Understanding digitally mediated civic engagement for infectious disease preparedness

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**NANYANG
TECHNOLOGICAL
UNIVERSITY**

SINGAPORE

**UNDERSTANDING DIGITALLY MEDIATED CIVIC
ENGAGEMENT FOR INFECTIOUS DISEASE
PREPAREDNESS**

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2019

**Understanding Digitally Mediated Civic Engagement for Infectious
Disease Preparedness**

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A thesis submitted to the Nanyang Technological University
in partial fulfilment of the requirement for the degree of
Doctor of Philosophy

2019

STATEMENT OF ORIGINALITY

I hereby certify that the work embodied in this thesis is the result of original research, is free of plagiarised materials, and has not been submitted for a higher degree to any other University or Institution.

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SUPERVISOR DECLARATION STATEMENT

I have reviewed the content and presentation style of this thesis and declare it is free of plagiarism and of sufficient grammatical clarity to be examined. To the best of my knowledge, the research and writing are those of the candidate except as acknowledged in the Author Attribution Statement. I confirm that the investigations were conducted in accord with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice.

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Prof May O. Lwin

AUTHORSHIP ATTRIBUTION STATEMENT

This thesis contains material from one paper accepted for publication in the following peer-reviewed journal where I was the first author.

Part of Chapter six is accepted for publication as Panchapakesan C, Sheldenkar A, Wimalaratne P, Wijayamuni R, Lwin M. O. Developing a digital solution for dengue through Epihack: Evaluation of a five-day health hackathon in Sri Lanka. JMIR Formative Res URL: <http://formative.jmir.org/2019/0/e0/>. doi:10.2196/11555

The contributions of the co-authors are as follows:

- I prepared the manuscript drafts. The manuscript was edited by Ms Anita Sheldenkar and Prof May O. Lwin.
- I co-designed the study with Prof May O. Lwin and performed all the data collection that included informal interviews and observations during the event. I also analysed the data.
- Ms Anita Sheldenkar, Dr Prasad Wimalaratne, Dr Ruwan Wijayamuni and Prof May O. Lwin provided guidance in the interpretation of the data and structuring the manuscript.

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ABBREVIATIONS AND ACRONYMS

DV	Dependent Variable
IV	Independent Variable
HC	Health Communication
CE	Civic Engagement
DMCE	Digitally Mediated Civic Engagement
HBM	Health Belief Model
PMT	Protection Motivation Theory
SC	Social Capital
PE	Political Engagement
FGD	Focus Group Discussion
TM_USE	Traditional Media Use
IM_USE	Internet Media Use
TM Perceived benefits	Perceived benefits of Traditional Media
IM Perceived benefits	Perceived benefits of Internet Media

SUMMARY

Infectious diseases have tremendous impact on the society. It is a complex health problem that poses a massive challenge in identifying solutions to tackle it effectively. Researchers feel that digitally mediated civic engagement (DMCE), which is a fast-developing field of research within health communication, can potentially help to enhance the health of a community (Boulos et al., 2011). DMCE makes the system faster and efficient by acting as proper bridge between the authorities and the public. The general public could reporting incidents, ask doubts and health authorities can respond to it without time delay. However, the motivators behind individuals' attitude towards and use of digitally mediated civic engagement for health communication are under studied. The major contribution of this Ph.D thesis is to understand the DMCE drivers in the context of infectious diseases based on grounded theory, protection motivation theory and social capital elements.

Dengue has been selected for studying the effect of DMCE, as it is a major health problem, especially in tropical countries such as Singapore, India and Sri Lanka (MOH, 2013, 2014a; Halasa, 2011; Epidemiology Unit, 2017).

This thesis has three main objectives: first, to understand the public's view, use and motivators of DMCE; second, to develop and assess a conceptual model to understand the key factors driving DMCE and third, to understand how digital media designers, medical professionals and developers view strategies that enable DMCE. A series of studies were undertaken to meet these objectives. First, a preliminary study is undertaken to provide a detailed understanding of general public's opinions and views towards DMCE. This study also provides an in-depth knowledge of the motivating factors and barriers of DMCE.

Using the results from this study and existing literature, a second study is planned and executed. A conceptual model is developed based on protection motivation theory and social capital elements to explain the motivators of DMCE, which is tested with a survey study in two countries- India and Singapore. The results of the study show the significant influence that individuals' social capital, beliefs towards disease protection such as self-efficacy and response efficacy, media use, etc., have on their DMCE.

Finally, it is vital to understand and examine the facets that are being considered by developers and health authorities in encouraging DMCE in health communication applications behind the app development process. This is the bedrock of the researcher's third study, which was conducted during an international workshop that brought health and IT professionals together to develop health communication apps for DMCE. Another key outcome of this final piece of research was the identification of other factors that need to be weighed in is the understanding the successful utilization of the tools for health interventions.

A significant contribution of this research is in the understanding of DMCE for infectious disease preparedness in the Asian context. This work is one of the first attempts to construct a conceptual model combining PMT variables with social capital elements to understand the motivators of DMCE in health communication context based on empirical findings and previous literature. The study also provides insights into the factors that are considered by the health developers and authorities while developing health application for encouraging public participation. The findings resulting from this body of research will be valuable in the design of social marketing strategies, educational interventions and framing health messages to motivate public to take part in DMCE.

CHAPTER ONE

INTRODUCTION

1.1 Background

Researchers have been looking for ways to better health communication to the public. Digitally Mediated Civic Engagement (DMCE) and Civic Engagement (CE) are increasingly viewed as one of the possible ideas for enhancing public health. Informal volunteering, caregiving, mutual aid, and other communal actions are some examples of civic engagements that intimates the potential of CE for health. Adler and Goggin (2005, p. 241) defined civic engagement as a concept where "an active citizen participates in the life of a community to improve conditions for others or to help shape the community's future."

In recent times, there are many digitally mediated civic engagement platforms that enable the general public to contribute their ideas or inputs to improve the community. For example. "Fix My Street" is a UK based platform that lets the public to record problems in their locality. The information will be passed to their government officials for action. "Neighborhood Planner" is another website that lets the public post their ideas to improve their surroundings. "City of Future Lab" is another example for an online portal that uses the general public's idea to make the city of Milan a better place.

Hanson (1989) pointed out that researchers have found that a population can achieve long-term health improvements when the public becomes engaged in their community and work collectively to produce change. Health authorities across the world have put in efforts to form positive surrounding and healthy community activities that foster neighbourhood collaborations (WHO et al., 1986). This reasoning

behind citizens' health, an extension of the social change campaigns of earlier times and more recently re-appearing as a powerful concept, highlights the effect of involving the general public in health communication (HC) and increasing public engagement in health promotion, health protection, and disease prevention attempts (Fawcett et al., 1993).

The advancements in the technology add an intriguing dimension to the concept of civic engagement and brings numerous new opportunities to engage people, along with the changing role of individuals in health care and health awareness. Overall, individuals are becoming more interested in taking an active role in health. Current proliferation of technology has made it even more convenient for the public to have access to health information and participate in health promotional activities.

Civic engagement research in health, to date, can be grouped into three main categories. First, explorations regarding associations between civic engagement and health; for example, Viswanath et al.'s (2006) study try to find a relationship between CE and healthcare. Second, the use of civic engagement to enhance public health; for example, Flanagan and Bundick (2011) explained how civic engagement can be used to improve the psychosocial well-being of college students. Third, applications in areas like public health surveillance and data collection through civic engagement for health; for example, Blaya, Fraser, and Holt (2010) evaluated the use of mobile phones on the gathering and organization of data for health research.

1.2 Research gaps and objectives

Civic engagement for health communication is a fast-developing field of study owing to its potential to improve public health. Though the importance of the field is acknowledged there are limited studies done so far on various important aspects of civic engagement. Based on detailed literature review the researcher has identified a

number of areas in the field of civic engagement for health communication that need to be studied. One major factor that will decide the success of civic engagement programs, either offline or online, is public participation. However, the topic of the general public's views and the use of civic engagement particularly for health communication is comparatively less researched. With the advent of digital media (Internet, social media, smartphone, etc.), civic engagement has better access to people through improved communication services and a wider reach of communication. However, previous studies have reported that they have experienced high attrition rates from their participants after a short period of time or the respondents contribute occasionally or irregularly (Theobald et al., 2015; Sauermann & Franzoni, 2015; Arazy & Anderson, 2014). Another major problem mentioned by civic engagement based application researchers are most of the involvement come from very few volunteers (Sauermann & Franzoni, 2015).

The topic of digitally mediated civic engagement in tackling public health concerns is also relatively understudied, as existing studies are still about merging of the civic engagement component into healthcare applications (Boulos et al., 2011). Research on past literature has also revealed that there is a lack of theoretical knowledge about an individual's motivation to take part in civic engagement for health communication, such as promoting preventive actions against diseases or healthy lifestyles, sharing information on diseases, and motivating others to share information and protect themselves from diseases. Also, there is little practical knowledge about how to motivate the public to actively take part in civic engagement.

Resnick (2002, p.6) reported that "In an era of information overload, this cannot be accomplished simply by increasing flows of information. It requires selective highlighting of what is important, so that the people who can benefit from it will

attend to it.” The thesis focuses on creatively using technology for a better future. In our particular case, enhancement in health communication and thus health of the society in general. ‘Why do certain people take part in DMCE and why don’t others’ is a valid question that need to be answered in order to educate the public to be part of the solution.

The dissertation doesn’t assume that the users will eventually adopt an app. The dissertation is aimed to understand the factors that play a role when people decide to use certain apps over others. These factors could influence an application uptake over others. The dissertation aims to address strategies that could be implemented by the health authorities and application developers for improved uptake of an application. The study findings could be used to promote any application that has DMCE element in it, particularly the ones that are created for infectious disease preparedness.

Based on the research gaps identified, this research focuses on identifying a comprehensive theory to explain motivators of civic engagement in the health communication context, particularly taking dengue as the health concern to test the model. Boxall and Purcell (2003) explained that performance is not only influenced by motivation, but also by accessibility and opportunity. For example, the specificity of the request can influence the ability of the crowd to contribute (e.g., having mobile internet connection or a smartphone can be considered as the ability of the crowd). Furthermore, the topic of the request can influence the motivation and the ability of the crowd. Contribution time and interest in the task can also be reasons for the crowd not taking part. These issues are likely to influence the decision of the public to take part in civic engagement. Understanding the factors that will possibly encourage the major population to take part in digitally mediated civic engagement (DMCE) for health

communication is an interesting research area, as there are several potential theoretical and practical implications that can be achieved from this thesis.

In this thesis, digitally mediated civic engagement in health context is operationalized as, "An instance where an active citizen digitally participating (through internet, social media, mobile app, etc.) in the life of a community through sharing information to reduce diseases and to improve the health conditions of others". In this thesis, an active citizen or engaging citizen is defined as "An individual of any community who takes part in the life of the community through digital media". The thesis aims to investigate DMCE for health communication in Singapore, Sri Lanka and India. Below are the objectives of the research.

Objective 1: *To understand (a) how the public views/use civic engagement, and (b) how digitally mediated communication can play a role as a facilitator of civic engagement, within the health communication context.*

Objective 2: *To (a) develop and (b) test a conceptual model proposing key motivators of DMCE for health communication.*

Objective 3: *To understand the elements that are being considered by developers and health experts for encouraging the public to take part in DMCE for health communication.*

To fulfil the research objectives, a mixed-method approach is adopted. First, the researcher aims to understand objective 1 through qualitative interviews and observations. Second, the proposed conceptual model and hypotheses will be tested through a survey to examine objective 2. Third, through qualitative interviews and observations, the researcher aims to accomplish objective 3.

1.3 Scope of the research

From the literature review (Chapter 2), it is understood that even though researchers have mentioned the potential of civic engagement to improve health, limited research has been conducted so far on civic engagement for health, and these studies are scattered all over the field. In particular, few studies have looked into reducing infectious diseases through civic engagement. The WHO (Website) explained that infectious diseases can be spread from one individual to another directly or indirectly and are an after effect of pathogenic microorganisms, such as bacteria, viruses, etc. Infectious diseases used to be localized and only affected the people who lived in the same community or country. With exponentially increased air travel, infectious diseases are spreading, very quickly and widely, from one part of the world to another. Hence, there is an urgent need for it to be studied through a more theoretical lens. There are infectious diseases that can be prevented through collectivistic public action. The vector-borne disease, dengue, is an infectious disease that has a significant burden on the public health especially in tropical regions. The studies in this thesis aim to collect data from three countries, Singapore, India, and Sri Lanka based on dengue burden. Singapore, a multi-cultural developed country, which is a hub for international travels with air traffic alone sums up to 62.2 million in 2017 (Changiairport, 2018), Singapore is also most mobile-savvy country in the Southeast Asia with a mobile penetration rate of nearly 148% (Infocomm Media Development Authority, 2018) and about 73.29% of the population owns a smartphone (The Statistics Portal, 2017), will be an ideal location to start this research.

Despite being developing countries, Sri Lanka and India have a high internet availability and mobile penetration rate. The mobile penetration rate in Sri Lanka has risen from 96% in 2012 to 126% in 2017, based on reports from Research and Markets

(CeylonToday, 2017). The mobile broadband penetration has improved to 21% in 2017, essentially because of the rise in cell phone subscribers (PRNewswire, Website). Among all the cell phone users in the world, India ranked second, surpassing the US in early 2016 and is now moving, rapidly, toward 4G (GSMA, 2016) connectivity.

1.4 The Dengue Problem

Dengue is a mosquito-borne viral disease that globally affects an estimated 390 million people each year (Bhatt et al., 2013). Nearly 40% of the world population live in areas that situate them susceptible to dengue, while around 50-100 million of them get infected. Stanway et al. (2016) estimated that in 2013, dengue was accountable for 1.14 million disability-adjusted life year (DALYs) worldwide. In Singapore, dengue returned after a relative lull in 2011-12 to infect more than 22,000 people in 2013 and nearly 17,000 people in the first 45 weeks of 2014 (MOH, 2013, 2014a). The economic costs to the country are profound. One estimate indicates that the average economic impact of dengue in Singapore ranged between US \$0.85 and US \$1.15 billion from 2000 to 2010. Reporting mosquito breeding sites to health authorities so that they can destroy the breeding sites will help to reduce and prevent dengue.

Sri Lanka, being a tropical country, has a higher risk of dengue endemics as mosquitos thrive in warm, humid areas. In 2016, vector-borne diseases such as the dengue pandemic afflicted 55,150 people in Sri Lanka, 16,767 of which occurred within the Colombo region (Epidemiology Unit, 2017). Two hundred fifteen deaths were reported in the capital city Colombo in the first half of 2017. This was 4.3 times higher than the typical number of dengue cases for the same period in previous years (WHO). With increasing need to combat such health threats in Colombo, Colombo stakeholders have been trying to create a robust disease surveillance system (Mo-Buzz) with the help of a research team in Singapore (Lwin, et al., 2013). Mo-Buzz

integrates predictive surveillance, civic engagement, as well as health education using social media. The concept and system flow are shown in Figures 1 and 2. The current system was designed specifically for health inspectors. The lack of applicability of the application to the general population may be a limitation as the dengue threat proliferates.

Figure 1. Mo-Buzz app concept diagram

Figure 2. Mo-Buzz app system flow

Shepard and his team (2014) reported that yearly average of dengue incidents from 2006 to 2012 was 20,474 in India. Due to inadequate data, the dengue impact is underestimated (Halasa, 2011). Local estimates indicate these officially recorded numbers rather show a minor percentage of the full bearing of the problem (Kakkar, 2012; Undurraga, 2013).

Through DMCE the public can report mosquito breeding sites and the mapping dengue clusters can help in prevention of the disease. This is one of the methods to reduce this disease burden. DMCE makes the system faster and efficient by acting as proper bridge between the authorities and the public. Removing mosquito breeding sites on time will have direct impact on controlling the disease itself and therefore people getting affected by it.

Furthermore, these countries were selected as they also share similar tropical environment. The purpose of conducting this research was to understand if results can be replicated across countries that have similar dengue burden, tropical environment and mobile penetration rate. Except for a few outliers, most of the factors were replicated across all the countries. These different factors that varied across countries are mainly because of their different medical system, type of government and degree of trust. These factors are elaborated further in the respective sections of the thesis.

1.5 Significance of the research

This research will be one of the first that focuses on understanding civic engagement in health context and will propose and test a conceptual framework to explain digitally mediated civic engagement for health, particularly infectious diseases. The concepts of the conceptual framework proposed in the study will hopefully pave the way for further research. In practice, the findings of the research aim to help researchers, mobile application developers and website developers who are

working on civic engagement for health. They should be able to understand motivators of digitally mediated civic engagement and use it to encourage participants accordingly. The findings of research can also be used for policy making and developing health education strategies.

1.6 Framing of the Thesis

The thesis tries to address two sides of the research gap. Studies one and two are planned and executed sequentially. Study one and two try to understand the public's point of view, at the same time study three is not continuation of study two. It is trying to answer tactics used by health authorities and health application developers. Figure 3 explains the same.

Figure 3. Framing of the thesis

1.7 Organization of Thesis

The structure of this dissertation is grouped into several chapters as follows.

As shown in Figure 4, the first chapter documents the changes that have happened with the introduction of two-way communication through digital technologies in the health care domains, and the potential benefits of mobile-based digital tools/applications for better health care. The chapter also discusses the magnitude of dengue fatality in the global context as well as in the context of the countries studied and what can be achieved with digitally mediated civic engagement. It also ascertains gaps in the current health communication strategy to address dengue burden, especially in developing countries. Thus, the chapter creates a proposal to understand whether digitally mediated civic engagement can be used to reduce dengue burden.

