites including Wikipedia), and other sources which can provide dengue-related information (i.e., healthcare providers such as doctors and nurses; family members, friends, and co-workers; printed posters/brochures). The second section of the questionnaire asked the respondents about their perceptions of the quality attributes of information acquired through these sources or channels. The attributes listed in the questionnaire were: accuracy, timeliness, accessibility, understandability, and information adequacy. The third section of the questionnaire asked about respondents' perceptions of using dengue-related information. A 5-point agreement scale was used, where 1 was "strongly disagree" while 5 was "strongly agree." The last section of the questionnaire sought demographic information on the respondents such as their gender, age group, education, and if they or any of their family members have ever suffered from dengue infection. The study and its questionnaire were approved by the institutional review board of Nanyang Technological University, Singapore (C1201617S2-005).

The questionnaire was pre-tested on six individuals to determine if the language of the questions and their measurements were appropriate and easy to understand. Based on their feedback, some of the jargon used in the questionnaire such as virus types (e.g., DEN-1, DEN-2) and the technical name of dengue mosquitos (i.e., *Aedes aegypti*) were removed.

The pre-tested questionnaire was used for data collection from different geographical zones of Singapore. The questionnaire was distributed at places where people were likely to gather and have enough time to complete the questionnaire such as libraries, student activity centers, and food courts. A total of 152 individuals participated in this study.

4. RESULTS

4.1. Demographic Profile of the Respondents

Out of the 152 participants, 55.9% were male and 44.1% female (Table 1). The age groups of the respondents were not quite well-distributed, partly due to the convenience sampling method. Sixty-four (42.1%) of the respondents were from the age group of 21 to 30 years old, and 83 (54.6%) belonged to the age group of 31 to 40 years, while only 5 (3.3%) were older than 40 years. However, the ethnicity representation was close to the national demographic distribution. There were 114 (75%) Chinese participants, followed by Malays (13% or 8.6%), and Indians (7 or 4.6%). The remaining 18 (11.8%) respondents belonged to other nationalities and ethnic groups.

The majority (58.6%) of the respondents possessed a bachelor's degree while another 28.9% were holding a master's degree. Once again this skewed distribution was due to convenience sampling where data was also collected from different institutions of higher education.

Table 1. Demographic attributes of the respondents (n=152)

Demographic data		Frequency	Percent
Sex	Male	85	55.9
	Female	67	44.1
Age (yr)	21–30	64	42.1
	31–40	83	54.6
	41–50	3	2.0
	More than 50	2	1.3
Race	Chinese	114	75.0
	Malay	13	8.6
	Indian	7	4.6
	Other races	18	11.8
Education	Post-secondary or less	19	12.5
	Bachelor's degree	89	58.6
	Master's degree	44	28.9

4.2. Dengue-related Information Needs

The respondents were asked to indicate the importance of various dengue-related information needs, using a 5-point Likert scale, where 1 represented the "least important" and 5 the "most important" (Table 2). The top three most important dengue-related information needs were: availability of dengue-related medicines and vaccines in Singapore (mean score 4.24); primary symptoms of dengue infection (mean score 4.18); and different treatment options available for dengue infection (mean score 4.14). Some previous studies, although either on H1N1 or H7H9 epidemics, also showed that these were the most important information needs (Li et al., 2014; Majid & Rahmat, 2013; Wong & Sam, 2010). It appeared that for mosquito-borne diseases, the general public usually wish to receive information about the disease symptoms, different available treatments and vaccines, preventative measures, and the current epidemic situation.

On the contrary, the three least important information needs were: the origin of dengue virus (mean score 3.07),

Table 2. Importance of dengue-related information needs (n=152)

Ranking	Information needs	Importance level	
		Mean score (1–5)	Standard deviation
1	Availability of dengue-related medicines and vaccines in Singapore	4.24	0.94
2	Primary symptoms of dengue infection	4.18	0.85
3	Different treatment options for dengue	4.14	0.90
4	Dengue cluster areas in Singapore	4.01	0.94
5	Current dengue status (e.g., no. of infected cases) in my neighborhood	4.01	1.02
6	Potential breeding sites in homes or public areas	3.92	0.99
7	Vulnerable groups and their risk levels	3.81	0.93
8	Availability of protection products (e.g., insect repellent)	3.74	1.06
9	Death rate due to dengue	3.72	0.97
10	Peak biting time in a day of dengue mosquitoes	3.69	1.08
11	Incubation period of dengue virus	3.39	1.04
12	Origin of dengue virus	3.07	1.21

incubation period of dengue virus (mean score 3.39), and the peak biting time in a day of dengue mosquitoes (mean score 3.69). However, it was worth noting that the mean scores for all the listed information needs were more than 3, indicating that the respondents were interested in receiving information on all possible aspects of dengue infection.