Chapter Two gives an overview of the previous literature on understanding civic engagement and the purposes for which it has been used in health communication research. An in-depth review was presented at this stage with the aim to provide background knowledge to understand civic engagement such as its definition and how it has been used in health research. Numerous sources, such as books, journals, seminar and conference proceedings, were studied to understand the existing knowledge in the field. After that, different categories and future directions of the current interventions for understanding civic engagement in the context of health were identified from the existing studies. Articles from leading journals and relevant conferences on psychosocial aspects of public engagement were reviewed to clarify the research gaps and trends. The goal is to highlight the gaps that exist in research about strategies pertinent to reduce the infectious disease rate. In doing so, it reviews

the evidence of existing studies that have used civic engagement for various types of health causes.

Chapter Three aimed to research the objective one by conducting a preliminary study using qualitative techniques in Sri Lanka, Singapore, and India. The preliminary study aimed to understand the public's view, use and intentions towards DMCE for infectious disease preparedness through focus group discussion sessions.

Participants were university students from the University of Colombo (Sri Lanka), Nanyang Technological University (Singapore), and the University of Kerala (India). The infectious disease used in this study was dengue. The study also aimed to understand interrelations among barriers, motivators, and use of a mobile application with a digitally mediated civic engagement (DMCE) component. The results from the preliminary study gave us in-depth knowledge of psychosocial factors towards DMCE.

Chapter Four develops a conceptual framework that assesses the factors that influence DMCE for health communication. This framework hypothesizes that media exposure and social capital are associated with individuals' civic engagement for health communication.

Chapter Five tested the conceptual model developed in the previous chapter using a survey study conducted using a qualtrics survey in late 2017. The data was collected online from two countries: Singapore and India. Method, analysis, and findings are then discussed.

Chapter Six aimed to understand, through the lens of grounded theory approach, via informal interviews and observations, the aspects that are being considered by developers and health experts for encouraging CE in a health communication

application. This study also helps us to pinpoint other elements that need to be evaluated during an application development and maintenance stages.

Figure 4. Research steps

Chapter Seven informs the overall research findings in line with the research objectives, conclusion, and implications of the research. It also suggests a set of key learning points to keep in mind while creating civic engagement platforms. This last chapter critically examines several aspects of the research and highlights areas for potential future work that would address other pressing issues identified in the studies.

CHAPTER TWO

LITERATURE REVIEW

The chapter aims to understand the existing information in the area of civic engagement for health through a systematic overview. General background knowledge on civic engagement is outlined to understand the meaning, prevalence, effects, and uses of civic engagement. The existing studies identified in the review help to distinguish what has been done in the area and what needs to be undertaken according to the research objectives mentioned in Section 1.2.

To understand and differentiate civic engagement from concepts related to it, a taxonomy is developed (Table 1) to highlight the type and level of engagements.

Table 1. Taxonomy table

Type of engagement	Level of engagement: Definition	Citation
Social capital (SC)	<p>Bourdieu defined SC as "The aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition."</p> <p>Coleman defined SC by its functions as "a variety of entities with two elements in common: They all consist of some aspect of social structures, and they facilitate certain actions of actors-whether persons or corporate actors-within the structure."</p> <p>Putnam defined SC as the "features of social organizations, such as networks, norms, and</p>	<p>(Bourdieu, 1985, p. 248)</p> <p>(Coleman 1988a: p.S98, 1990, p.302)</p> <p>(Putnam, 1993. P35-36)</p>

	trust, that facilitate action and cooperation for mutual benefit.”	
Volunteering	<p>Volunteering is defined as “the voluntary giving of time and talents to deliver services or perform tasks with no direct financial compensation expected. Volunteering includes the participation of citizens in the direct delivery of service to others; citizen action groups; advocacy for causes, groups, or individuals; participation in the governance of both private and public agencies; self-help and mutual aid endeavors; and a broad range of informal healing activities.”</p> <p>Volunteering is “offering themselves for a service without obligation to do so, willingly, and without pay.”</p>	<p>(President’s Task force on Private sector Initiatives, 1982, p.4)</p> <p>(Shure, 1991)</p>
Crowdsourcing	“Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.”	(Howe, 2006).
Public participation	Public participation may be defined as a general level as “the practice of consulting and involving members of the public in the agenda-setting, decision-making, and policy-forming activities of organizations or institutions responsible for policy development.”	(Rowe & Frewer, 2004).
Civic engagement	Civic engagement is defined as “an active citizen participates in the life of a community to improve conditions for others or to help shape the community’s future.”	(Adler & Goggin, 2005, p. 241)

Civic engagement is defined as an activity carried out by a member of the community to make and shape improve surroundings for the general public and help to improve the society's future (Adler & Goggin, 2005). CE can be either online or offline. In this thesis, the focus is on digitally mediated civic engagement (DMCE), i.e., civic engagement through digital media. DMCE is conceptually defined as “an active citizen digitally participating in the life of a community to improve conditions for others or to help shape the community's future” (modified based on Adler & Goggin, 2005, p.241) Several concepts are similar to civic engagement such as social capital, public participation, volunteering, and crowdsourcing. These engagements and their definitions are discussed in the taxonomy table (Table 1). Even-though these concepts are similar to each other, they differ from each other in some levels. To explain further, the idea of civic engagement is related to volunteering; volunteering is offering themselves (investing time) for a service whereas civic engagement can be sharing valuable information to improve the life of others, not necessarily spending time. Public participation deals with engaging the public particularly for “agenda-setting, decision-making, and policy-forming activities” for policy development whereas civic engagement is citizens participating in the life of the community for its betterment, not necessarily for policy developments. Similarly, “civic engagement is a manifestation of social capital but not social capital itself” (The social capital foundation, webpage).

Civic participation and civic engagement are two terms that are being interchangeably used in many instances. Study.com explained civic participation as “Civic participation is the way we involve ourselves within our community. The degree to which we engage ourselves relates to how much we make a difference in the lives of those around us. It is active involvement that focuses on the common

good”. The explanations for civic participation is very much comparable to civic engagement. Hence it could also be argued that both terms mean the same thing and can be interchangeably used. In this thesis, civic engagement was selected as it was clearly defined in the literature more times than participation. It also felt more specific about one engagement, one incident or an activity such as sharing information or reporting an incident while participation tend towards spending time or volunteering time for a cause.

Another term that is similar to civic engagement is civic information sharing. Civic information sharing is happening in the disease scenario selected for the thesis and civic information sharing may not always be classified as civic engagement. However, from the literature civic engagement is defined as an activity carried out by a member of the community to improve surroundings for the general public and help to improve the society’s future. So, in the context of health communication, civic information sharing will essentially help in the continuous improvement of health of the general public. And hence, it was defined as civic engagement in the context of infectious disease preparedness.

Civic engagement can be either online or offline, in this thesis the researcher will only be looking at civic engagement that occurs through digital media and this is termed as digitally mediated civic engagement (DMCE). DMCE can be through the internet, mobile phone or social media. DMCE is very similar to crowdsourcing. Crowdsourcing is getting the public to do a task that is conventionally done by a selected individual or an employee (Howe, 2006) and not necessarily for the betterment of the society whereas DMCE is individuals deciding to share information with others through digital medias to advance the general well-being of a community. Hence crowd-sourcing is different from DMCE.

2.1 Civic Engagement Background in Healthcare

Civic engagement is increasingly viewed as a potential medium for improving healthcare, and a considerable amount of studies already exist on the various forms of community engagements such as informal volunteering, care-giving, public participation in community activities etc. Numerous applications currently allow the general public to use Internet-enabled smartphones to provide on the go updates of vehicles on the road or upload audio recordings of noise levels on the paths. This data is used to generate a noise pollution map of the city at different points of time during the day including for weekdays and weekends (Kanhare, 2011). These apps that enable input from the general public are usually called as ‘crowd-sourcing’ or ‘participatory sensing’ applications because these apps capitalize and utilize the strength of the people through civic engagement to achieve their aims (Boulos et al., 2011).

Geolocation-aware mobile crowdsourcing applications such as Love Clean Streets, and HealthMap’s Outbreaks Near Me exploit the power of smartphones and high-speed internet to give various potential stages of civic participation. These applications show how public participation-enabled applications are revolutionizing problem-solving and enabling almost anything, anywhere to be monitored and acted upon just after the information is submitted without any time delay.

M-health will have remarkable advantage with public participation particularly in phone-based health risk communication and response systems to obtain more accurate information regarding diseases in disease prevalent areas. However, for these systems to be implemented efficiently, there needs to be higher social awareness of the need and effects of civic engagement in the field of healthcare. Moreover, there is a need to understand the prevailing social beliefs in the areas in which these systems are implemented and to do that the systems that are currently available must be studied.

While the existing research demonstrates civic engagement as a research tool, not much is identified about the categories of questions civic engagement answers appropriately and its limitations. High quality data collection is expected in studies related to health care and hence it is executed mostly by professionals. Additionally, participants who take part in health research often need protection about privacy and physical harm. To comprehend the use of civic engagement approaches in health-communication research, a systematic literature review was conducted to detect the primary peer-reviewed studies on civic engagement in healthcare and health communication. The goal was to determine the types of healthcare and health communication problems that civic engagement has been used for and the methods were used to solve these issues. This will help us define future research opportunities and challenges.

2.2 Study Procedure

Methodical Literature Search was conducted in late 2014, by exploring NTU One Search, International encyclopedia of communication online, Oxford bibliographies and Google Scholar using a search string as follows: "Civic engagement" OR "Social movements" OR "POLITICAL Participation" OR "PUBLIC interest" OR "Social action" AND "public health" OR "community health" OR "NATIONAL health" OR "HEALTH promotion" OR "health communication" OR "health education". A multistage selection process was used whereby the obtained papers were combined, and copies were separated. Based on the inclusion condition, the researcher evaluated the abstracts of the papers for their applicability to the study and then assessed the papers based on their full-text for confirmation. The authors of the published papers that met the inclusion norms were probable to be experts in the area of research. Additional articles were obtained by going through the reference of

the initial set of selected papers to identify potential papers and Google Scholar, International encyclopaedia of communication online, Oxford bibliographies and NTU One Search were also searched with the name of the authors of all the papers that met the researcher's selection criteria.

The studies were included based on the following inclusion conditions: (i) peer-reviewed articles on public health, (ii) health care mentioned, (iii) civic engagement suggested. Studies that included a point of view, outlines, commentaries, and wikis only produced material but did not answer any particular research question were excluded from the review. The Internet-based survey studies that did not contain the search keywords used in the study in their title or abstract were not included in the study. Certain studies had the keywords searched in their title and abstract, those were excluded after going through the abstract and confirming that they were not suitable for the literature review. For e.g. papers like "Hawkes, C. (2007). Regulating and litigating in the public interest: regulating food marketing to young people worldwide: trends and policy drivers. *American journal of public health*, 97(11), 1962-1973.", "Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health promotion international*, 15(3), 259-267." were excluded as they were focusing on Food marketing, health literacy and not on civic engagement or public participation towards public health.

The researcher obtained the following reported information from the selected articles (i) "research framework, title, author, publication year, research field, methodology type, study objective, study outcome, monetary incentives offered, (ii) demographic and other features of the respondents like size of the sample, age, gender, racial/ethnic background, geographic location, job, education, connection to the

research problem,” as suggested by Higgins & Green (2011) and (iii) the administration of civic engagement in various forms. The administration of civic engagement in various forms were coded to explore and understand what kind of themes developed. Based on the results use of civic engagement could be grouped into three categories of studies. The researcher examined and gathered information from these research and summary statistics was used to represent the amount of studies and results from the studies.

2.3 Key Findings

Systematic Literature Search

Fifty individual journals articles were identified from the One Search database and Google Scholar. Of the 50 articles, 25 articles were evaluated after going through the whole paper, of which 15 satisfied the eligibility guidelines. The final cohort comprised 18 different health research related journals and articles that are peer-reviewed and used civic engagement or crowdsourcing as the main research component.

Study Characteristics

Three types of research tasks relating to civic engagement were identified: the association between CE and health, the use of CE to enhance public health and civic engagement via digital media for healthcare and communication.

2.3.1 Impact of Civic Engagement on Health care

Five of the 18 studies tried to find an association between civic engagement and health care (causality: civic engagement leading to better health). Three of these five studies defined and tried to measure civic engagement. The dependent variables in these studies were cardio vascular disease message recalling (Viswanath et al., 2006), self-rated health (Khawaja et al., 2006), contribution to society (Martinez et al., 2011),

increasing social engagement and decreasing isolation (Cullinane, 2008), obesity (Bagdonis, Hinrichs, & Schafft, 2009). Viswanath et al. (2006) mentioned the theory of social capital but did not use it, and Khawaja et al. (2006) used Putnam's concept of civic engagement. Four of the five research were carried out in the United States (Viswanath et al., 2006; Martinez et al., 2011; Cullinane, 2008; Bagdonis, Hinrichs, & Schafft, 2009) and one in Jordan (Khawaja et al., 2006). Two research (Viswanath et al., 2006; Khawaja et al., 2006) were survey studies with around 2000 participants, and two used qualitative methodologies such as focus group discussions (Martinez et al., 2011), observations, and semi-structured interviews (Bagdonis, Hinrichs, & Schafft, 2009) and one study discussed four civic engagement programs (Cullinane, 2008). Most of the respondents in the research were of lower social economic status and lower educational background. In all the reviews, civic engagement was found to have a positive influence on the participants' health.

Viswanath et al. (2006) measured effects of CE using society ties, size, character of the community on an overall number of messages (specific and nonspecific), about cardio vascular disease (CVD) recalled and no. of specific CVD messages remembered. The study reported community membership could potentially increase exposure to health messages, proving a significant suggestion that social capital (SC) can conceivably improve individuals' health and thus public health outcomes.

Khawaja et al. (2006) used items such as "membership in clubs" and "civic associations, newspaper reading", and news attention on TV to gauge CE and used self-rated health as the dependent variable for the study. In their study, gender difference in community participation was reported. They also mentioned that CE was a strong and notable predictor of self-evaluated health for males but not for females.

Khawaja et. al. (2006, p. 197) explained that continuing patriarchy and lower

education among the females could be accountable for non-relation between CE and their self-evaluated health.

Martinez et al (2011) tried to understand the definition of volunteering and CE from the participants. The participants were asked to define what they considered to be volunteering. No particular health issue was specified, and the study measured barriers, motivators, and benefits of CE amongst older participants. The study concluded that CE involves more than formal volunteering and notable limitations must be reduced or eliminated to create higher engagement of older participants in formal and informal exercises. Cullinane (2008) defined civic engagement in his study as “older adults’ participation in activities of personal and public concern that are both individually life enriching and socially beneficial to community” and the study explained how older individuals stay healthy and help others by taking part in civic engagement activities such as providing social, emotional, and practical support. Bagdonis, Hinrichs, & Schafft (2009) used civic engagement by introducing farming and healthy eating habits to reduce obesity in children.

2.3.2 Use of Civic Engagement to Enhance Public Health

In the previous section, papers used civic engagement as an independent variable affecting the health of individuals, whereas in this section civic engagement is possibly the result to have a healthier society. Four of the 18 articles discussed or mentioned how civic engagement could be used to enhance healthcare and public healthcare systems (causality: healthcare enhancement through civic engagement). All four research were conducted in the USA and none of the studies mentioned or used any theory in their study. One of the four studies was based on content analysis (French, 2011) and the others were literature papers (Manchandra & Silver-Isenstandt,

2010; Flanagan & Bundick, 2011; Cullinane, 2006) that discussed how civic engagement could be used to improve the health of the community or society. The participants in these studies were of lower education and lower socio-economic status.

French (2011, p. 253) evaluated the “pandemic influenza preparedness plans in 28 large metropolitan areas across the U.S. to determine the extent to which engagement and transparency have been utilized to enhance public understanding and support”. He also suggested using civic engagement to improve planning for pandemic influenza. Manchandra & Silver-Isenstandt (2010) evaluated the perception of better and improved government through the role of public health and civic participation. They proposed that while people visit the health clinic to get necessary help for diseases, doctors and clinic staff can gain the patients’ trust and educate them on civic engagement. Flanagan & Bundick (2011) tried to explain how civic engagement can be implemented to progress the psychosocial well-being of college students and Cullinane (2006) explained the use of civic engagement to enhance the health of older adults.

2.3.3 Civic Engagement via Digital Media

Internet has greater reachability than the traditional avenues for civic engagement. Nine out of 18 articles examined civic engagement via digital media. Four of the nine studies used data from multiple countries (Luengo-Oroz, 2012; Freifeld, 2010; Hill, 2013); two studies used data from the United States (Chunara, 2013; Kamel Boulos, 2011); and three studies examined Sri Lanka (Lwin et.al, 2013), Thailand (Ocampo, 2013), and India (Chunara, 2012), respectively. The data collection methods used in these papers differed from the traditional methods. Three of the nine studies used mobile applications (Kamel Boulos et al, 2011; Lwin et al, 2013; Freifeld,

2010), four used websites (Pindolia et al., 2012; Hill, 2013; Chunara, 2012; Chunara, 2013), one used online gaming (Luengo-Oroz, 2012), and one used Google queries to obtain data (Ocampo, 2013). Two studies used AMT (Amazon MTurk), is a service offered by Amazon.com. It enables participants to set up accounts and log in to take part in online jobs or assignments, and they get paid in some cases (Chunara, 2012; Chunara, 2013). In one of studies, an independent online game was created and used to interpret “thick blood smears containing malaria parasites” (Luengo-Oroz et al, 2012).

Another research studied the usability of an android mobile app that receives input from a user-wearable device with wire-less health sensors along with GPS coordinates. The app then transmits this information through the internet to a server which is accessible and monitored by healthcare experts. This app helps them to keep an eye on their older patients with several chronic diseases in real time Kamel Boulos et al. (2011). Kamel Boulos et. al. (2011) also explored environmental health monitoring and inspection and emergency control. In the study, they examined the key issues, trends, and the difficulties encountered during rationalizing and making conclusions with current-time crowdsourced information.

Freifeld et al. (2010) used short messaging services to enhance health, emergency alerts and pest/disease controls in Malawi. Hill (2013) used crowd surveillance, from the results of forum updates and queries to understand public belief, attitude regarding diseases and health care; this information can be used to improve the citizen’s health beliefs. Luengo-Oroz et. al. (2012) tried to determine the likelihood of a crowdsourced method to malaria image review. Specifically, the research aimed to understand whether unidentified and nameless participants from the

public who didn't have any formal knowledge of malaria parasite would be able to calculate the count by playing an online game that has pictures of thick blood smears.

One of the research used AMT in India to collect data from the public about malaria symptoms to evaluate malaria prevalence (Chunara, 2012). In another study, the research team used a mobile app that permitted the participants to report possible flu traits; the app also allowed the users to tag the GPS location and other details. This allowed the researchers to plot the GPS locations to a map creating the flu symptoms density map (Chunara, 2013). The flu density map created was comparable with the data from CDCP (Centres for Disease Control and Prevention) Lwin et al. (2013) developed a cell phone app that enabled users to locate and take pictures of mosquito breeding sites and report mosquito bites and dengue symptoms. Finally, Ocampo (2013) used Google queries to collect data to create a predictive surveillance database for malaria in Thailand.

2.4 Understanding of the Existing Literature

The primary goal for the research is to understand the different categories of civic engagement used in major peer-reviewed health communication research. The research has three main findings. First, only eighteen papers were identified relating to the use of civic engagement for health-related research. Second, these studies used civic engagement in three different ways over a wide range of healthcare research fields, and the studies has shown that there are numerous benefits to making use of civic engagement. Third, there was substantial range in the methodologies and purposes in which the studies used civic engagement.

Even though the idea of citizen science was introduced more than a century ago and civic engagement has been used in political science and other areas since the 1950s, a lot still needs to be learnt about the potential use of civic engagement in

health context. Various health areas ranging from the study of long-lasting illness to a basic communicable flu can have a possible advantage with a civic engagement element. Prior research has investigated the use of civic engagement to improve public health. On top of this, the Internet media has added another dimension to the idea of civic engagement. Nonetheless, surprisingly only small amount of research have studied the use of civic engagement in health context, and how civic engagement, with the help of the Internet, can be used in the area of health care.

Although eighteen articles on civic engagement were identified, civic engagement was clearly not applied extensively in these research. Only two of the eighteen studies mentioned theory but did not use them. The papers also did not discuss how the civic engagement was operationalized, measured and what theory was used. For example, it is pointless measuring civic engagement using club membership or asking participants if they watched television yesterday and using healthcare as a dependent variable, as the two factors are unrelated. However, civic engagement could be measured with the number of health-related clubs an individual is part of or the number of health-related magazines he/she reads to understand about a health problem. The reason for this may be because the research papers were not focused in one particular area but scattered over a large spectrum of healthcare research.

Recent studies that used DMCE (e.g.: Kamel Boulos et al, 2011; Lwin et. al., 20013) are still in their prototyping stage, and maybe they are still figuring out how to execute it. Lack of theoretical base is a research gap that is identified in the literature review, and this is apt time to formulate a conceptual model as there is potential practical utility value in the field.

The measurement problem did not occur in the second set of studies as they did not measure civic engagement or health problems. The problem did not arise in the

DMCE studies either, as these systems were used for a health cause and the participants were taking part to provide health-related data. Nonetheless, these studies show that digital media can be used to customize civic engagement to specific health problems.

Although the use of civic engagement in public health research is a very new notion, the articles identified in the literature review successfully used or planned to use (created a prototype) DMCE to solve health problems by tracking flu, dengue, and malaria outbreaks in near real time, and identifying RBCs infected with *Plasmodium falciparum* parasites. In areas with severe mosquito infestations, the public can help to report mosquito breeding sites so that government employees only need to destroy them. As this saves the time that would have been spent trying to find the breeding sites, the government employees will be able to kill more mosquito sites. This approach could be very effective and timely actions can be taken as a result.

The knowledge from the current research also portrays that civic engagement can be used to beneficially report on quality, price, quantity, momentum, and unique and new science. Luengo-Oroz et al (2002) mentioned that Civic engagement was verified as a practical method to improve the precision of the “computer recognition of RBCs infected with malaria parasites (quality)”. A cost-effect substitute to reporting mosquito breeding sites (cost), address sizeable public health problems (Lwin et al., 2013) (volume).

CE also enables the study to advance more quickly than a study that is left alone to be conducted by researchers only (Kamel Boulos et al., 2011; Chunara, 2013; Hill, 2013) (speed). The current research also shows the production of new scientific discoveries (Kamel Boulos et al., 2011; Lwin et al., 2013) (novel science). Additionally, CE also brings in the benefit of the unused expertise of the masses. It is

reasonable to assume that among citizens there are experts in many different fields and assignments, particularly when the job is given out engagingly (for example as a game) can benefit the community with the public expertise. One of the major deciding factor of civic engagement programs is public participation. To encourage the citizens of the society to engage in DMCE. It is essential to understand how the public view and use CE and what psychosocial factors influence and act as motivators or barriers of DMCE. This area is also relatively unexplored.

The articles that were analysed in this research ranged broadly about the quantity and variety of information regarding the participants and the research arrangement. The studies that tried to associate civic engagement with healthcare used regular methodologies and reported demographic data. Most of the nine papers in this category used a lower educated, lower economic status population, although it is unclear why the researchers selected these particular communities. There were no gender disparities that were seen in the eight studies.

However, the research conducted in a Jordanian refugee camp had more active male than female participants. The author of that paper attributed this phenomenon to the prevailing patriarchal culture in Jordan. The rest of the research in this category were conducted in the USA. Most of the DMCE studies did not include demographic details such as age, gender, location etc. of the respondents which are information fundamental to most researches. These studies had sufficient flexibility to collect data from anywhere in the world as they were executed through Internet-based mobile phone apps or websites.

One main problem with the internet is that there is less control over the quality of data and who is reporting it. Hence, collecting the demographic details of participants, for e.g.: age, gender, the reason for engagement, etc. can help us in

understanding the people who are involved and it also helps us to know how civic engagement works and how to make the best use out of it. Nevertheless, collecting demographic details can cause privacy violation if not handled carefully. The use of DMCE for health research is in an initial stage of construction, and further research must be done to produce the necessary processes and other documenting criteria. In some of the studies examined in this literature review, the methodologies were custom made by mixing and matching the existing approaches.

Even though there are many studies that have emphasised on the use of civic engagement on the internet and science magazines, it is crucial for the studies to be published in academic journals to get validated and checked by research community on the research rigor. Viswanth et al (2006) and Chunara (2012) were two studies that were most cited and discussed in other peer-reviewed papers. Finally, the literature review showed that civic engagement through the traditional methods and digital media had been explored to get significant answers to important health-related research questions.

All of the articles reviewed mentioned that utilizing civic engagement can help to take the research to another level. There will be many benefits while using civic engagement for research such as reduction in price, timely actions can be taken because of efficiency and feedback from the public, etc. The methodical evaluation recognized three classifications of study practices in health care and health communication and identified the gaps in current literature, and this thesis will focus to find answers for few of the research gaps identified to normalize applicability of civic engagement in public health research.

2.5 Summary

The literature review conducted in the chapter was to gain an understanding of the existing works on the role of civic engagement in health care. However, there is a lack in (1) understanding the public's view and use of civic engagement for health and (2) a theoretical framework that explains how civic engagement can be used to promote healthy behaviours. The literature review identified research gaps and the knowledge gained from this chapter serve as the background for the studies presented in the following chapters.

CHAPTER THREE

PRELIMINARY STUDY: UNDERSTANDING PUBLIC'S VIEW OF CIVIC ENGAGEMENT FOR DENGUE PREVENTION

This chapter discovers the concept of general public's perception towards civic engagement and the role of digitally mediated communication via a preliminary study which provides a robust grounding for conceptual model building and testing.

Previous studies that reported the adoption and use of technology generally dealt with individuals' usage of technology for their own needs and convenience. On the other hand, one of the main use of disease specific application such as an application for dengue is to help the authorities and the public, even though it has a two way communication channel. Hence it is important to understand why the public will take part in using such a health communication application. What will motivate them or how can we motivate them to use the app.

The focus of the study is to understand individual level participation. This will help health communication experts and IT developers to design and motivate more individuals to be part of two-way health communication systems and this can help in improving the society's health. The qualitative study also has potential contributions to the body of literature by providing an in-depth understanding of the psychosocial factors of digitally mediated civic engagement (DMCE). This study centres on dengue as it is a common public health concern across India (Jain & Chugh, 2011) and Sri Lanka (Bhattacharya et al, 2013) and Singapore (Lee et. al., 2010). Specifically, this chapter is intended to address the following list of research questions:

RQ1: What are the opinions and views of the general public towards digitally mediated civic engagement?

RQ2: What are the key factors that motivate the public towards digitally mediated civic engagement for infectious disease prevention?

RQ3: What are perceived barriers to digitally mediated civic engagement for infectious disease prevention?

3.1 Methods

3.1.1 Qualitative Research Approach

The selection of an appropriate qualitative research approach was done by weighing the positives and negatives of available approaches. The research needs to get an in-depth understand of public opinions and views towards public engagement in infectious disease reporting. The study also aims to generate more data on the same. Hence, under qualitative research methodologies, focus group discussion was selected to be the most appropriate technique as it helps best for directly interacting with participants.

Focus group discussions are considered as interviews with a group of individuals on a particular subject. Generally a focus group contains 6 to 10 participants who belong to similar backgrounds. Focus group methodology suggest to conduct multiple focus groups to acquire a diversity of viewpoints and increase sureness in the themes that develops (Patton, 2002). Focus group discussions are cost effective as it helps the researcher to gather data from a group of individuals than one person within the same amount of time. It also increases the sample size of the participants.

Comparing focus group discussion with interviews, participants who take part in focus group discussions get to hear one another's answer and this helps them to make

extra remarks outside their own point of views. The interactions between the individuals in a group discussion increases the data quality (Patton, 2002). Krueger & Casey (2000) argued that individuals in a group discussion brings valid checks and establishes balances to one another's point of views and this removes untrue or extreme views. The group setting also helps to identify similar, shared or varied views within small amount of time. This helps the researchers to discern minority opinions from majority opinions during the course of a discussion. Focus group sessions are best suited for focused topics such as discussion regarding a product or program etc. (Patton, 2002).

This study used semi-structured questions that give the researcher leeway to probe further depending on the environment. Focus group discussions were conducted in the English language.

3.1.2 Data collection- Sample and Procedures

The data for the research was collected from three countries (Sri Lanka, India, and Singapore) among university students after receiving approval from Nanyang Technological University's Institutional Review Board (IRB) (Appendix A). The students were informed about the focus group discussions through announcements in class or broadcasting emails, asking to sign up for the focus group discussions if they were interested. Forty-two participants from the University of Colombo, Sri Lanka, forty participants from the University of Kerala, India and forty participants from Nanyang Technological University in Singapore took part in the focus group study.

The foremost goal of the research was to learn the participants' perception of civic engagement concept in depth along with its barriers and motivators. Participants who may have their smartphones or know how it works will mostly be college going students, especially in developing countries like Sri Lanka and India. According to the

mobile consumer report (2013), the highest incidence of smartphone users fall under 18-24 age group (13%), and country overview report of Sri Lanka (2013) reported the median age of smartphone users is 31.1 years. It was assumed that recruiting people from similar backgrounds may help to create more discussions than people from varied backgrounds. This explains the choice of selecting all participants from a university setting as they are more aware of popular apps and mobile games.

Respondents were selected based on the following conditions: (a) 21 years old or above, (b) University students, (c) Participants must currently reside in Sri Lanka/ India/ Singapore, (d) Similar socio-economic status (SES), (e) Ability to speak English as the researcher wanted to directly interact with the participants, (f) Users of smartphones or good understanding of how smartphones work.

Five focus group discussions (FGD) with each session having seven to nine participants were held each in Sri Lanka, Kerala, India, and Singapore at university meeting rooms. Participants were from similar age group and was grouped with a balanced gender ratio.

3.1.3 Questionnaire and Interview Guide

A semi-structured focus group guide (Appendix E) containing a set of open-ended questions was prepared in English to understand a person's opinions and views towards civic engagement regarding infectious disease reporting. First, the respondents were requested read and sign an informed consent form (Appendix B) which was followed by a small questionnaire to collect basic demographic data (Appendix C). This provided baseline information. The questionnaire also contained a question (Question no: 10, Appendix C) to rate the severity of dengue on a 5-point severity scale. Participants were also asked in the Focus group discussion sessions "how severe they

think dengue was”. The focus group discussions were guided by three main themes mentioned in the research questions section. Before beginning the discussion on civic engagement, the participants were provided with a screenshot of an application with which they could report a mosquito breeding site (Appendix D).

The average duration of a focus group conversation was approximately 45-50 minutes and was moderated by the researcher. During the focus group sessions, the researcher often summarised and clarified on the answers that were vague. The researcher also encouraged and enquired the participants to verify the summarised statements before moving to the next question. Focus group sessions were documented with the use of both audio and video recordings and were then transcribed when they concluded. The researcher also documented detailed notes of respondent interactions.

3.1.4 Qualitative analysis

The data were coded according to grounded theory approach (development of themes from within the data) and codes were further elaborated as new themes developed during the coding procedure. The data was grouped according to the themes developed during coding exercise. Based on Neumans’ (2014) qualitative data analysis, coded themes were then categorised based on the original research questions, theoretical concepts, ideas, thoughts and discussions created during the focus group sessions and coding process. The key purpose of the research was to uncover the crucial factors influencing, motivating or de-motivating civic engagement. It also helps to stay open to new themes that develops from the data. The transcripts were first coded line by line in the paper. Then, they have coded again in Nvivo. Here are the findings from the focus group discussions:

3.2 Results and Discussion

Sample characteristics

All the participants in the study were University students and smartphone users. Participants reported the medium-to-high severity of dengue and acknowledged the potential of civic engagement system to address the issue. Medium-to-high severity rating of dengue means that participants were aware of the severity of the disease dengue.

Table 2: Demographics profile of FGD respondents

		Frequency (N)		
		Sri Lanka	Singapore	India
Categories				
Total No of participants		42	40	40
	Female	20	19	20
	Male	22	21	20
Age Group				
	21-30	42	37	39
	31-40	0	3	1
Marital Status				
	Single	42	39	37
	Married	0	1	3
Educational Level				
	Bachelor Students	42	30	0
	Master Students	0	5	40
	PhD Students	0	5	0

3.2.1 Publics' view and use of civic engagement

The researcher did not offer the study respondents with an explanation of what civic engagement or volunteering means in order to understand what their view points are, as assumed some definitions emerged from the focus group discussions. Very few participants had heard about civic engagement (CE). They thought it was another term

for volunteering. For the question, what have you heard about CE, one participant, SG1P6 said *“I have been doing volunteering activities for 8 or more years and have also been part of different organizations”*. According to SG2P4, *“It’s basically the public, citizens of a country engaged along with the researchers working on a problem, it can be anything.”* SG1P3 defined CE as *“Social activities for the betterment of the community.”* SG1P1 defined volunteering as, *“volunteering is thought as being part of some organization that does something of the betterment of others that is the first thing that comes to mind is being part of some organization.”*

Reason for doing volunteering activities

Reasons for volunteering emerged as a theme in focus group discussions. Most of the participants felt good about themselves when they took part in volunteering. It was evident that personal gratification was commonly offered as a reason for most of the participants to take part in volunteering activities.

SG1P1: “Started because it was compulsory, but I continued it because it felt quite nice.”

SG1P3: “It’s a nice feeling to do something to others without expecting anything in return”.

SG1P7: “I felt really happy doing it. My friend does these types of activities and I joined him”.

SG1P2: “I felt I was contributing to solve a big problem. I was not able to help financially at that point of time, but it was still a contribution from my end which made me feel really good at the end”.

Age group of volunteers

Another discussion that emerged was the general age group of volunteers. One participant from first focus group discussion said, *“I think, age group between 15 to 50s, I have hardly seen older people (above 60) taking part in volunteering; also very few younger than 15 as well”*. To which another participant replied that *“I thought older people would volunteer more as they do not work anymore and they need something to engage them with and also school kids who will be engaged in volunteering activities from their schools.”* Other participants engaged in the discussions and expressed that it may also be influenced by the type of the work. If it is cumbersome task may be more youngers take part in it, and if it is a light task, anyone can take part in it.

3.2.2 General Opinions and Views towards DMCE for Infectious Disease

Preparedness

Before going into details regarding the mobile application, participants were asked in the Focus group discussion sessions about how severe they think dengue was. During discussion, participants mentioned that they have suffered from dengue or seen someone close to them suffer and based on this they rated the severity of dengue. Few participants, their friends and family members had been affected by the disease previously. To the question “can you tell me how severe do you think dengue is in Sri Lanka?” SL4P3 answered *“I also had dengue before myself”* and another participant SL4P1 responded saying *“a lot of people are dying, it’s very serious here.”*

After discussing the severity of dengue, the discussion continued to probe further to understand the public opinions and views towards digitally mediated civic engagement for infectious disease preparedness.

Table 3. Matrix of participants' insights

	Sri Lanka	India	Singapore
General opinions and views	<ul style="list-style-type: none"> • Fine system (also barrier) • Lack of trust in health authorities acts as a barrier • Concern regarding Identity of the reporter (e.g. lack of trust in the health inspector that they will keep the identity of reporter secret) 	<ul style="list-style-type: none"> • Lack of trust in health authorities acts as a barrier • Political involvement for their own political gain (e.g. opposition party using it against ruling party if they know about active breeding sites) 	<ul style="list-style-type: none"> • Trust in authorities acts as a motivator • Social responsibility
Motivators	<ul style="list-style-type: none"> • Gamification • Social media app like Four Sq • Token of appreciations 	<ul style="list-style-type: none"> • Gamification • Social media app like Four Sq • Token of appreciations 	<ul style="list-style-type: none"> • Govt. mentioning to use the app acts as a motivator
Barriers	<ul style="list-style-type: none"> • Language • Downloading the app <p>Technological constraint</p> <ul style="list-style-type: none"> • lack of smart phones • internet connectivity • Cost of the data • Limited data package 	<ul style="list-style-type: none"> • Language • Downloading the app <p>Technological constraint</p> <ul style="list-style-type: none"> • lack of smart phones • internet availability • Cost of the data • Limited data package 	<ul style="list-style-type: none"> • Bystander effect • Older adults who have smart phones but continue to use it as normal phones

Fictitious stimuli

To discuss about DMCE for infectious disease preparedness, the participants were provided a hypothetical situation where an app was made publicly available for

the users to report mosquito breeding sites, and users were familiar with it. The participants were then asked what they thought they would do with the app. To this hypothetical situation participants from all three countries mentioned that most people would not be inclined towards spending time discovering the app and then installing it. However, if the app came pre-installed and the customers were made aware of its presence in their phones, the chances of the app being used were higher.