4.3. Preferred Communication Channels

The respondents were asked about the information sources and communication channels used by them for seeking dengue-related information. The purpose was to map respondents' information needs with their preferred information sources and channels for seeking the needed information. Based on the top three most preferred channels for acquiring the needed information, it was found that "websites of hospitals and other health agencies" and "social media" were used to satisfy all the listed information needs (Table 3). General websites, including Wikipedia, were used by the respondents to get information about "primary symptoms of dengue infection," "incubation period of dengue virus," "the origin of dengue virus," and "peak biting time in a day of dengue mosquitoes."

Television was among the top three preferred channels for seeking information about "vulnerable groups and their risk levels," and "potential breeding sites in homes or public places." Newspapers were among the top three preferred channels for getting information about "dengue cluster areas in Singapore," and "current dengue status in the neighborhood." Finally, medical staff, such as doctors and nurses, were preferred for seeking information about "different treatment options available for dengue treatment," and "availability of dengue-related medicines and vaccines in Singapore."

Table 4 shows a ranking of the top three most preferred communication channels for satisfying each dengue-related information need. It was worth noting that out of 12 listed information needs, different Internet-based platforms were the first choice for 10 information needs. Television and newspapers were the first choice for only one information need each. It appeared that the participants were heavily dependent on Internet sources for seeking dengue-related information, followed by mass media (TV and newspapers). These findings are in line with some previous studies which showed that online information sources (Li et al., 2014) and mass media (Boonchutima et al., 2017; Harish et al., 2018; Javed et al., 2018) were the most heavily used sources for seeking information about dengue infection.

A summary of the top three preferred sources for 12 dengue-related information needs is given in Table 5. Websites of hospitals and other health agencies as well as social media were considered suitable for meeting 100% of dengue-related information needs. General websites were expected to meet one-third of dengue-related information needs. However, it was worth noting that medical staff (doctors, nurses, technicians,

Table 3. Preferred communication channels for seeking dengue-related information (multiple response)

Information needs	Mass media			Internet			Human sources		Print
	TV	Radio	News-papers	Websites of hospitals and others	Social media	General websites	Medical staff	Family, friends, co-workers	Posters, brochures & others
1. Primary symptoms of dengue infection	44.1	13.2	36.8	60.5	59.9	49.3	29.0	36.8	34.9
2. Incubation period of dengue virus	30.9	6.6	27.0	50.0	44.1	43.4	19.1	15.8	21.7
3. Death rate due to dengue	40.1	11.2	42.1	47.4	43.4	31.6	15.8	12.5	17.8
4. Different treatment options for dengue	21.7	6.6	23.7	60.5	42.8	33.6	42.8	19.1	25.0
5. Availability of dengue-related medicines and vaccines in Singapore	24.3	5.9	28.3	58.6	38.2	30.3	40.1	18.4	23.0
6. Origin of dengue virus	26.3	7.2	26.3	45.4	36.2	53.3	19.1	11.8	13.8
7. Vulnerable groups and their risk levels	38.2	9.9	32.2	52.0	40.8	31.6	25.7	18.4	21.7
8. Potential breeding sites in homes or public areas	46.1	15.8	39.5	45.4	45.4	28.3	15.8	23.0	27.0
9. Peak biting time in a day of dengue mosquitoes	27.6	7.9	24.3	46.7	36.9	36.2	18.4	14.5	19.1
10. Availability of protection products (e.g., insect repellent)	29.6	8.6	28.3	47.4	49.3	27.0	27.0	30.9	19.1
11. Dengue cluster areas in Singapore	44.7	13.2	46.7	50.7	48.0	22.4	9.9	17.1	20.4
12. Current dengue status (e.g., no. of infected cases) in my neighborhood	42.1	14.5	42.8	44.7	44.7	20.4	13.2	23.0	18.4

Values are presented as %.