Category of people who would use the app

Another discussion topic that emerged was the category of people to use the app. For the category of people, most of them agreed that tech-savvy people or proactive people would take part more in the app than others. There were also few participants who mentioned that homemakers or mothers would use the application more than others as they will be more concerned about their children's or family member's health. Most participants also thought that older adults might not be using the app mostly because they do not use smartphones or use it as feature phones in case of Singapore.

Institutional Trust

Another theme that emerged as a motivator and barrier was participants' trust or mistrust in their health authorities. As an example, participants from Sri Lanka mentioned that there is a "fine" system that exists in Sri Lanka. The health authorities decide to give fine or warning to the owner of the plot of land where mosquito breeding sites are found. Hence, they expressed concern that there may be a chance that the house owners will demand to know who complained the mosquito breeding site in their land and the health officers may corporate with them and show who reported the complaint. The participants mentioned this might affect their relationship

with their neighbours, and hence people may think twice to report on their neighbours if the health authorities have access to the reporter's identity (e.g. phone number). They said a solution to this problem is not giving the identity information to the health authorities.

SL4P8: *"there should be some evidence to show them, show the accused people someone has reported you (them). So if they (accused) ask for evidence, there should be some evidence to show them"*

SL4P1: *"Authorities, moment you tell anything to the authorities, that will become public one", "maybe we should have an option to make it (reporting) confidential from the app itself".*

Participants from Singapore were more positive that the app could help in reducing the impact of the disease whereas participants from Sri Lanka and Kerala, India were of the opinion that the application could only help disease reduction if the respective authorities took necessary actions. Participants in Singapore had complete trust in their authorities; that if a mosquito breeding site were to be reported, the authorities would take the necessary steps towards solving a potential public health hazard whereas participants from India and Sri Lanka were more mistrustful of their government's promptness in responding. When presented with the idea of the public reporting mosquito breeding sites rather than the health authorities looking after the issue, they were of the opinion that civic engagement could be a potential solution provided the authorities take necessary action

SL4P2: *"I think they will not immediately act on it".*

SL5P7: *"so now if they first of us they will come and check the building. Then if the data is not accurate, and sometimes, someone has uploaded a picture but*

there is no, any effect. Then the PHI will come and they (after the first time), laziness, they will ignore it. Going to ignore it.

3.2.3 Motivating Factors for Civic Engagement

Participants enthusiastically took part in the discussion on motivating factors. They were very creative in bringing up ideas that may work according to the local culture. Motivating factors identified by the participants that could enhance digitally mediated civic engagement for infectious disease prevention could be grouped into three-Social, Intrinsic and Extrinsic motivators. Celebrity endorsements, advertisements, game factor, social media based campaigning where few motivators discussed during the focus group discussions.

Social motivators

Celebrity endorsements: The participants were of the opinion that it would be difficult to generate public attention for the app owing to the multiplicity of apps that are already existing. They believed that proper campaigning/awareness programs using celebrity endorsements and advertisements could help in promoting the app.

Social media based campaigning: They also thought that the authorities should market the app through social media so it can give a personal touch and will reach more people. Media exposure and connectivity among friends and daily sociability were mentioned though social space.

Societal Responsibility: Participants from Singapore were of the opinion that the public would start using the app if the government asks them to use it as a societal responsibility.

Figure 5. Types of motivators chart

Political use of the situation: Participants from India mentioned that there is a high possibility for political involvement and making it into a political issue. The participants thought the opposition politicians would complain against the ruling party if the reported mosquito breeding sites are active. They thought that it might even work as a motivating factor for the authorities to clear the mosquito breeding sites.

Extrinsic motivators

Token of appreciation: The participants of the study provided ideas on extrinsic rewards. Very few participants suggested money as an attractive reward – the majority believed that monetary enticements might lead to a misuse of the app to make some quick money. Monetary rewards are the main extrinsic motivating factors (Harper et al., 2008; Kittur & Suh, 2008; Antikainen & Väättäjä, 2010).

SLIP6: Like a t-shirt that says “I hate mosquitoes with an image of a mosquito.”

Intrinsic motivators

All the participants in the study contributed ideas on motivating the public with intrinsic rewards to use the app.

Institutional Response: The participants also mentioned that the institutional response to the people’s behaviour (i.e., reporting breeding sites) would be one factor that will determine the app’s sustained usage and popularity. Participants from all three countries believed that response from the authorities would result in the prolonged use of the application, and may also act as a motivating factor for the participants to help in developing trust among the general public to use the app.

SLIP8: “it depends on the institutional response, if the response is not good, they will not try it again”.

SLIP9: “Because we know that they have some kind of concern towards what we have done. Unless we see that they have concern towards what we have done, we don’t know whether it is of value what we have done”.

Recognition: Recognition also appeared to be a good motivator which is in line with what Jeppesen & Frederiksen (2006) reported. Participants expressed that recognition from government officials would go a long way towards promoting the app – like virtual medals/cup with “You made a difference” logo for notifying mosquito breeding sites, with the option to share this virtual cup on social media could motivate people to use the app.

SLIP9: You can give a kind of recognition like publish their photo mention their contribution on social media page so the person would be involved in it even more.

Most respondents believed that acknowledgment of efforts of the public by the government authorities- by giving them report/ reply upon fixing the issue –would serve as a motivating factor for the public to continue using the app.

Game factor: A few participants suggested using mobile games as an attractive method of communicating about the app, such as awarding points for reporting mosquito breeding sites like the mobile game called FourSquare. Participants from Sri Lanka and India spoke of the gaming app, FourSquare, very frequently during the discussion sessions as an example. They mentioned that it is a gaming app and the more time a person logs in to it, they will be declared as the mayor of the town. This

app also links between friends so that they can see who is currently Mayor of the town. They mentioned that most of their friends spend time in the app.

I2P2: *“by levels, if he reach one level we can give a small gifts, so he can redeem that on that level or higher levels”.*

These can attract young adults towards the app’s utility as mobile games provide an easy and popular way of spreading the app. Enjoyment, fun, and recreation (Lakhani & Wolf, 2005) are few among other intrinsic motivating factors. The participants suggested that these points can also be converted into physical rewards such as campaign slogan T-shirts, caps, electronic gadgets like pen drives etc. With this, they suggested coupling intrinsic motivators with extrinsic motivators to attract more people.

3.2.4 Barriers to Civic Engagement

Four barriers were identified by the participants that could inhibit effective civic engagement - time constraint, bystander effect, language and technological constraint.

Time Constraint

While time constraint is an issue in popularizing and widely mobilizing the app, many participants were of the opinion that app usage time would not be a major hurdle as most app users were well-versed with smartphones. They also thought that by creating awareness of the disease while simultaneously campaigning for the app will also help people notice the app and use it.

SG1P4: *“it should be user friendly, if not the learning curve is too high, then probably, I wouldn’t bother to use it, so it should be self-explanatory.”*

Bystander Effect

Participants believed that there is a high chance of people assuming that the breeding site would have already been reported and hence they may not report it. They also thought that if people are part of a crowd, they will not take individual actions and may not report and mirror the group's actions. To overcome the bystander effect, the app awareness campaign should highlight the need to make multiple reporting of the same breeding sites till the authorities undertake credible action.

Language

English as the only application language did not seem to be a current problem for the participants. However, participants from Sri Lanka and India suggested that it will be better to add in multiple languages as it will help in widening the user pool in the long run. It may also be better to think of non-verbal communication as a medium for applications to expand the user base. It was also observed that males were more actively participating in the discussion than the females in Sri Lanka and India. Few times the moderator has to pinpoint in a friendly way to get opinions from some participants. After the discussion, the moderator (the researcher) had the chance to ask why they were not actively participating in the discussion. Some participants with weaker command of the English language volunteered that they were shy to speak in English.

SL2P8: *“and also the language, it's in English. And the language problem is everywhere”* SL2P6 said instead of languages, *“if there is a way to show pictures or images, that's also good”*.

Technological Constraint

Most of the participants thought that people might not put effort to download the app. The solution suggested overcoming this were to establish partnerships with smartphone operators to pre-download the app into the mobile platforms before sale. Participants from Sri Lanka and Kerala reported technological barriers such as lack of smartphones, internet connectivity, limited data packages and cost of data. They also reported that only youngsters who are between 18 to 30 years old would mostly use smartphones whereas participants from Singapore highlighted that even though older people have smartphones, they continue using it as a regular phone.

SG3P2: “My thinking is, for example, maybe you upload the picture right, and it consumes data right? Should I upload it at home or should I upload it on the go? Because I am paying my bill.”

The main barriers to the study are the technological constraints. One way of overcoming this constraint is through motivating existing smartphone users to download the application. The solution is to make tie-ups and collaborate with government authorities and mobile phone network providers to allow people to use mobile internet data package free of cost as it is for a social cause, especially in developing countries like Sri Lanka and India.

3.3 Limitations and Future Research

One of the key constraints of the research is the sample size and sample diversity – around 150 respondents, all college students, majority of them unmarried, thereby not representative sample of the general population. The study sample was not also a representative of major age groups. The study also did not cover all the social, economic status groups as the participants were all students. As part of discussion, it was understood that the awareness of the disease was high, so these findings of the

focus group discussions can be viewed as of the public who are very aware of the disease. This may be considered as another limitation of the study as it is not covering the representative population. Despite these key limitations, this qualitative study has offered details and ideas to guide future research. Study results indicate the need for motivating factors and various types of motivating factors for encouraging the public to participate in civic engagement activities. Future studies will be planned to incorporate representatives of the general population such as an equal number of single and married people to understand whether time or other factors will be different.

3.4 Summary

To summarise, the purpose of the study was to get in depth understanding of the factors that influence the publics' DMCE. The simplest way one could try to understand the topic is by asking them what they think about DMCE, how do they feel about it and whether they feel it is a useful deed. These basic questions can be perfectly looked through the research question 1 (What are the opinions and views of the general public towards digitally mediated civic engagement?). Participants mentioned that they felt DMCE could be a possible solution in the case of infectious disease preparedness. They mentioned that DMCE can help to reduce the action time and bring the impact of the disease down. Participants also discussed the type of people who may be more active contributors to a system like this. They mentioned about institutional trust playing a major role in prolonged use of the application. Understanding of the disease and actions that need to be taken to prevent it and media use were also other factors that can play a role when a person decides to use such an application. Social systems such as penalties, political environment etc. can also play a role in the uptake of an application.

There are many applications that are being developed with two-way communication and DMCE element in them. Researchers and stakeholders often report high attrition rate and involvement from small number of volunteers. Public use of these applications is the best way to achieve fruitfulness of such applications. Hence it is important to understand, how can the public be motivated to be actively partake in them. What are the factors that will act as motivators in this context (RQ2 What are the key factors that motivate the public towards digitally mediated civic engagement for infectious disease prevention?). Participants mentioned various methods with which the public could be motivated to use such applications. This suggested that they believed that with right tactics, public will adopt and use applications with DMCE element.

It is also important to understand if there are concerns or issues that may potentially prohibit the adoption of applications with DMCE element. The best way to look at this was through RQ3 (What are perceived barriers to digitally mediated civic engagement for infectious disease prevention?). Understanding the type of issues or concerns in advance can help us to find proper solutions for those. Participants mentioned that spending their valuable internet data on an application for a social cause could be one of the concerns. As a solution to this, developers or stakeholders could collaborate with mobile subscription companies to provide free data for using the application.

Hence the research questions try to get in-depth answers that can be used as a solid base for further studies. The study one helps us to understand that public do value applications with DMCE element and they feel this could help in reducing the impact of diseases. It also mentions the ways in which we could motivate the public and the factors to consider while developing such applications.

In summary, this chapter detailed the preliminary study with an intention to provide an in-depth understanding of general public's opinions and views towards digitally mediated civic engagement. The findings in the chapter also provides in-depth knowledge of motivating factors and barriers. With this study as a foundation, the researcher will proceed to understand more about civic engagement in the context of infectious diseases.

CHAPTER FOUR

UNDERSTANDING THE THEORETICAL PREDICTORS OF DIGITALLY MEDIATED CIVIC ENGAGEMENT

This chapter focuses on developing a conceptual model to understand the factors that influence DMCE in one particular domain (infectious diseases) based on a literature review (chapter 2) and the findings from the preliminary study (chapter 3). The literature review helped to identify the research that has been done and the research gaps that still exist. A lack of theoretical base is one of the research gaps that was identified during the literature review. This could be because the research papers were not focused on one particular area but were scattered over a vast spectrum of healthcare research.

The data from the existing studies also shows that civic engagement can be used to beneficially report on quality, cost, volume, speed, and novel science. One of the significant factors that will decide the success of civic engagement programmes is public participation. It is essential to understand how the public views and uses civic engagement (CE) and what psychosocial factors influence and act as motivators or barriers of digitally mediated civic engagement (DMCE). These factors can be used to motivate the public to participate in DMCE. This area of research is also relatively unexplored.

The pilot study (chapter 3) provided an exploratory understanding of the general public's opinions and views towards digitally mediated civic engagement. It also provides in-depth knowledge of the motivating factors and barriers. It was learned that participants' attitude towards institutional trust and their beliefs in the government

authorities influenced their intention to report mosquito breeding sites. Participants also mentioned that their relationship with their neighbours might be affected if they came to know who reported against them.

Participants indicated they felt togetherness and everyday social ability through their social media presence (media use and attention to media). Hence, the pilot study pointed out the importance of institutional trust, volunteerism, togetherness, and neighbourhood connections. All of the elements can be best viewed through the lens of social capital. The study one also linked media exposure to everyday social ability and togetherness. Thus, this conceptual model aims to keep most of the important elements from the pilot study as the foundation of the conceptual framework.

The conceptual model is developed to theoretically address key factors that would influence DMCE for infectious disease preparedness. One of the novelties of this model is that it combines social capital, media use, attention to media, disease beliefs to predict individual's intention to take part in DMCE.

In this research, DMCE is operationalized as “an instance where an active citizen is digitally participating (through the internet, social media, mobile app, etc.) in the life of a community through sharing information to reduce infectious diseases and to improve the health conditions of others” (modified based on Adler & Goggin, 2005, p.241). The focus of the study is looking at how individual level involvement in DMCE will help and affect the community at society level. Hence, the units of analysis is ‘individual level involvement’ and level of analysis is ‘affect it has on society level’.

The next section deals with the structuring of the conceptual framework and proposes hypotheses for the research.

4.1 Theoretical Framework

This section proposes a conceptual model, as shown in Figure 6, which examines how social capital, media exposure and disease beliefs will influence the individuals' intention to take part in DMCE for infectious diseases. The variables in the model are discussed in detail in the sections below.

Figure 6. Conceptual model

[Labels: TM-Traditional Media, IM- Internet Media, DVs-Dependent Variables]

4.1.1 Dependent Variables - Intention to take part in DMCE for infectious diseases

The effect of social capital on health has been examined by few studies (Kawachi, Subramanian, & Kim, 2008). There are even fewer studies (Viswanath, Randolph Steele, & Finnegan 2006; Lwin et al., 2013) that have explored the possibility of civic engagement for improving health. Even though there are studies that mention the potential of civic engagement for improving health, there is a lack of theoretical background that supports the argument. Table 4 shows the predictors of civic engagement across disciplines. Social capital, demographic variables, media exposure, and media use are the most mentioned predictors of CE. There are also

studies that have looked at economic inequality, the influence of video games, parental mediation, and country of residency as civic engagements' predictors. To test the model, a survey study was planned to collect data from participants who have internet access. In this study, economic inequality may not be affected as the study is set in Singapore, where smartphone penetration rates are 87% (Nielsen, website), and in India, which is becoming the world's second-largest smartphone market (GSMA, 2016). Parental mediation will not be a predictor as the participants of the study are adults. The influence of video games will also not be a predictor as the study is not focused on video games. Hence, this research will apply social capital, media exposure and use, demographic variables, beliefs towards disease protection, and information gathering attitude as predictors of DMCE in this study.

Table 4. Predictors of civic engagement across disciplines

Predictors of Civic Engagement	Papers
Social capital, demographic, location (country)	(Costa & Kahn, 2003)
Social capital (trust), media exposure, demographic, situational/contextual, orientational, and attitudinal variables	(Shah, 1998)
Economic inequality, social capital (trust)	(Uslaner & Brown, 2005)
Video games, parental mediation (ethnicity, political participation, civic participation), demographic (low income group), social context	(Lenhart et al., 2008)
Internet use (media attentiveness), internet used for politics (political involvement), demographics (different age groups), Trust (political and social trust), volunteering activities	(Jennings & Zeitner, 2003)
Social capital (trust), cultural values (ethnicities)	(Uslaner & Conley, 2003)
Online political exposure and participation	(Woo-Young, 2005)
Country of residency	(Schofer & Fourcade-Gourinchas, 2001)
Media exposure, media use (discussions online)	(Gil de Zúñiga, Jung, & Valenzuela, 2012)

Generational differences, Media use (Internet use, television use, newspaper use) interpersonal trust,	(Shah, Nojin Kwak, & Lance Holbert, 2001)
Media use, political interest	(Xenos & Moy, 2007)

Accordingly, the model aims to observe, through the lenses of social capital, trust, beliefs towards disease protection and media exposure, how people use digitally mediated civic engagement in their daily lives for infectious disease prevention. Hence, this research aims to look at the intention to take part in civic engagement (by sharing information with in-groups (family and friends) and out-groups (general public and authorities)) to achieve infectious diseases preparedness (the dependent variable). To take part in DMCE for infectious diseases, one must have enough knowledge or information to share with family, friends, the general public, and the authorities.

Risk information seeking research concentrates on identifying the importance of information when people are threatened by threats and are unsure on possible recourses against the threat (Afifi & Weiner, 2004; Case, 2002). In general, it examines how risk perceptions have an impact on the way in which individuals seek and manage risk information. Risk Information Seeking and Processing Model (RISP) (Griffin, Dunwoody, & Neuwirth, 1999), is one of the popular models that was developed to separate various factors that drive risk information seeking like psychological, social and communicative factors. Information seeking, and processing can be directly predicted by information insufficiency, according to RISP model, whereas perceived information gathering capacity and relevant channel beliefs moderate this relationship.

An extended version of the RISP model, planned risk information seeking model (PRISM), focuses more on information seeking intention (Kahlor, 2010). PRISM

defines information insufficiency by also including the attitude towards seeking and its perceived control along with affective response and seeking-related subjective norms. This could be considered the most significant contribution of PRISM. Hence, information gathering attitude will also be DV in the research.

4.1.2 Media Exposure and Perceived Benefits of Media

Previous research has reported that traditional media can develop and nurture the opinions of members of the general public, as they are influenced by these media (Gerbner, Gross, Morgan, & Signorielli, 1980; Gerbner & Gross, 1976). Gitlin (1980) suggested that the news media has the ability to focus public attention on certain subjects and formulate an argument to tell the audience how they need to think about the topic. The media's capability to show various perspectives on social problems and individuals' exposure to them can influence their attitude towards the problems diversely (Boomgaarden & Semetko, 2011; Price, Nir, & Cappella, 2005; Brewer, 2002). Studies (Calzo & Ward, 2009; Bryant & Zillmann, 2002; Levina, Waldo, & Fitzgerald, 2000) have shown that the public's exposure to traditional media is related to their attitude towards societal causes. Katz and Gurevitch's research has shown that the public uses media for various reasons such as monitoring, self-identity creation, building social connections, and recreation (1974).

People's information gathering and monitoring attitude have a positive association with the individual-level creation of SC and engagement; simultaneously, the type of actions undertaken such as leisure, recreation, and amusement have a negative or subdued consequence (Prior, 2007; Zhang & Chia, 2006; Wellman, Haase, Witte, & Hampton, 2001). Positive association between social media use for news and SC has been identified by previous research (Gil de Zúñiga, Jung, & Valenzuela, 2012). Piotrow et al. (1997, p.22) explained that strong recurring exposure and

different meanings of ‘reality’ in the traditional media might cause the viewers to think of that ‘reality’ as natural. The effect is a make-believe “reality” presented in the traditional media, which can affect behaviour change. Because of this, traditional media, such as television and radio, is widely used to motivate people to take preventive measures against diseases and to lead a healthier lifestyle (Sood & Nambiar, 2006).

Internet media is a rapidly developing area of research, also in health communication field, where it is known as eHealth. The rapidly changing media landscape with the advent of new media technologies creates a significant opportunity for health promotion and disease prevention. According to the Pew Internet & American Life Project (2011), health information is one of the top search categories, with 80% of internet users seeking such information. Mostly, these searches involve looking for data about a certain disease or health issue. Internet technology, unlike traditional media, has advantages such as interactivity and multimedia features, the ability to deliver individualized content, and automated delivery of interventions, which can reduce program cost. With the key structures of the internet, there is potential to reach wider audiences.

Ho & Niederdeppe (2008) reported that trust in online health information was positively related with individual's online health information seeking. Previous studies conducted in USA reported that 72% of health information seeking participants found online health information to be trustworthy, 69% did not find any incorrect health information online and only 28% reported that they have seen bad health information (Fox & Raine, 2002). Participants from previous studies have also reported that they can trust the health information that is found online if they see the same information in multiple sources (Fox & Raine, 2002).

Social media is the latest development on the internet (Thackeray, Neiger, Hanson, & Mckenzie, 2008). The potential of mHealth through social media to change health care is evidenced by the fact that 53% of smart phone owners use their phones to collect health information, and one-fifth of these users have at least one health application installed on their phones (Fox & Duggan, 2012). The implications of social media innovations are most directly felt by two groups of stakeholders in the public health ecosystem: citizens and public health authorities. Social media channels such as Twitter and Facebook enable the general public to share health-related information, receive tailored health messages on their smartphones, and report disease incidents as and when they happen (McNab, 2009; Korda & Itani, 2013). The same channels can be used by the health authorities to establish direct communication with the general public during disease outbreaks, disseminate health educational messages, and collect real-time health information through surveys (Thackeray et al., 2012).

The section discusses in detail regarding individuals' media exposure and perceived benefits of media. It is essential to distinguish between media exposure and perceived benefits of media. Previous research has explained that these two terms refer to two dissimilar notions. Exposure to media essentially means the usage of media tools and content according to Chaffee and Schleuder (1986) whereas individuals' notion of media is termed as perceived benefits of media. In this thesis we focus on both media exposure and perceived benefits of media. Based on the above discussion, the following hypotheses are proposed:

H1: Individuals' traditional media use will be positively associated with individuals' (a) social capital, (b) trust and (c) beliefs towards disease protection

H2: Individuals' internet media use will be positively associated with individuals' (a) social capital, (b) trust and (c) beliefs towards disease protection

H3: Individuals' perceived benefits of traditional media will be positively associated with individuals' (a) social capital, (b) trust and (c) beliefs towards disease protection

H4: Individuals' perceived benefits of on internet media will be positively associated with individuals' (a) social capital, (b) trust and (c) beliefs towards disease protection.

4.1.3 Social Capital

The concept of social capital has piqued interest among scientists, activists, and policymakers interested in understanding intergroup relations and social changes in a broad spectrum of studies such as communication, public health, sociology, and political science (Portes, 1998). Kapucu (2008) stated that defining the concept of social capital is complex; social capital has been defined with different descriptions and meanings throughout the literature.

Coleman's (1988) definition of social capital is based on its functions as a “variety of entities” that enables actions by the public. According to Coleman (1988), social capital helps in explaining different results of actions of people as well as linking them to larger structural changes. On the other hand, Putnam (1993, p35-36) defined SC as the “features of social organizations, such as networks, norms, and trust, that facilitate action and cooperation for mutual benefit.” Thus, SC offers benefits at a societal level than individual level. Koch-Weser, Karan, and Viswanath (2008) explain this further, saying that people form associations that help their interests. Nevertheless, the networks they form will influence broader society, so the advantages of social

relationships not only belong to the people but reasonably can contribute to well-being at the community level.

Putnam (2000) argued that social capital has a considerable significance that enables resolving collective problems efficiently. It also increases personal benefits through cooperation, safeguarding compliance with established norms, and lessening individual liability in carrying out tasks. Koch-Weser, Karan, and Viswanath (2008) said that civic engagement is seen as a promising method to look into interactions and associations among people and groups. It could influence public health, politics, and economics among dissimilar social groups.

Kapucu (2008) wrote that SC has a positive influence on the public along with institutional effectiveness. These factors point to “communication, exchange of resources, knowledge, and trust which all contribute to improved organizational advantage, innovation, and value” (Kapucu, 2008). Based on the above literature, the following hypotheses are proposed:

H5: Individuals’ (a) social capital and (b) trust will be positively associated with individuals’ beliefs towards disease protection.

H6: Individuals’ social capital will be positively associated with individuals’ information gathering attitude for infectious diseases.

H7: Individuals’ social capital will be positively associated with individuals’ intention towards digitally mediated civic engagement such as (a) sharing information with family and friends, (b) sharing information with the public and (c) sharing information with authorities.

H8: Individuals’ trust will be positively associated with individuals’ information gathering attitude for infectious diseases.

H9: Individuals' trust will be positively associated with individuals' intention towards digitally mediated civic engagement such as (a) sharing information with family and friends, (b) sharing information with the public and (c) sharing information with authorities.

4.1.4 Beliefs towards Disease Protection

Much insight can be drawn from the existing health communication literature on why and how people take preventive measures toward infectious diseases. It is essential that the strategies be based on theory so that they can be implemented in diverse geographical and social settings. Melkote & Steeves's (2001) health belief model (HBM) is based on value expectancy theory and concludes that people take cautionary steps to reduce risk behaviours when they think they are vulnerable to disease (self-perception of risk) and believe that the repercussions will be critical. In this case, people think that taking precautionary measures will help to subdue the disease threat and that the assumed gains should be enough to overcome perceived obstacles, for e.g., the expense or difficulty of taking the necessary steps (Melkote & Steeves, 2001).

Roger developed Protection motivation theory (PMT) in 1975 and later modified it in 1983. This theory provides a comprehensive description of effects of persuasive communication with a weight on the cognitive methods that mediate behavioural changes. PMT assumes that people are motivated to protect themselves against disease when the disease is perceived to be severe. They believe they are vulnerable to the disease, and by the effects of actions taken to prevent the disease (response efficacy), their confidence in doing the task well (self-efficacy), and the response costs, such that the time or cost of doing the work is not too high. Based on that, individuals' coping

mechanism towards disease protection construct will be developed from the theories discussed. Hence that the following hypotheses is proposed:

H10: Individuals' beliefs towards disease protection will be positively associated individuals' information gathering attitude for infectious disease.

H11: Individuals' beliefs towards disease protection will be positively associated with their intention towards digitally mediated civic engagement for infectious diseases such as (a) sharing information with friends and family, (b) sharing information with public and (c) sharing information with authorities.

H12: Individuals' information gathering attitude for infectious disease will be positively associated with their intention towards digitally mediated civic engagement for infectious diseases such as (a) sharing information with friends and family, (b) sharing information with public and (c) sharing information with authorities.

Figure 7. Conceptual model with hypotheses

CHAPTER FIVE

SURVEY STUDY

Chapter four developed a conceptual model to address motivators of DMCE for infectious disease preparedness. The variables incorporated in the conceptual model are media use, news attention, civic engagement, trust, health beliefs, information seeking and information sharing. This chapter elaborates on the research that was conducted through a quantitative survey to test the facets of the conceptual model discussed in the previous chapter. Aspects of the survey including methods used, findings and discussions are reported in the sections below.

5.1 Methods

To comprehensively and deeply examine the predictors and impacts of civic engagement for infectious diseases, this study adopted a survey approach. In the next section, the research design and methods that were used for the study are discussed in detail. For this study, the disease dengue (MOH, 2013; MOH, 2014a) was selected as it is a common public health concern across Singapore and India. (Further details on dengue is covered in chapter one under the scope of the study.)

5.1.1 Sampling and Data Collection Procedures

A cross-sectional self-reported survey using quattrics.com (online) survey was designed. It was decided that an online survey will be used as it offers the most economical and efficient way of collecting data in India and Singapore at the concurrent time. Two online strategies were used to recruit participants. University students were recruited for the study through research participation pool organised by the university. The survey was uploaded via the research participation website and students were invited to log in and take part in the study. The survey was also

published via AmazonMTurk to recruit respondents from the public. AmazonMTurk is a crowdsourced platform where the public login and take part in human intelligent tasks (Buhrmester et al, 2011), for example “comparing product images, transcribing podcasts, copying business card text into a database, etc.” (Casler, Bickel, & Hackett, 2013, p.2157), in this case, take part in a survey and expressing their opinion.

Buhrmester, Kwang, & Gosling (2011, p.5) in their study compared MTurk participants against regular Internet participants and found that MTurk samples were varied and more representative. They also found that the quality of MTurk data “met or exceeded the psychometric standards associated with published research”. The data collection period was from 25 Oct 2017 to 15 Jan 2018.

Random quota sampling method was used to recruit respondents for the survey. This sampling technique was implemented to insure equal representation of gender in the study by controlling gender quota (Acharya et.al., 2013). Older adults above 40 were excluded from the final data set as the percentage of those who participated in the survey was not very high (<5%) without having any age limit set for the participants to take part in the study. By defining the age group up to 40 we are looking at the current active citizens and as well as citizens of the future who are smart phone users.

Older adults may be less inclined to use new media and furthermore the survey study was conducted online and individuals who are comfortable with technology would only be part of a service like Amazon MTurk. This possibly be a reason why not many of them took part in the study. Participants who may have their own smartphones or know how it works will mostly be individuals age less than 40, especially in developing countries like India. It is reported that highest number of smart phone users fall between the age of 10 to 24 in India making it 80% of the smart phone users under the age of 25 years (Vserv, 2015).

Similarly, It is been reported that 80% of internet users are below 44 years of age in Singapore (Digital influence lab, 2015; Statista, 2013). Also from the FGD study we found out that even though older people have smart phones most of them would use it as a feature phone. Due to the sampling techniques used in the study and the survey respondents, the survey is not representative. Questionnaire/survey method was considered a good option as it provides a “reliable sense of anonymity and little fear of reprisal” to the participants (Brener, Billy, & Grady, 2003 p.439).

The estimated amount of time for the participants to finish the survey was 15 to 20 minutes. 70% of the participants finished the survey within 15 minutes. Each participant was requested to read the informed consent form page and click on an ‘I Agree’ button before taking part in the survey. This form described the aim and goal of the study and the amount of time a person may need to take part in the study. The survey was administered in the English language as English is one of the official languages in Singapore and India. The informed consent webpage is conformed to international standards where respondents are informed of their rights and their choice to opt out of the survey at any given point of time (Appendix I). Data collection for the study happened after the approval from the Institutional Review Board of the university. The participants were given USD 0.40 (public) and 0.25 credits (students) as a token of appreciation.

5.1.2 Survey Instrument

The questionnaire was developed by identifying, adapting and creating appropriate measures from the existing literature. The questionnaire consisted of five sections: (a) demographic characteristics; (b) media use and perceived benefits of media; (c) public engagement constructs; (d) beliefs towards disease protection

constructs and (e) civic engagement for health communication. The final version of the survey used in the study is attached in Appendix J.

5.1.3 Measures

The scales and items of all the variables used in this study are presented as follows:

Demographic variables, age was measured using continuous variable ($M=26.78$, $SD=4.8$), gender was coded with male as '1' and female as '2' (50.8%) and countries were coded such that India=1 ($N=1001$) and Singapore=2 ($N=259$).

Media Use was measured on a 1 ('never') to 7 ('few times a day') scale on a list of media (Twitter, Google+, Blog, Forums, Health websites, radio, posters, magazines). The items of the measure were adapted from El Ouiridi, et.al (2015).

Perceived benefits of media was measured using a composite measure with four items on a 1 ('strongly disagree') to 7 ('strongly agree') scale. The items requested the participants to note how much they agreed or disagreed on the following statements on three separate mediums (newspapers, television, radio, the Internet, and social media): (a) 'enable me to stay connected with my community', (b) 'enable me to stay updated of health information', (c) 'help me find health information', and (d) 'help me connect with people from whom I regularly get health information'. The scale is adapted from Ho, Chen and Sim (2013). The final variable for perceived benefits of traditional media ($M=5.3$, $SD=1.03$, Cronbach's $\alpha=.84$), the internet media ($M=5.6$, $SD=.93$, Cronbach's $\alpha=.86$) was formed by averaging the four and six items together, respectively.

Social Capital was measured using Gil de Zúñiga, Jung, & Valenzuela, (2012) scale which consisted of six items covering various characteristics of participants' social capital. Sample items include 'share community values, talk about community

problems.’ Respondents were requested to rate on a 1 (‘strongly disagree’) to 7 (‘strongly agree’) scale. The higher the score, the greater the individual's social capital level. A composite variable was created by averaging all the items ($M=5.45$, $SD=.97$, Cronbach’s $\alpha=.90$).

The researcher measured *trust* using ten items on a 1 (‘Not at all’) to 7 (‘Extremely trusting’) scale adapted from Narayan and Cassidy’s (2001). Higher score indicated higher level of trust among the people in the group. An exploratory factor analysis was executed and 5 items (Trust of business owners, politicians, government service providers, local/municipal government and judges/courts/police) were grouped together to form a composite variable called Trust ($M=4.67$, $SD=1.24$, Cronbach’s $\alpha=.85$).

Beliefs towards disease protection constructs capture the core “protecting motivation theory variables namely response efficacy, perceived self-efficacy” along with disease knowledge on a 1 (‘strongly disagree’) to 7 (‘strongly agree’) scale. The scale was adapted from the study conducted by Lwin and Saw (2007) and Rogers (1975). An exploratory factor analysis was executed and the 5 items were grouped together to become the beliefs towards disease protection variable based on the factor analysis ($M=5.36$, $SD=.87$, Cronbach’s $\alpha=.73$).

To measure individual’s intention to *gather information and preventive measures*, respondents were asked to inform if they intended to gather information ($M=5.37$, $SD=.97$, Cronbach’s $\alpha=.83$) from the following sources such as Healthcare professionals (e.g. Doctors, nurses), Personal networks (e.g. Family, Friends, Colleagues), Traditional media (e.g. Newspapers, TV, Radio, Posters), Internet Media (e.g. Health websites, forums, blogs) and Social Media (e.g. Facebook, Twitter, WhatsApp), on a 1 (‘strongly disagree’) to 7 (‘strongly agree’) scale.

Intention to take part in Civic Engagement for Infectious diseases: The items are adapted from Lwin et al. (2012). Participants will be asked to rate on a 1 ('Extremely unlikely') to 7 ('Extremely likely') scale regarding their frequency of sharing health information with (a) family, friends and peers, (b) member and/or public, and (c) govt. authorities through the following medias Internet Media (e.g. Health websites, forums, blogs), Social Media (e.g. Facebook, Twitter, WhatsApp) and Mobile phone health application. An exploratory factor analysis divided the items into three groups (a) family and friends ($M=5.38$, $SD=1.23$, Cronbach's $\alpha=.78$), (b) general public ($M=5.33$, $SD=1.27$, Cronbach's $\alpha=.84$) and (c) authorities ($M=5.2$, $SD=1.49$, Cronbach's $\alpha=.89$).