Table 4. Ranking of top three most preferred communication channels

Information needs	Three top ranked channels		
	1	2	3
1. Primary symptoms of dengue infection	Health websites (hospitals & others)	Social media	General websites, e.g., Wikipedia
2. Incubation period of dengue virus	Health websites (hospitals & others)	Social media	General websites, e.g., Wikipedia
3. Death rate due to dengue	Health websites (hospitals & others)	Social media	Newspapers
4. Different treatment options for dengue	Health websites (hospitals & others)	Social media	Medical staff (doctors, nurses, etc.)
5. Availability of dengue-related medicines and vaccines in Singapore	Health websites (hospitals & others)	Medical staff (doctors, nurses, etc.)	Social media
6. Origin of dengue virus	General websites, e.g. Wikipedia	Health websites (hospitals & others)	Social media
7. Vulnerable groups and their risk levels	Health websites (hospitals & others)	Social media	Television
8. Potential breeding sites in homes or public areas	Television	Health websites (hospitals & others)	Social media
9. Peak biting time in a day of dengue mosquitoes	Health websites (hospitals & others)	Social media	General websites, e.g., Wikipedia
10. Availability of protection products (e.g., insect repellent)	Social media	Health websites (hospitals & others)	Family, friends & co-workers
11. Dengue cluster areas in Singapore	Health websites (hospitals & others)	Social media	Newspapers
12. Current dengue status (e.g., no. of infected cases) in my neighborhood	Newspapers	Health websites (hospitals & others)	Social media

Table 5. Summary of top three preferred channels for seeking dengue-related information (based on 12 information needs)

Ranking	Communication channeled	No. of information needs
1	Websites of hospitals & other health agencies	12 (100)
2	Social media	12 (100)
3	General websites, e.g., Wikipedia	4 (33.3)
4	Newspaper	3 (25.0)
5a	Television	2 (16.6)
5b	Medical staff (e.g. doctors, nurses)	2 (16.6)
7	Family, friends & co-workers	1 (8.3)

Values are presented as number (%).

etc.) were considered suitable for seeking only two out of listed 12 information needs. Basically the respondents were interested in only getting "treatment" related information from medical staff. As medical staff, particularly doctors, are usually busy attending to a large number of patients daily, probably that is why the respondents preferred asking only for essential information from them. For other information needs, they probably thought that they can get this information on their own from other sources and channels.

4.4. Perceptions of Information Quality

Information quality is usually a major concern while seeking health information. The respondents were asked to provide their assessment on five aspects of information quality for different information sources and channels (Table 6). For information accuracy, 113 (74.3%) of the respondents picked medical staff for providing accurate information. Other communication channels considered to provide accurate information by more than one-half of the respondents were: newspapers (63.2%), websites of hospitals and other health agencies (61.2%), and television (59.9%). It was interesting to note that only 11.8% of the respondents felt that information available through social media was accurate although earlier (Table 4) it was among the top three channels for seeking information for all the 12 dengue-related information needs.

It appeared that although a majority of the respondents were using social media for seeking dengue-related information, they were aware that this information may not be completely accurate. It was probably because a majority of the respondents were well-educated and aware of the limitations of information available through social media. However, some senior citizens

Table 6. Perceived quality of dengue information accessible through different channels

Channel		Accuracy	Time-liness	Accessibility	Understand-ability	Adequacy
Television		59.9	44.7	48.7	63.2	34.9
Radio		41.0	37.5	30.3	45.4	23.7
Newspapers		63.2	30.9	50.0	57.2	40.1
Internet	Hospital & health websites	61.2	36.2	59.9	42.1	43.4
	Social media	11.8	49.3	75.0	46.7	21.7
	General websites	18.4	21.1	73.0	48.7	24.3
Medical staff (e.g., doctors, nurses)		74.3	9.9	15.8	39.5	38.8
Family, friends & co-workers		7.2	23.0	58.6	57.9	17.8
Posters, brochures and other materials		45.4	13.8	31.6	59.2	34.9

Values are presented as %.