Items adapted from some studies had used different point Likert scales (e.g: Gil de Zúñiga, Jung, & Valenzuela, 2012; Lwin & Saw, 2007; El Ouiridi et.al, 2015). However, for this research, it was decided to keep scales for all the items to achieve uniformity. The adapted scales were modified to 7-point Likert to incorporate more depth in the measurements. Table 5 shows items for constructs, factor loadings and reliability values.

Table 5. Items for Constructs, Factor Loadings and Reliability values

Constructs	Items	Factor loadings	α
<i>Perceived Benefits of Traditional media</i>	Attention to news through Traditional media (a) 'enable me to stay connected with my community' (b) 'enable me to stay updated of health information' (c) 'help me find health information' (d) 'help me connect with people from whom I regularly get health information'	.78 .84 .86 .80	.84
<i>Perceived Benefits of Internet media use</i>	Attention to news through Internet media (a) 'enable me to stay connected with my community' (b) 'help me find health information' Attention to news through Social media (a) 'enable me to stay connected with my community' (b) 'enable me to stay updated of health information' (c) 'help me find health information' (d) 'help me connect with people from whom I regularly get health information'	.76 .76 .78 .79 .81 .73	.86
<i>Social Capital</i>	(a) Feel part of the community	.79	.90

	(b) Share community values (c) Talk about community problems (d) Feel connected (e) Help resolve problems (f) Watch out for community members	.83 .84 .81 .81 .80	
<i>Trust</i>	Trust in the following: (a) business owners (b) politicians (c) government service providers (d) local/municipal government (e) judges/courts/police	.74 .64 .89 .91 .82	.85
<i>Beliefs towards disease protection</i>	(a) Regular checking on stagnant water will prevent you from getting dengue (b) It is convenient to drain stagnant water on your own (c) It is easy for you to spot stagnant water around your home and neighborhood (d) Information about dengue in this mobile application will help me to protect myself from dengue better (e) I know how to protect myself from dengue	.64 .74 .71 .69 .70	.73
<i>Intention to gather information</i>	Intention to gather information from the following sources: (a) Healthcare professionals (e.g. Doctors, nurses) (b) Personal networks (e.g. Family, Friends, Colleagues) (c) Traditional media (e.g. Newspapers, TV, Radio, Posters) (d) Internet Media (e.g. Health websites, forums, blogs) (e) Social Media (e.g. Facebook, Twitter, WhatsApp)	.74 .80 .83 .76 .76	.83
<i>Intention to take part in DMCE through information sharing with (a) family, friends and peers</i>	Through the following medias: (a) Internet Media (e.g. Health websites, forums, blogs) (b) Social Media (e.g. Facebook, Twitter, WhatsApp) (c) Mobile phone health application	.87 .83 .81	.78
<i>Intention to take part in DMCE through information sharing with (b) member and/or public</i>	Through the following medias: (a) Internet Media (e.g. Health websites, forums, blogs) (b) Social Media (e.g. Facebook, Twitter, WhatsApp) (c) Mobile phone health application	.90 .85 .84	.84
<i>Intention to take part in DMCE through information sharing with (c) govt. authorities</i>	Through the following medias: (a) Internet Media (e.g. Health websites, forums, blogs) (b) Social Media (e.g. Facebook, Twitter, WhatsApp) (c) Mobile phone health application	.92 .90 .89	.89

5.1.4 Pre-testing and pilot study

A pre-test was conducted on the preliminary questionnaire to collect feedback on the length and to evaluate the quality and clarity of the questions. The pre-test was

conducted with five researchers who did not participate in the main study. The participants in the pre-test were instructed on the research objectives and were asked to examine the questionnaire for various discrepancies, redundancies, uncertainties, grammatical mistakes, wrong sentence structure and any other issues which would create problems in answering the questions. Based on their feedback, some items were edited. Next, 90 participants took part in the survey to test the validity and reliability of the items in the scales. The items that didn't have strong reliability and validity were then removed to make the questionnaire comprehensive. After this study, the questionnaire was deemed ready for dissemination to target respondents.

5.1.5 Data Analysis

Path analysis technique using AMOS 24.0 was used for analysis. This method of analysis implements a confirmatory method, meaning that this technique can be very good for deduction purposes. Furthermore, it keeps records of measurement error, includes both unobserved and observed variables and identifies the direct and indirect effects. No variables were dropped out of the study. Traditional media use, internet media use, news attention to traditional media and news attention to internet media are the independent variables and social capital, trust, beliefs towards disease protection, information gathering, information sharing among family and friends, public and authorities are the dependent variables.

5.1.6 Model Fit

Nine common model-fit measures were used to evaluate the goodness-of fit: (1) Chi-square/degree of freedom (CMIN/df) CMIN should be between 2 to 5; (2) the Goodness-of-Fit Index (GFI) should be greater than 0.9 (Bagozzi & Yi 1988); (3) adjusted goodness-of-fit statistic should be more than .8 (Fornell & Larcker, 1981); (4) standardised root mean square residual should be more than 0.8 (Hu & Bentler, 1999);

(5) Root Mean square Residual (RMR) should be less than .08 (Bagozzi & Yi, 1988); (6) Root Mean Square Error of Approximation (RMSEA) should be less than .06 (Joreskog & Sorbom, 1996); (7) Normed Fit Index (NFI) should be more than .9 (Fornell & Larcker, 1981); (8) Non-Normed Fit Index or Tucker-Lewis index (NNFI or TLI) should be more than .9 (Bagozzi & Yi, 1988); and (9) Comparative Fit Index (CFI) should be more than .9 (Joreskog & Sorbom, 1996).

5.2 Results

Table 6 shows all the model-fit indices for three models (Model 1) Information sharing with friends and family: fit indices ($\chi^2/df = 4.13$; GFI= .993; AGFI= .968; SRMR= .023; RMR=.037 ; RMSEA=.05; NFI=.992; CFI = .994; TLI =.978), (Model 2) Information sharing with general public : fit indices ($\chi^2/df = 3.69$; GFI= .994; AGFI= .971; SRMR= .022; RMR=.037 ; RMSEA=.046; NFI=.993; CFI = .995; TLI =.981) and (Model 3) Information sharing with authorities : fit indices ($\chi^2/df = 4.31$; GFI= .992; AGFI= .966; SRMR= .023; RMR=.039 ; RMSEA=.051; NFI=.991; CFI = .993; TLI =.976) and the models please their respective acceptance criteria suggested in the previous literature based on nine fit indices. Therefore, it is determined that the measurement models have a good fit with the data collected. Hair et al. (1998) recommended that a comparison between the fit indices and their corresponding recommended values inmate a good model fit.

Table 6. Fit indices for the models

No.	Fit statistics	Info Sharing Friends & Family	Info Sharing Public	Info Sharing Authorities	Recommended value
1	CMIN/DF	4.13	3.69	4.31	<5
2	GFI	0.993	0.994	0.992	>0.90 (Bagozzi & Yi, 1988)
3	AGFI	0.968	0.971	0.966	>0.80 (Fornell & Larcker, 1981)
4	SRMR	0.023	0.022	0.023	<.08 (Hu & Bentler, 1999)
5	RMR	0.037	0.037	0.039	<0.08 (Bagozzi & Yi, 1988)
6	RMSEA	0.05	0.046	0.051	<0.06 (Joreskog & Sorbom, 1996)
7	NFI	0.992	0.993	0.991	>0.90 (Fornell & Larcker, 1981)
8	CFI	0.994	0.995	0.993	>0.90 (Joreskog & Sorbom, 1996)
9	TLI	0.978	0.981	0.976	>.90 (Bagozzi & Yi, 1988)

5.2.1 Structural paths and hypotheses tests

Figure 8. Recap-Conceptual model with hypotheses

Figure 9. Model 1- Path analysis for information sharing with family and friends

H1a, H2a, H3a and H4a stated that individuals' traditional media use, internet media use, perceived benefits of traditional media and perceived benefits of the internet media will be positively associated with individuals' social capital. To address these hypotheses, in Figure 9 paths relating to TM_USE to SocialCapital, IM_USE to SocialCapital, TM Perceived benefits to SocialCapital and IM Perceived benefits to SocialCapital reveal that individuals' traditional media use (TM use) (Figure 9; $\beta = 0.095, p < .001$), internet media use (IM use) ($\beta = 0.117, p < .001$), perceived benefits of traditional media (TM perceived benefits) ($\beta = 0.178, p < .001$) and perceived benefits of internet media (IM perceived benefits) ($\beta = 0.519, p < .001$) were significantly associated with individuals' social capital. Hence hypotheses H1a, H2a, H3a and H4a are supported.

H1b, H2b, H3b and H4b stated that that individuals' traditional media use, internet media use, perceived benefits of traditional media and perceived benefits of the internet media will be positively associated with individuals' trust. To address these hypotheses, in Figure 9 paths relating to TM_USE to Trust, IM_USE to Trust, TM Perceived benefits to Trust and IM Perceived benefits to Trust reveal that individuals' traditional media use (Figure 9, $\beta = 0.141, p < .001$), internet media use ($\beta = 0.381, p < .001$) and perceived benefits of traditional media ($\beta = 0.153, p < .001$) were significantly associated with individuals' trust supporting hypotheses H1b, H2b, H3b. However, perceived benefits of internet media ($\beta = .013$) was not significantly associated with individuals' trust, and therefore H4b is not supported.

H1c, H2c, H3c and H4c stated that that individuals' traditional media use, internet media use, perceived benefits of traditional media and perceived benefits of

the internet media will be positively associated with individuals' beliefs towards disease protection . To address these hypotheses, in Figure 9 paths relating to TM_USE to HB_Dengue, IM_USE to HB_Dengue, TM Perceived benefits to HB_Dengue and IM Perceived benefits to HB_Dengue reveal that individuals' traditional media use (Figure 9; $\beta = .014$) and internet media use ($\beta = .052$) were not significantly associated with individuals' beliefs towards dengue, protection and therefore H1c and H2c was not supported. At the same time perceived benefits of traditional media ($\beta = 0.139, p < .001$) and perceived benefits of internet media ($\beta = 0.278, p < .001$) were significantly associated with individuals' beliefs towards dengue protection supporting hypotheses H3c and H4c.

H5a and H5b stated that individuals' social capital and trust will be positively associated with individuals' beliefs towards disease protection. To address these hypotheses, in Figure 9 paths relating to SocialCapital to HB_Dengue and Trust to HB_Dengue reveal that individuals' social capital (Figure 9; $\beta = 0.234, p < .001$) and individuals' trust in public ($\beta = 0.149, p < .001$) were significantly associated with individual's beliefs towards disease protection supporting hypotheses H5a and H5b.

H6, H8 and H10 stated that individuals' social capital, trust and beliefs towards disease protection will be positively associated with individuals' information gathering attitude for infectious diseases. To address these hypotheses, in Figure 9 paths relating to SocialCapital to InfoGathering attitude, Trust to InfoGathering attitude and HB_Dengue to InfoGathering attitude reveal that individuals' social capital (Figure 9; $\beta = 0.206, p < .001$) and individuals' beliefs towards disease protection ($\beta = 0.264, p < .001$) were positively associated with individuals' information gathering attitude supporting H6 and H10 whereas individuals' trust ($\beta = .023$) was not significantly associated with individuals' information gathering attitude, hence H8 was not

supported. Two exploratory relationships were identified during the analysis process, Individuals' perceived benefits of traditional media ($\beta = 0.216, p < .001$) and perceived benefits of internet media ($\beta = 0.147, p < .001$) were significantly associated with individuals' information gathering attitude.

H7a, H9a, H11a and H12a stated that individuals' social capital, Trust, beliefs towards disease protection and their information gathering attitude will be positively associated with individuals' intention towards sharing information with family and friends. To address these hypotheses, in Figure 9 paths relating to SocialCapital to InfoSharing_FF, Trust to InfoSharing_FF, HB_Dengue to InfoSharing_FF and InfoGathering Attitude to InfoSharing_FF reveal that individuals' social capital (Figure 9; $\beta = 0.241, p < .001$), individuals' beliefs towards disease protection ($\beta = 0.116, p < .001$) and individuals' information gathering attitudes ($\beta = 0.435, p < .001$) were positively associated with individuals' intention towards information sharing with family and friends supporting H7a, H11a and H12a whereas individuals' trust ($\beta = -.009$) was not significantly associated with individuals' intention towards information sharing with family and friends, therefore H9a was not supported. Two exploratory relationships were identified during the analysis process, Individuals' traditional media use ($\beta = 0.084, p < .05$) and internet media use ($\beta = 0.069, p < .05$) were significantly associated with individuals' intention towards information sharing with family and friends.

Figure 10. Model 2- Path analysis for information sharing with the general public

H7b, H9b, H11b and H12b stated that individuals' social capital, Trust, beliefs towards disease protection and their information gathering attitude will be positively associated with individuals' intention towards sharing information with general public. To address these hypotheses, in Figure 10 paths relating to SocialCapital to InfoSharing Public, Trust to InfoSharing Public, HB_Dengue to InfoSharing Public and InfoGathering Attitude to InfoSharing Public reveal that individuals' social capital (Figure 10; $\beta = 0.21, p < .001$), individuals' beliefs towards disease protection ($\beta = 0.112, p < .001$) and individuals' information gathering attitudes ($\beta = 0.428, p < .001$) were positively associated with individuals' intention towards information sharing with the general public supporting H7b, H11b and H12b whereas individuals' trust ($\beta = -.014$) was not significantly associated with individuals' intention towards information sharing with the general public, hence H9b was not supported. Two exploratory relationships were identified during the analysis process, Individuals' traditional media use ($\beta = 0.089, p < .05$) and internet media use ($\beta = 0.103, p < .001$) were significantly associated with individuals' intention towards information sharing with the general public.

Figure 11. Model 3- Path analysis for information sharing with the authorities

H7c, H9c, H11c and H12c stated that individuals' social capital, Trust, beliefs towards disease protection and their information gathering attitude will be positively associated with individuals' intention towards sharing information with authorities. To address these hypotheses, in Figure 11 paths relating to SocialCapital to InfoSharing authorities, Trust to InfoSharing authorities, HB_Dengue to InfoSharing authorities and InfoGathering Attitude to InfoSharing authorities reveal that individuals' social capital (Figure 11; $\beta = 0.253, p < .001$) and individuals' information gathering attitudes ($\beta = 0.309, p < .001$) were positively associated with individuals' intention towards information sharing with the authorities supporting H7c and H12c whereas and individuals' trust ($\beta = .012$) and individuals' beliefs towards disease protection ($\beta = 0.046$) were not significantly associated with individuals' intention towards information sharing with authorities, hence H9c and H11c were not supported. Two exploratory relationships were identified during the analysis process, Individuals' traditional media use ($\beta = 0.148, p < .001$) and internet media use ($\beta = 0.147, p < .001$) were significantly associated with individuals' intention towards information sharing with the authorities.

Table 7. Summary of results for research hypothesis

Hypotheses			Path coefficient	Support
H1a	TM USE →	Social Capital	0.095***	YES
H2a	IM USE →	Social Capital	0.117***	YES
H3a	TM Perceived benefits →	Social Capital	0.178***	YES
H4a	IM Perceived benefits →	Social Capital	0.519***	YES
H1b	TM USE →	Trust	0.141***	YES
H2b	IM USE →	Trust	0.381***	YES
H3b	TM Perceived benefits →	Trust	0.153***	YES
H4b	IM Perceived benefits →	Trust	0.013	NO
H1c	TM USE →	HB Dengue	0.014	NO
H2c	IM USE →	HB Dengue	0.052	NO
H3c	TM Perceived benefits →	HB Dengue	0.139***	YES
H4c	IM Perceived benefits →	HB Dengue	0.278***	YES
H5a	Social Capital →	HB Dengue	0.234***	YES
H5b	Trust →	HB Dengue	0.149***	YES
H6	Social Capital →	Info Gathering Attitude	0.206***	YES
H8	Trust →	Info Gathering Attitude	0.023	NO
H10	HB Dengue →	Info Gathering Attitude	0.264***	YES
H7a	Social Capital →	Info Sharing FF	0.241***	YES
H9a	Trust →	Info Sharing FF	-0.009	NO
H11a	HB Dengue →	Info Sharing FF	0.116***	YES
H12a	Info Gathering Attitude →	Info Sharing FF	0.435***	YES
H7b	Social Capital →	Info Sharing Public	0.21***	YES
H9b	Trust →	Info Sharing Public	-0.014	NO
H11b	HB Dengue →	Info Sharing Public	0.112***	YES
H12b	Info Gathering Attitude →	Info Sharing Public	0.428***	YES
H7c	Social Capital →	Info Sharing Authorities	0.253***	YES
H9c	Trust →	Info Sharing Authorities	0.012	NO
H11c	HB Dengue →	Info Sharing Authorities	0.046	NO
H12c	Info Gathering Attitude →	Info Sharing Authorities	0.309***	YES

Table 8. Summary of results-exploratory paths

Hypotheses			Path coefficient	Support
Exploratory	TM Perceived benefits →	Info Gathering Attitude	0.216***	POSITIVE RELATIONSHIP
Exploratory	IM Perceived benefits →	Info Gathering Attitude	0.147***	POSITIVE RELATIONSHIP
Exploratory	TM USE →	Info Sharing FF	0.084**	POSITIVE RELATIONSHIP
Exploratory	IM USE →	Info Sharing FF	0.069**	POSITIVE RELATIONSHIP
Exploratory	TM USE →	Info Sharing Public	0.089**	POSITIVE RELATIONSHIP
Exploratory	IM USE →	Info Sharing Public	0.103***	POSITIVE RELATIONSHIP
Exploratory	TM USE →	Info Sharing Authorities	0.148***	POSITIVE RELATIONSHIP
Exploratory	IM USE →	Info Sharing Authorities	0.147***	POSITIVE RELATIONSHIP

Once a potentially mediated relationship was established, saturated model including the hypothesized mediation and potential direct effects was specified. This aids in noting the significance as well as the strength of the relationship that exist among different predictor and criterion variables. As a final step, the recommendations by Preacher and Hayes (2004) of performing bootstrap procedures on the saturated model was followed. Bootstrapping is an effective testing strategy for data with smaller samples (Shrout & Bolger, 2002) and facilitates testing for indirect effects through mediation. A common criticism for traditional mediation methods is the assumption of normal distribution of data while mediation analysis (Preacher & Hayes, 2004; Zhao, Lynch, & Chen, 2010). For mediation analysis to be interpreted based on data distribution, the data was resampled 2000 times to estimate the confidence intervals of the mediated effects, in the bootstrap procedure. A predictor variable has a fully mediated effect on the criterion variable if in the specified saturated model there exists an insignificant relationship between the predictor and criterion variables and a significant indirect effect is found in the bootstrap. A

predictor variable has a partially mediated effect on the criterion variable if in the specified saturated model there exists a significant relationship between the predictor and criterion variables and a significant indirect effect is found in the bootstrap.

Bootstrapping results reported in Table 9 and Table 10 showed a significant indirect effect of trust through Beliefs towards disease protection variable towards information gathering attitude ($\beta=0.04, p < .05$), information sharing with family and friends ($\beta=0.03, p < .05$), general public ($\beta=0.03, p < .05$) and authorities ($\beta=0.02, p < .05$). The direct effects of trust to information gathering, information sharing with friends and family, general public and authorities were not significant. Hence beliefs towards disease protection variable fully mediated trust in this study.

Beliefs towards disease protection has a significant indirect effect through information gathering attitude towards information sharing with family and friends ($\beta=0.12, p < .05$), general public ($\beta=0.11, p < .05$) and authorities ($\beta=0.08, p < .05$). Beliefs towards disease protection also has significant direct effects towards information sharing except for information sharing with authorities. This results showed that beliefs towards disease protection has partial indirect effects through information gathering towards information sharing with family and friends and general public and full mediation through information gathering attitude towards information sharing with authorities.

Table 9. Bootstrapping- Standardized Indirect Effects ($p < .05$)

	TM Perceived benefits	IM News Attention	IM USE	TM USE	Social Capital	Trust	HB Dengue
HB Dengue	0.065**	0.122**	0.084**	0.043**			
Info Gathering Attitude	0.09**	0.212**	0.046**	0.031**	0.062**	0.039**	
Info Sharing FF	0.2**	0.328**	0.058**	0.042**	0.144**	0.034**	0.115**
Info Sharing Public	0.191**	0.308**	0.054**	0.038**	0.141**	0.034**	0.113**
Info Sharing Authorities	0.149**	0.26**	0.048**	0.036**	0.093**	0.019**	0.081**

Table 10. Bootstrapping Lower Bound and Upper Bound results

Bootstrapping- Lower Bounds Results	TM Perceived benefits	IM News Attention	IM USE	TM USE	Social Capital	Trust	HB Dengue
HB Dengue	0.051	0.095	0.065	0.028			
Info Gathering Attitude	0.072	0.183	0.033	0.018	0.047	0.028	
Info Sharing FF	0.171	0.298	0.04	0.024	0.121	0.024	0.095
Info Sharing Public	0.163	0.278	0.038	0.022	0.118	0.024	0.093
Info Sharing Authorities	0.125	0.234	0.032	0.02	0.076	0.012	0.065
Bootstrapping- Upper Bounds Results	TM Perceived benefits	IM News Attention	IM USE	TM USE	Social Capital	Trust	HB Dengue
HB Dengue	0.081	0.151	0.107	0.059			
Info Gathering Attitude	0.11	0.242	0.062	0.045	0.081	0.053	
Info Sharing FF	0.227	0.356	0.078	0.06	0.169	0.047	0.136
Info Sharing Public	0.217	0.335	0.073	0.055	0.166	0.046	0.134
Info Sharing Authorities	0.172	0.286	0.066	0.052	0.115	0.029	0.1

Social capital has a significant indirect effect towards information gathering ($\beta=0.06, p < .05$) through health belief. Social capital also has significant indirect effects through beliefs towards disease protection and information gathering attitude towards information sharing with family and friends ($\beta=0.14, p < .05$), general public ($\beta=0.14, p < .05$) and authorities ($\beta=0.09, p < .05$). Social capital has significant direct effects towards information gathering and information sharing. This result shows that social capital has partial indirect effects through beliefs towards disease protection towards information gathering. Social capital also has partial indirect effects through beliefs towards disease protection and information gathering towards information sharing with family and friends and general public and authorities.

Perceived benefits of internet media has a significant indirect effect towards beliefs towards disease protection ($\beta=0.12, p < .05$) through social capital and towards information gathering ($\beta=0.21, p < .05$) through beliefs towards disease protection and social capital. Perceived benefits of internet media also has significant indirect effects through social capital, beliefs towards disease protection and information gathering attitude towards information sharing with family and friends ($\beta=0.33, p < .05$), general public ($\beta=0.30, p < .05$) and authorities ($\beta=0.26, p < .05$).

Perceived benefits of internet media has a significant direct effect towards beliefs towards disease protection and information gathering but there is no direct path to information sharing. This result shows that perceived benefits of internet media has partial indirect effects through social capital towards health belief, through social capital and beliefs towards disease protection towards information gathering. Perceived benefits of internet media also has partial indirect effects through social capital, beliefs towards disease protection and information gathering towards information sharing with family and friends and general public and authorities.

Perceived benefits of traditional media has a significant indirect effect towards beliefs towards disease protection ($\beta=0.07, p < .05$) through social capital and towards information gathering ($\beta=0.09, p < .05$) through beliefs towards disease protection and social capital. Perceived benefits of traditional media also has significant indirect effects through social capital, beliefs towards disease protection and information gathering attitude towards information sharing with family and friends ($\beta=0.2, p < .05$), general public ($\beta=0.19, p < .05$) and authorities ($\beta=0.15, p < .05$).

Perceived benefits of traditional media has significant direct effects towards beliefs towards disease protection and information gathering but there is no direct path to information sharing. This result shows that perceived benefits of traditional media has partial indirect effects through social capital and trust towards health belief, through social capital and beliefs towards disease protection towards information gathering. Perceived benefits of traditional media also has partial indirect effects through social capital, beliefs towards disease protection and information gathering towards information sharing with family and friends and general public and authorities.

The bootstrapping effect for variables with trust as mediator showed bias corrected and accelerated Confidence Interval (CI) for information gathering attitude, information sharing with family and friends, general public) and authorities contains no zero (CI= .03 to .05), (CI= .02 to .05), (CI=.02 to .05), and (CI=.01 to .03) respectively within its lower and higher limits.

Similarly, the bootstrapping effect for variables with beliefs towards disease protection as mediator showed bias corrected and accelerated Confidence Interval (CI) for information sharing with family and friends, general public) and authorities contains no zero (CI= .10 to .14), (CI=.09 to .13), and (CI=.07 to .1) respectively

within its lower and higher limits. The bootstrapping effect for variables with social capital as mediator showed bias corrected and accelerated Confidence Interval (CI) for information gathering attitude, information sharing with family and friends, general public) and authorities contains no zero (CI= .05 to .08), (CI= .12 to .17), (CI=.12 to .17), and (CI=.08 to .12) respectively within its lower and higher limits.

The bootstrapping effect for variables with perceived benefits of internet media as mediator showed bias corrected and accelerated Confidence Interval (CI) for health belief, information gathering attitude, information sharing with family and friends, general public) and authorities contains no zero (CI= .10 to .15), (CI= .18 to .24), (CI=.30 to .36), (CI=.28 to .34), and (CI=.23 to .29) respectively within its lower and higher limits.

The bootstrapping effect for variables with perceived benefits of traditional media as mediator showed bias corrected and accelerated Confidence Interval (CI) for health belief, information gathering attitude, information sharing with family and friends, general public) and authorities contains no zero (CI= .05 to .08), (CI= .07 to .11), (CI= .17 to .23), (CI=.16 to .22), and (CI=.13 to .17) respectively within its lower and higher limits. These results provides confirmatory support to our earlier propositions.

5.3 Discussion -Digitally Mediated Civic Engagement through Information Sharing with FF, Public and Authorities

Individuals' traditional media use, internet media use, perceived benefits of traditional media and perceived benefits of internet media were positively associated with individuals' social capital, supporting hypotheses H1a, H2a, H3a and H4a. Individuals' traditional media use, internet media use and perceived benefits of traditional media were significantly associated with individuals' trust supporting

hypotheses H1b, H2b, H3b and perceived benefits of internet media was not significantly associated with individuals' trust, not supporting H4b. The results show that media plays a big role for the participants of the study to understand and relate to their society. Participants from India were asked to think of a community before answering the social capital set of questions. 86% of participants mentioned that they thought about an online community before answering the questions.

Online communities such as forums and social networking sites that offer two-way communication channel encourages participation in group activities, this builds attachment towards the group members and creates a community atmosphere. This is in line with Zhang et al.' work (2010) in which the researcher noted that trust in social networking sites is positively associated with public engagement. Internet media on the other hand makes news available for people who purposefully look for it but doesn't necessary provide two-way communication. Hence this platform lacks in creating bonds or a community feel among the participants. Many web pages can be fake and may mimic official websites, misleading consumers that they are from medical experts (Bernhardt et al., 2002).

Trust becomes a crucial element in the existence of uncertainty and lack of regulation. In the case of internet as a source of information for health, trust is divided in society. In the study by Hesse et al (2005) one fourth of participants expresses a lot of trust and one fourth had no trust. Similarly, misleading information can also come from online support groups. Support group members often use their personal experiences instead of the critical perspective of health professionals (Cline & Haynes, 2001). Hence, it is essential that online health information is validated by the consumers (Xiao, Sharman, Rao & Upadhyaya, 2014). Another study reported on how

trending topics on Twitter were mostly initially reported in traditional media (Asur, Huberman, Sabo, & Wang, 2011). This shows the inter-connectivity between traditional and internet media use.

Individuals' traditional media use and internet media use were not significantly associated with individuals' beliefs towards disease protection towards dengue not supporting H1c and H2c. At the same time attention to news in traditional media and attention to news in internet media were significantly associated with individuals' beliefs towards disease protection towards dengue supporting hypotheses H3c and H4c. The reason could be that media use doesn't indicate that participants purposefully use media to gather disease information, whereas perceived benefits of health information on the traditional and internet media show that individuals are taking note of the health information they see upon the media sources.

This is in line with previous studies and suggests that there are individuals who use new media to seek health information and have joined health-related groups (Greene et al., 2011; Paul, Hong & Chi, 2011; Fox & Jones, 2009). The studies also hint that not all new media users will be health information seekers. Recent studies have also noted that public health programs have successfully integrated social media into their communication channels for health promotion purposes (Vance, Howe, & Dellavalle, 2009; Thackeray, Neiger, & Hanson, 2008; Khanna, 2008).

Individuals' social capital and trust in public were significantly associated with individual's beliefs towards disease protection supporting hypotheses H5a and H5b. These significant paths show that active community engagement and people's interaction through various communities online and offline creates community ties and can enhance health communication.

Individuals' social capital and beliefs towards disease protection were positively associated with individuals' information gathering attitude supporting H6 and H10 whereas individuals' trust was not significantly associated with individuals' information gathering attitude not supporting H8. Two exploratory relationships were identified during the analysis process, Individuals' attention to news in traditional media and attention to news in internet media were significantly associated with individuals' information gathering attitude. Johnson, Meischke, Grau, & Johnson (1992, p.186) defined health Information gathering as “one of the primary functional coping strategies that individuals have at their disposal”.

Information is necessary to evaluate, manage or change one's health and health behaviours (Goldsmith, 2001; Johnson & Meischke, 1993). Other studies have reported that information gathering happens in an atmosphere in which a range of sources are accessible and available (Brashers et al., 2002; Johnson & Meischke, 1993). Research has also explained that health information can be gathered from various sources such as family and friends, doctors, traditional media and even new media (Napoli, 2001). One of the main aims of the study was to understand the predicting factors for individual's information gathering attitude to fight dengue. The results indicate that media use, attention to media along with social capital has significant associations with participants' intentions.

Individuals' social capital, beliefs towards disease protection (expect for information sharing with authorities) and information gathering attitudes were positively associated with individuals' intention towards information sharing with family and friends and the general public supporting H7a, H7b, H7c, H11a, H11b, H12a, H12b and H12c whereas individuals' trust was not significantly associated with individuals' intention towards information sharing with family and friends, the general

public and the authorities, not supporting H9a, H9b and H9c. Individuals' beliefs towards disease protection were not significantly associated with their intention towards information sharing with authorities, not supporting H11c. Two exploratory relationships were identified during the analysis process, Individuals' traditional media use and internet media use were significantly associated with individuals' intention towards information sharing with family and friends, the general public and the authorities.

In summary, there are mainly four major findings in this segment of the research. First, information gathering attitude played a substantial role in shaping individuals' information sharing attitude. Researchers have observed a positive relationship linking health information gathering online and health behaviour shifts in individuals (Ayers & Kronenfeld, 2007). The results suggest that individuals who tend to gather more information also tend to share more.

Second, perceived benefits of media acts as an enabler for information sharing. Previous studies have reported that social networking sites have emerged as another channel for health information sharing and health information seeking (Choudhury et al., 2014). Another research stated that individuals are using Twitter as a tool to search health-related data (Paul, Hong & Chi, 2011). Greene et al. (2011) indicated that specific health interactions on SNSs give information and comfort, including interactions between the participants.

Third, social capital played a significant role in influencing individuals' information sharing attitudes. Studies have found that individuals find comfort through online health communities (Rodgers & Chen, 2005; Eysenbach et al., 2004). Another research reported that 30% of internet users from the USA had been part of health-related groups (Johnson & Ambrose, 2006). This shows that individuals' social

capital, i.e., feeling connected to a community, either offline or online creates a relationship with that group and enables civic engagement for the betterment of the society. Other researchers have also suggested community building for the improvement of health (Grimes et al., 2010).

Fourth, individuals' coping appraisals such as self-efficacy and response efficacy along with knowledge played an essential role in motivating the participants to gather information on dengue as well as share information. Individuals' beliefs towards disease protection that self-efficacy, response efficacy and disease knowledge can help to prevent dengue, and this might be the reason for them to share information.

Based on the results and discussion a modified model is proposed below.

—— Original relationship (from the Initial model) - - - - New relationships (after analysis)

..... Removed relationships from the original model (after analysis)

Figure 12. Modified model for information sharing

5.4 Limitation and Future Research

There are some limitations to the current study. First, the model was tested based on established literature background with individual components supported by previous studies. Second, even though a decent sample size was collected, the sample size from Singapore was only approximately 260 (compared to 1001 In India) and most of them were university students. This makes the research lacking in wide variation of participants from all ways of life in Singapore. Future studies could extend this examination to a proper representative sample of Singapore population to test the generalizability of the results. Third, the study only focused on one infectious disease context. Future studies could be conducted in different infectious diseases to test the conceptual model.

Fourth, one of the reasons for non-significant relationship between the trust variable and the DVs may be because the trust variable was measuring general trust the participants have with different groups such as (a) business owners (b) politicians (c) government service providers (d) local/municipal government (e) judge/courts/police. This could be a limitation of the study as the study only focused on general trust variables and did not focus on specific trust variables such as trust in health authorities, hospitals, health expects, government health system etc. Finally, not all the themes that emerged in the FGD study became part of the conceptual model due to limitation in the number of variables that could be included in the conceptual model. Themes that were supported by theories were given priority than other variables in the study. Future studies should include the eliminated themes and test their effects theoretically and practically. Future studies should also look into older population

specifically as they may be more likely to take part in civic engagement due to the availability of spare time and commitment to give back to the society.

5.5 Summary

In summary, this chapter presented the methods, results and discussion of the survey study with an aim to test the conceptual model that was developed in the previous chapter. An in-depth understanding of various facets that motivate and associate with DMCE, disease prevention behaviour and information gathering were found through the research. The study enables researchers to understand more about civic engagement in the context of infectious diseases.

CHAPTER SIX

WORKSHOP OBSERVATIONS- UNDERSTANDING MOTIVATORS OF DMCE FROM APP DEVELOPERS AND HEALTH AUTHORITIES

Chapters three, four and five addressed factors affecting DMCE from public's point of view. This chapter aims to understand additional factors that are considered for public participation during application development by health application developers and health authorities. This study is not a continuation of previous studies but provides a complementary vantage point on DMCE in addition to the public perspective on DMCE studied in the previous chapters.

6.1 Introduction

As discussed in the previous chapters dengue remains a serious health problem in Sri Lanka. An effective way to reduce dengue is to try and monitor the disease through surveillance by tracking the number of cases and investigating the outbreak source; and by tracing and eliminating the potential mosquito breeding grounds that could spread the disease (Lwin et al., 2013). However, health authorities are struggling to monitor and control the spread of the disease through their outdated and time-consuming paper-based systems.

To try and address this, in 2013, Nanyang Technological University (NTU), Singapore, developed an integrated digital surveillance tool called Mo-Buzz to target dengue in the Colombo region. The application was made available to the local health authorities to integrate predictive surveillance, dengue hotspot mapping, civic engagement and health education through social media. The health inspectors who would usually use paper-based forms to input potential breeding sites and paper maps

to pinpoint dengue hotspots were able to report through the system and get notifications from the public. This reduced reporting time considerably.

A similar Mo-Buzz application was piloted with the general public, to encourage reporting of potential breeding sites to the health authorities and to educate them on how to prevent the spread of dengue. However, although Mo-Buzz has been a success with Colombo health authorities, uptake of the application is low with the general public. The application has also become dated having been launched in 2013 and is in need of upgrading, both conceptually and technologically (ref mo-buzz papers).