Table 7. Ranking of communication channels by various information quality attributes

Information attributes	Ranking		
	1	2	3
Accuracy	Medical staff	Health websites (hospitals & others)	Newspapers
Timeliness	Social media	Television	Radio
Accessibility	Social media	General websites	Health websites (hospitals & others)
Understandability	Television	Posters and brochures	Family, friends & co-workers
Adequacy	Health websites (hospitals & others)	Newspapers	Medical staff

and comparatively less educated individuals might not be fully aware of the reliability issue. It is, therefore, desirable that efforts should be made to provide basic information literacy skills to different segments of society (Mokhtar, Majid, & Foo, 2006).

For the time attribute, social media (49.3% of respondents), television (44.7%), and radio (37.5%) were considered as the top three channels for providing timely information. For information accessibility, all the Internet based platforms such as social media (75%), general websites (73%), and websites of hospitals and other health agencies (59.9%) were chosen for easy information accessibility. For information understandability, television (63.2%) was at the top, followed by dengue-related posters and brochures (59.2%), and family members, friends, and co-workers (57.9%). Finally for the information adequacy attribute, the top three channels were websites of hospitals and other health agencies (43.4%), newspapers (40.1%), and medical staff (38.8%).

Table 7 provides ranking of different communication channels based on five information quality attributes.

4.5. General Perceptions of Using Dengue-related Information

A set of 11 statements were used to investigate participants' perceptions of using dengue-related information. A 5-point Likert scale was used for measuring responses, where 1 represented "strongly disagree" and 5 "strongly agree." A majority of the participants agreed (mean score 3.95) that they would more actively look for information if either they or their family members are infected by dengue. A majority of the participants also agreed that usually it is easy to understand dengue-related information (mean score 3.50), the Internet can provide all the necessary information about dengue (mean score 3.25), and that social media is very useful in getting reliable dengue-related information (mean score 3.03) (Table 8).

The remaining 7 statements (i.e., statements 5 to 11) were presented in a negative manner and disagreements with these statements actually represented a positive connotation of the given scenarios. All the negative statements received mean scores of less than 3 which indicate that a majority of the respondents did not agree with these statements. In

Table 8. Respondents' perceptions of using dengue-related information

Statements	Mean score (1–5)	Standard deviation
1. I will actively look for dengue information if I or a family member is infected.	3.95	1.35
2. Usually it is easy for me to understand dengue-related information.	3.50	1.02
3. The Internet can provide all the necessary information about dengue.	3.25	1.02
4. Social media is very useful in getting reliable dengue-related information.	3.03	0.94
5. I don't know how to determine credibility of dengue information available through different information channels.	2.95	1.00
6. Availability of too much dengue information is causing confusion.	2.95	1.00
7. I already know all the necessary information about dengue.	2.81	0.94
8. I feel dengue-related information changes too frequently.	2.71	0.80
9. I receive too much information on dengue from different government agencies.	2.70	0.85
10. Dengue information coming from different agencies is usually contradicting.	2.66	0.91
11. Usually I face difficulty in finding desired dengue-related information.	2.56	0.94

other words, the majority of the participants know how to assess information credibility; too much dengue information was not causing any confusion; they did not think that they know all the necessary information about dengue; dengue-related information was not changing too frequently; too much information was not pushed on them (no information overload); information coming from different agencies was not contradictory; and they were not facing difficulty in getting access to dengue-related information. On the whole, it appeared that the respondents had a good understanding of dengue-related information and were not facing any serious issues in using this information.

5. DISCUSSION AND CONCLUSION

In recent years, the topic of information needs and seeking behavior during epidemics has gained more attention from researchers, and the findings of such studies can be applied in designing effective awareness campaigns. Although for a specific outbreak citizens may have a unique set of information needs, this knowledge can be used for designing awareness campaigns for other similar outbreaks. For example, information needs and seeking behavior for different mosquito-borne diseases such as malaria, dengue, chikungunya, and Zika viruses could have several similarities. This means lessons learnt during one outbreak can be used for developing information communication strategies for possible future epidemics.

This study revealed that the most important dengue-related information needs included information about the availability of dengue-related medicines and vaccines, primary infection symptoms, various available treatments, and dengue cluster areas in Singapore. Previous studies on dengue, H1N1, and H7N9 viruses in different countries had also shown somewhat similar findings. This means that usually the general public is interested in getting information about the symptoms of an epidemic disease, possible treatments, and the necessary preventive measures. Agencies involved in public awareness campaigns can take note of these findings and should try to provide adequate information on these aspects. Currently the Singapore government is actively running dengue awareness campaigns such as "Do the Mozzie Wipeout," mainly focusing on common dengue symptoms, and "Do the 5-step Mozzie Wipeout" with emphasis on key preventive measures. However, it is desirable that the Singapore National Environment Agency should review its campaign messages and try to align these with the information needs of the general public. This review is desirable as a considerable number of respondents said that they do not get access to the necessary dengue-related information. Moreover, the National Environment Agency can also ask its Dengue Prevention Volunteers to share such information during their community visits and public engagements.

Regarding the information seeking behavior, it was found that the participants were heavily dependent on the Internet for getting dengue-related information. This finding is not surprising, as the Internet penetration rate in Singapore is quite

high and according to the Global Information Technology Report, issued by the World Economic Forum (2016), Singapore was ranked first in the world for information technology penetration. According to Singapore InfoComm Media Development Authority, in 2017 around 91% of Singapore households had access to the Internet (InfoComm Media Development Authority, 2018). Thus, heavy dependence on the Internet for seeking dengue-related information is quite understandable. Another possible explanation for high reliance on the Internet could be the demographics of the respondents. A sizeable majority of the respondents were less than 40 years old and possessed a bachelor's degree or a higher qualification. These individuals are likely to be IT literate and comfortable with using the Internet for seeking health as well as dengue-related information.

The most popular source was websites of hospitals and other healthcare agencies. It is understandable as these websites are expected to provide accurate, up-to-date, and comprehensive information about dengue infection. It was also found that social media was also popular, although respondents were aware of the fact that not all the information accessible through this platform is credible. The study revealed that more frequently sought after types of information through social media were: primary symptoms of dengue infection, availability of protective products, and dengue hotspots in Singapore. This indicates that the respondents were familiar with the limitations of social media and were only seeking non-critical dengue-related information through it. They were mostly using authoritative online sources for seeking more critical information, such as different treatment options for dengue infection, and availability of dengue-related medicines and vaccines. The Singapore National Environment Agency should take note of these findings and try to further strengthen its presence on the Web. In addition to revamping its Facebook page, it should also consider other social media platforms such as Twitter and Instagram for disseminating dengue-related and other health information. It is equally important that efforts should be made to enhance information literacy skills of different segments of the society to help them avoid using questionable and low-quality online information.

It is also important to understand that preference for Internet sources does not reduce the power and value of mass media, particularly television and newspapers, for creating awareness about the dengue virus. It is therefore desirable that government agencies should use a variety of communication channels for reaching out to the general public. Although this study was carried out in Singapore, other countries suffering from high rates of dengue infections can also use these findings to decide what information should be disseminated to their citizens and what communication channels will be more appropriate for this purpose.

Overall, the findings of this study provided some useful insights for health information communicators about the types of information required by the general public during health epidemics and their preferred channels for seeking the needed information. In addition, government healthcare agencies, hospitals, public welfare departments, and other agencies involved in designing public health awareness campaigns can use the findings of this study to review their current promotional materials and determine if any changes are desirable. Although the study participants exhibited some knowledge and understanding of the types and quality of information accessible through different sources and communication channels, it is desirable that appropriate measures should be undertaken to further improve the health information literacy of the general public. For this purpose, government agencies can develop online information literacy tutorials and quizzes which can easily be accessed by different segments of the society. Improvement in information literacy skills will empower the general public to seek quality health information effectively and efficiently.

Although the study findings are useful in understanding the information needs and seeking behavior of the general public, it is important to note that these findings cannot be fully generalized to the whole Singapore population. The majority of the study participants were in the age group of 21 to 40 years and possessed a bachelor's degree or a higher qualification. Information needs and seeking behavior of these individuals could be different from teenagers and those individuals who are more than 40 years old. For more comprehensive and generalizable findings, future studies should try to include participants from all age groups with different education levels. Similarly, this study used a survey questionnaire for data collection, whereas future studies can consider using a combination of quantitative and qualitative data collection techniques to collect a more comprehensive dataset.

REFERENCES

Alhazmi, S. A., Khamis, N., Abalkhail, B., Muafaa, S., Alturkstani, A., Turkistani, A. M., & Almahmoudi, S. (2016). Knowledge, attitudes, and practices relating to dengue fever among high school students in Makkah, Saudi Arabia. *International Journal of Medical Science and Public Health*, 5(5), 930-937.

Alves, A. C., Fabbro, A. D., Passos, A. C., Carneiro, A. M., Jorge, T. M., & Martinez, E. Z. (2016). Knowledge and practices related to dengue and its vector: A community-based study from Southeast Brazil. *Revista da Sociedade Brasileira de Medicina Tropical*, 49(2), 222-226.

Bhatt, S., Gething, P. W., Brady, O. J., Messina, J. P., Farlow, A. W., Moyes, C. L., . . . Hay, S. I. (2013). The global distribution and burden of dengue. *Nature*, 496(7446), 504-507.

Boonchutima, S., Kachentawa, K., Limpavithayakul, M., & Prachansri, A. (2017). Longitudinal study of Thai people media exposure, knowledge, and behavior on dengue fever prevention and control. *Journal of Infection and Public Health*, 10(6), 836-841.

Brusich, M., Grieco, J., Penney, N., Tisgratog, R., Ritthison, W., Chareonviriyaphap, T., & Achee, N. (2015). Targeting educational campaigns for prevention of malaria and dengue fever: An assessment in Thailand. *Parasites & Vectors*, 8, 43.

Cabrera, R., de la Torre-Del Carpio, A. G., Jesus, A. I. B., Borit, J. M. C., Fuente, F. J. H, Poma. P. V. U., & Ibarra-Casablanca, E. (2016). Knowledge, attitudes and practices about dengue fever in elementary school students in Chorrillos, Lima, Peru [Conocimientos, actitudes y prácticas sobre dengue en estudiantes de educación primaria en Chorrillos, Lima, Perú]. *Anales de la Facultad de Medicina*, 77(2), 129-135.

Chowdhury, P. D., Haque, C. E., & Meyur, S. (2013). Role of primary care providers in dengue prevention and control in the community: Practitioners' and local laypersons' perspectives in Dhaka, Bangladesh. *International Journal of Integrated Care*, 13. Retrieved January 27, 2019 from https://ijic.ubiquitypress.com/articles/10.5334/ijic.1300/galley/2138/download/.

Elsinga, J., Schmidt, M., Lizarazo, E. F., Vincenti-Gonzalez, M. F., Velasco-Salas, Z. I., Arias, L., . . . Tami, A. (2018). Knowledge, attitudes, and preventive practices regarding dengue in Maracay, Venezuela. *American Journal of Tropical Medicine and Hygiene*, 99(1), 195-203.

Firdous, J., Mohamed, A., Al-Amin, M., Ihsan, M., Imadi, M. F., Hakim, M. K., . . . Muhamad, N. (2017). Knowledge, attitude and practice regarding dengue infection among Ipoh community, Malaysia. *Journal of Applied Pharmaceutical Science*, 7(8), 99-103.

Hanim, A. K., Razman, M. R., Jamalludin, A. R., Nasreen, E. H., Phyu, H. M., SweSwe, L., & Hafizah, P. (2017). Knowledge, attitude and practice on dengue among adult population in Felda Sungai Pancing Timur, Kuantan, Pahang. *International Medical Journal Malaysia*, 16(2), 3-9.

Harish, S., Srinivasa, S., Shruthi, P., Devaranavadagi, R. A., Bhavya, G., & Anjum, S. K. (2018). Knowledge, attitude and practice regarding dengue infection among parents of children hospitalized for dengue fever. *Current Pediatric Research*, 22(1), 33-37.

Hassan, S. A., Khail, A. K., Waris, A., Alam, G., & Marwat, S. K. (2017). Assessment of knowledge, attitude and practices regarding dengue fever among adult population of district Dir Lower, Khyber Pakhtunkhwa, Pakistan. *Pakistan Journal of Public Health*, 7(2), 71-74.

InfoComm Media Development Authority. (2018). *Household access to internet 2007-2017*. Retrieved January 27, 2019 from https://www.imda.gov.sg/industry-development/facts-and-figures/infocomm-usage-households-and-individuals#2.

Javed, N., Ghazanfar, H., & Naseem, S. (2018). Knowledge of dengue among students exposed to various awareness campaigns in model schools of Islamabad: A cross-sectional study. *Cureus*, 10(4), e2455.

Lee, K. S., Lo, S., Tan, S. S. Y., Chua, R., Tan, L. K., Xu, H., & Ng, L. C. (2012). Dengue virus surveillance in Singapore reveals high viral diversity through multiple introductions and in situ evolution. *Infection Genetics and Evolution*, 12(1), 77-85.

Li, T., Feng, J., Qing, P., Fan, X., Liu, W., Li, M., & Wang, M. (2014). Attitudes, practices and information needs regarding novel influenza A (H7N9) among employees of food production and operation in Guangzhou, Southern China: A cross-sectional study. *BMC Infectious Diseases*, 14(4), 1-12.

Majid, S., & Rahmat, N. A. (2013). Information needs and seeking behavior during the H1N1 virus outbreak. *Journal of Information Science Theory and Practice*, 1(1), 42-53.

Mokhtar, I. A., Majid, S., & Foo, S. (2006). Teaching information literacy through multiple intelligences and mediated learning: A quasi-experimental study. *Singapore Journal of Library and Information Management*, 35(3), 10-25.

National Environment Agency. (2018). *Dengue: Quarterly dengue surveillance data*. Retrieved January 27, 2019 from https://www.nea.gov.sg/dengue-zika/dengue/quarterly-dengue-surveillance-data.

Nivedita. (2016). Knowledge, attitude, behaviour and practices (KABP) of the community and resultant IEC leading to behaviour change about dengue in Jodhpur City, Rajasthan. *Journal of Vector Borne Diseases*, 53(3), 279-282.

Ooi, E. E., Goh, K. T., & Gubler, D. J. (2006). Dengue prevention and 35 years of vector control in Singapore. *Emerging Infectious Diseases*, 12(6), 887-893.

Rajarethinam, J., Ang, L.-W., Ong, J., Ycasas. J., Hapuarachchi, H. C., Yap, G., . . . Ng, L.-C. (2018). Dengue in Singapore from 2004 to 2016: Cyclical epidemic patterns dominated by serotypes 1 and 2. *American Journal of Tropical Medicine and Hygiene*, 99(1), 204-210.

Seltenrich, N. (2016). Singapore success: New model helps forecast dengue outbreaks. *Environmental Health Perspectives*, 124(9), A167.

Siddiqui, T. R., Ghazal, S., Bibi, S., Ahmed, W., & Sajjad, S. F. (2016). Use of the health belief model for the assessment of public knowledge and household preventive practices in Karachi, Pakistan, a dengue-endemic city. *PLoS Neglected Tropical Diseases*, 10(11), e0005129.

Singapore Ministry of Health. (2018). *Dengue fever in Singapore*. Retrieved January 27, 2019 from https://www.healthhub.sg/a-z/diseases-and-conditions/192/topic_dengue_fever_MOH.

Siriwardana, E., & Samarasinghe, K. (2018). Secondary school teachers' knowledge, attitudes and preventive practices of dengue fever. *GSTF Journal of Nursing and Health care*, 5(1).

Viennet, E., Ritchie, S. A., Williams, C. R., Faddy, H. M., & Harley, D. (2016). Public health responses to and challenges for the control of dengue transmission in high-income countries: Four case studies. *PLoS Neglected Tropical Dieases*, 10(9), e0004943.

Voeten, H. A., de Zwart, O., Veldhuijzen, I. K., Yuen, C., Jiang, X., Elam, G., . . . Brug, J. (2009). Sources of information and health beliefs related to SARS and avian influenza among Chinese communities in the United Kingdom and the Netherlands, compared to the general population in these countries. *International Journal of Behavioral Medicine*, 16(1), 49-57.

Wong, L. P., & Sam, I. C. (2010). Public sources of information and information needs for pandemic influenza A (H1N1). *Journal of Community Health*, 35(6), 676-682.

World Economic Forum. (2016). *The global information technology report 2016: Innovating in the digital economy*. Retrieved January 27, 2019 from http://www3.weforum.org/docs/GITR2016/WEF_GITR_Full_Report.pdf.

World Health Organization. (2019a). *What is dengue?* Retrieved January 27, 2019 from http://www.who.int/denguecontrol/disease/en/.

World Health Organization. (2019b). *Dengue control: Epidemiology*. Retrieved January 27, 2019 from https://www.who.int/denguecontrol/epidemiology/en/.

Yboa, B. C., & Labrague, L. J. (2013). Dengue knowledge and preventive practices among rural residents in Samar province, Philippines. *American Journal of Public Health Research*, 1(2), 47-52.