To make the Mo-Buzz applications contemporary and more effective, NTU organized a 5-day hackathon event, 'Epihack Sri Lanka', in Colombo in November 2017 with funding received from Skoll Global Threats Fund (SGTF). Local and international IT and Health experts participated in Epihack Sri Lanka to improve capacities and capabilities of the existing applications. They collectively brainstormed, shared expert information, experiences, and guided each other in stimulating vibrant discussions and formulating best practices to create prototyped digital tools to prevent the spread of dengue. In this study, the terms Epihack and workshop are interchangeably used.

The main aim of Epihack Sri Lanka, was to develop a cutting edge participatory reporting tool with features for implementing prevention strategies to battle dengue and bridge communication gaps in dengue control. The intention was to build on the existing features of the mobile platform used by the public health inspectors of Colombo. The event also intended to revamp the application used by the general public to achieve effective communication between health authorities and members of the general public within Colombo. This provided an excellent opportunity to learn

and understand the health experts' and application developers' point of view of the things that are required for civic engagement.

Objectives of the study: The workshop provided a platform for health facilitators and participants, IT facilitators and participants to come together to develop a health communication app for CE. It was an exceptional opportunity to observe and understand the facets that are being considered by app developers and health authorities for encouraging the public to take part in the application once the app is developed. This study also helped us to identify other facets that need to be weighed during the application development and maintenance stages.

6.2 Method

6.2.1 Data collection- Sample and procedures

This research was conducted based on grounded theory approach, through field observations and qualitative interviews with the attendees of the event after receiving approval from Nanyang Technological University's Institutional Review Board (IRB) (Appendix F). Participants were observed in their area of work, and they were informally interviewed during the 5-day period. The interviews were recorded to ensure descriptive validity, and observations and themes were noted down.

6.2.2 Participants

Approximately 60 participants from 11 countries all over the world attended the event. A total of 58 facilitators and participants attended Epihack Sri Lanka, of which 16 were women. Twenty two attendees were health experts, while thirty six were IT experts. Event consisted of participants from Sri Lanka, India, Pakistan, USA, Albania, Laos, Thailand, Singapore, Australia, Belgium, Cambodia. Sixteen% had taken part in a previous Epihack. Participants can be grouped as follows: eight international health facilitators, eight local health participants, six international health

participants, four international IT facilitators, four local IT facilitators, three international IT participants and twenty seven local participants.

Participants included technological experts from industry and epidemiologists from the epidemiological units in Colombo and the local hospitals. In addition, participants consisted of public health inspectors, faculty and computer science students from Nanyang Technological University (NTU), University of Colombo, School of Computing (UCSC), the Computer Society of Sri Lanka (CSSL), representatives from the Ministry of Health (MOH), and Colombo Municipal Council (CMC).

6.2.3 Interview Guide

A basic interview guide containing a set of open-ended questions was prepared in English to understand the interviewee, the type of work they are involved in and how does that impact (if it does) health communication. The respondents were requested to be take part in the informal interview and after receiving their consent, they were briefed about the informal interview and purpose of it. The interviews were guided by three main themes (Appendix K), general questions about the interviewee and their work, motivating factors they have considered for their app/work and barriers they feel will affect public involvement in their apps/work.

The average duration of conversations were approximately 15-20 minutes and was moderated by the researcher. During the interview sessions, the researcher often summarised and clarified on the answers that were vague. The researcher also encouraged and enquired the participants to verify the summarised statements before moving to the next question. Interview sessions were documented with audio recordings and were then transcribed when they concluded.

6.2.4 Qualitative analysis

The data were coded according to grounded theory approach and codes were further elaborated as new themes developed during the coding procedure. The data was grouped according to the themes developed during coding exercise. According to Neuman (2014) the thematic categories were created based on the original research questions, theoretical concepts, ideas, thoughts and discussions created during the interview sessions and coding process. The key purpose of the research was to uncover the crucial factors (considered by the developers and health care professionals) influencing, motivating or de-motivating civic engagement. The transcripts were first coded line by line, based on the codes they were categorised into themes. The findings from the informal interviews and observations are reported in the results and discussion section of the chapter.

6.2.5 Epihack format

The 5-day Epihack event was held from 6th to 10th November 2017 in a hotel in Colombo. The experts took on the roles of facilitators and participants, to share information, experiences, and guide teams during discussion, to stimulate vibrant discussion and formulate best practices. The international collaborative effort facilitated an intensive environment to develop, integrate, and improve technological solutions in order to detect and reduce the spread and impact of dengue fever in Colombo, and required all participants to work together and create new solutions.

Procedure: Day by day run down of the event (Prototype creation in 5 days)

Day 1 of the event, consisted of an introduction to the problem of Dengue within Sri Lanka and examples of various digital health surveillance solutions that have been implemented around the world, to educate facilitators and participants about the

challenges at hand. The talks were predominantly health based and focused on educating those that were not aware of the problems, a brainstorming session was organised-particularly for IT participants- to try and clarify and solidify information presented to them on the current dengue issues.

Day 2 entailed visiting dengue hotspots around Colombo. Three groups were each taken to two sites that have had high levels of dengue outbreaks to interview the locals and view the area. The sites included construction sites, temple, schools, Independent Square and dengue affected family.

The aim of the field trip was to observe the mosquito breeding sites, and to collect information from the staff or individuals who are knowledgeable on the current dengue problems and programs that are in place at the site. The groups were given enough time to ask questions and get a better idea of the problem with the hope of giving them a clearer picture of the dengue situation.

The field trip can be encapsulated into two main questions:

1. What do they have? i.e. what problems is the site currently facing, what current dengue prevention systems are in place
2. What do they need? i.e. what are the problems with the existing dengue systems, how feasible are their ideas to improve the situation

A mini discussion session was organised to share information gathered from the field trips where each group presented their findings to the other groups. This session was continued by brainstorming the issues at hand, and the requirements were discussed and documented. Both health experts and IT experts contributed to the conversation to ensure that the requirements were valid and technologically achievable. Possible work topics were also discussed during the session.

Days 3 and 4 consisted of amalgamating ideas and creating groups consisting of IT and Health experts to develop the chosen work topics. The facilitators had a meeting to discuss, categorize and divided the project into achievable sub-projects/modules and were then assigned to each group based on their expertise. This is different to usual hackathons that generally create groups before ideas are defined and due to the more collaborative nature of the event. Five defined groups were formed, each consisting of one IT and one health facilitator. The sub-projects were then presented to the whole team, who were asked to select the group they wanted to work in. Facilitators explained the ideas behind their groups and the work topics were discussed further with participants to expand on ideas that were popular and to further define the group priorities. The work topics that formed were all different facets of the same surveillance system to prevent the same ideas being redeveloped. The groups then began working on their ideas which included:

- 1) A database for public health officials. Converting the paper-based methods into digital ones.
- 2) Work management and visualisation for public health officials. Creating a database that feeds information smoothly between various stakeholders.
- 3) Analytics. Creating a centralised database to consolidate all of the various information from different sources into one dashboard.
- 4) Education (e.g.: construction workers). Creating an application for use by construction workers.
- 5) Education (schools and public). Creating an application for use by schools and the general public.

Each group consisted of approximately 12 members, of which about 8 people were IT experts. Throughout the two days, each group presented their ideas to the attendees at regular intervals to gather opinions, ideas and potential issues from the other groups. The groups worked closely together throughout to ensure that each part was developed in parallel with ideas that could be incorporated with the others.

Day 5 of the event involved the presentation of the developed ideas by each group to invited guests and VIPs.

6.3 Results and Discussion

From the qualitative interviews conducted with attendees and workshop observations, three main themes were identified: Environment, Communication and Engagement.

6.3.1 Current Disease Environment

“Dengue is a complicated problem, we can’t pin point to what are the things we want”.

-Doctor (local health facilitator)

Paper based system Currently, most of the dengue reportings are paper-based. PHIs have a paper-based reporting system and also an application that has not been updated (Mo-Buzz) that they use to report mosquito breeding sites, disease burden, etc. So much effort and time are spent to check and eradicate dengue hotspots on a daily basis manually. General practitioners are not properly linked to the dengue reporting system. GPs typically have a money-making attitude and are also overworked with other priorities and partially because the paper-based reporting system is time-consuming to do, they choose not to be part of it.

Leaflets are given out to the public, with information and instruction on how to destroy breeding sites and a card is distributed to school children to take home and

educate them. The kids are asked to note down in their cards if they see any breeding sites. The class teacher will check the cards on a weekly basis to see if the children have noted down any potential breeding sites, and this information is then passed on to PHIs for inspection and action. However, this may not be executed in all schools, as some schools take more efforts than others to help the authorities. Lack of communication and communication channels between various parties leads to delay in actions and stop timely actions. As it is still paper based system, all the numbers are in individual files e.g. PHIs and general practitioners working in an area will know about their location and others may not be updated on this.

Cultural nuances such as religious belief also become a hindrance to control mosquito breeding. The priests in religious places (Buddhist temples) do not want to kill mosquitoes as killing life forms are considered sin. Most priests are against it, but being a holy place where 1000s visit each day, that could be a problem. The PHIs cannot take legal actions against the religious places making it difficult for the authorities to insist on what needs to be done.

Another cultural nuance is that if a child gets dengue, the teachers are put in an ethical dilemma. They feel like they can't inform or warn other kids or their parents about this. As it may lead to the isolation of the dengue affected child.

Diverse Population As the public consist of diverse group of people, such as people from all education backgrounds and migrant workers from China who don't follow Sinhala language but work in highly dengue prone area, it is important to think about the target audience, the purpose of the app, and the ways to get people to use the app. One of the local doctors said, a lot of people don't even know "*Information and knowledge, like what the normal temperature is or what is the colour of blood?*"

Attitude of the public Currently, even if the public is aware the dengue situation and how to reduce the spread, they do not necessarily follow dengue prevention methods. Civic engagement in preventing the spread would reduce the amount of time and work public health inspectors have. At the moment, the PHIs have to go from house to house inspections. The PHIs are also bombarded with other problems such as garbage collection, which should be actually handled by the sanitation department, as the public think it is one of the breeding grounds. The PHIs are put in a situation where they feel they are required to follow up on all the complaints as they need to keep a good relationship and good reputation with the public. Solutions suggested by the participants were to get the public involved in the process, make them feel empowered and show them their act as value. Show them that they are part of the dengue control activity group.

Environmental factors Rain falls and small rains can fill containers making it quick and fast breeding spots for mosquitos. In the last year the dengue cases have increased 4 times (WHO) as much compared to previous years, and one of the main reasons for this is heavy rainfall and flooding. Garbage disposal is another problem that enables mosquito breeding sites in Sri Lanka.

6.3.2 Workshop observations-Communication

6.3.2.1 Team Work and Expert knowledge availability

One of the main advantage of having an international team in the workshop was their experience along with their expertise. The workshop created an environment where the international experts could help and collaborate with the local team to come up with better solution for solving a health problem. The international experts brought in knowledge, expertise and lessons learned from previous workshops and similar projects they had been part of. When ideas were proposed they were able to give

suggestions based on their previous experience of whether something would work or not. At the same time, experts also understood that each country had its own unique problems, but solutions could be found from other countries. The ‘adapt and apply’ technique was employed here. The research team observed that there was exceptional communication and collaboration between the teams.

6.3.2.2 Language & Cultural barrier

As the event consisted of an international group of people of varying ages and expertise, the researchers identified certain gaps in communication during the event. During the first day of the event language was one of the barriers as different people have different accents and ways of communicating their ideas. As the days progressed participants got more acquainted with each other and this barrier drastically dropped.

Language was not the only barrier that was identified. One of the facilitators said *“Some people are shy, everyone has opinion but when you mix the group, they don’t want to tell, or sometimes they don’t get to tell. When there are many high-ranking people who attend, local junior people don’t want to speak”*. As day two progressed the imagined power-distance dropped, and participants and facilitators started talking to each other more freely. Even the student participants who had never worked before were working well with professionals and lecturers.

The research team also noticed that an informal hierarchy was perceived or practised by the participants with the white male at the top, followed by white females, local males and females in that order. This perceived hierarchy and small number of female IT professionals in the team seemed to restrict their putting forth their view points to the entire group. Sri Lanka also has a laid-back culture and people from various countries may have different working styles (preference to work alone, work in the morning or late at night etc.).

6.3.2.3 Knowledge Gap

In an ideal setting, the client would know what they want but here the health team knew their disease burden and problem but they don't have the solution that can help them fix the disease situation. This is where an event like Epihack can play a collaborative part to help the health authorities with international experts discuss ideas and solutions from around the world and see if that could be adapted and applied in Sri Lanka. The event also brings together local health experts who do not usually get the time to talk to each other about the health and disease problems they handle. Officers from different areas of Colombo might face different problems (e.g.: dealing with more wealthy or commercial areas etc.) increasing their knowledge pool. While interacting with them, we had also noticed that some offices were well equipped but some others were really run down.

There is a knowledge gap between the IT facilitators and participants and health facilitators and participants. The workshop was planned in such a way that the health facilitators will lead the first two days of the discussion telling the IT team what are their problems, challenges and clarify doubts for the IT team. Two days is very small about of time to understand all the procedures and workflows, but at the same time, the two days were conducted mostly in lecture style rather than group discussion format which some of the IT people found overwhelming. IT team considers this as a starting point where the team starts working on it which can be improved further later with local collaboration. The main goal was to understand critical problems and find ideas that can help to ease the disease burden and the whole idea of Epihack is to bring together multidisciplinary teams who never usually interact so that different angles can be used to see the big picture

“Bottom up approach, not top down approach”, this approach helps us (the developers) to find the missing element in the whole system. Once we know the missing elements it’s easier to put the pieces together. The method helps us to do an action oriented plan, explained one of the IT facilitators.

6.3.2.4 Time constraint

After two days of discussion and brain storming sessions between IT and health facilitators and participants, the IT facilitators and participants only got 48 hours to create a tangible prototype of the proposed solution. The amount of time was so limited that the focus was to get all the ideas in and create a quick prototype. The prototype could later be expanded to a workable solution. IT experts opined that it would take another four to six months of work for the prototype to be converted into a full-fledged working application. However, the health team experts were impressed by the amazing amount of effort that the IT team had put together in just two days in creating a prototype.

6.3.2.5 Ideas developed during Epihack

Currently as everything is manual it takes a lot of time and manpower to file and execute procedural items. This also results in time lags in taking needed actions. The Public Health Inspectors (PHIs) take 7 to 10 days to fill in and submit the dengue forms to their office. A critical communicable disease like dengue needs timely actions for disease prevention. During the event, the team sat down and came up with technological and non-technological ideas that could potentially solve the dengue problem in Sri Lanka.

Technological Ideas- A software system can be developed with the following features to motivate the public:

1. Predictive analysis based on rainy season and disease burden

2. Dynamic hotspot mapping
3. User friendliness for the application
4. Push notification to be sent as a standard message, on the occurrence of specific events, requesting the public to take necessary actions
5. Training videos
6. Updated geotagged system for accurate location reporting.
7. A forecast system could give enough time to prepare for the situation.

Non-technological Ideas

1. Targeting local communities-make people responsible through civic engagement
2. Dengue prevention method training for those that are unaware of the problem and at most risk
3. Motivate people through real life stories
4. Engaging laboratories to notify PHIs of potential dengue cases
5. Education campaign targeted at dengue hotspots such as construction sites and schools.

6.3.3 Community Engagement - Sustainability

A facilitator mentioned that “*future is not to work hard but to work smart,*” and another facilitator added “*The wheel is already invented, but we want to make it faster.*” This shows the facilitators’ belief in civic engagement and how it can enhance health of a community. Few types of sustainability questions were identified during the workshop that will need local support and groundwork to keep the project running. Two main themes that emerged within were stakeholder motivation and motivating of the public.

6.3.3.1 Stakeholder motivation

While talking to one of the health experts, she mentioned that local stakeholders have to be the ones to sustain the product as they know their environment. “*The application is not the challenge; it is the social and government support that will be critical for a project like this*”, said another health expert. She believes that this project should be outlined as a social responsibility project, and it needs work post the workshop.

Another expert stated, “*How to get the tools is difficult but how to maintain and continue working with the tool is most difficult.*” There are also other factors such as manpower and finding skilled collaborations that affect sustainability as well. Participants of Epihack created a prototype app, putting in lot of effort during the limited period available. After the epihack, another team will have to develop this prototype in to a workable solution, and there needs to be continuous communication and collaboration between the hackathon participants and the solution developers for the process to be smooth. This will also help the new solution in avoiding the fate of the previous application (Mo-Buzz). Mo-Buzz was developed by the research team, however it was not properly updated or maintained due to lack of funding and manpower. This led to a high attrition rate of PHIs using the application and eventually forced them to stop using the app itself. This background made the last day of the event equally important. During the last day, the work done, and ideas created during the hackathon were showcased to stakeholders, government representatives and the media. The support from key stakeholders would go a long way in fruitful completion of the project.

6.3.3.2 Motivating the public

An important question that need to be asked is what makes the public or participants use the app?

One of the main things to do should be to get public's attention and get them to use the app to report mosquito breeding sites. Campaigns, celebrity endorsements were few of the ideas that came as part of the discussion. Incentivising, social media integration, real life anecdotes, and gamifications were some other ideas as motivators for public use. The ideas and themes that emerged in this study that would motivate the public to take part in DMCE were similar to the themes observed in study 1.

Intrinsic Motivators

Message framing: One of the health experts raised a very critical sustainability matter, which is human behaviour change. Understanding the mechanisms of change and the levels of change that is required to make a change in behaviour are important for any sustainable behaviour. He said “*Because it's a health hackathon, they come from the epidemiological field. It is an interdisciplinary field. We need people who are not only doctors but also health communication experts, and there aren't many of them here.*

Ultimately what we have to do is change people's behaviour. You want them (the public) to take the stagnant water and throw it away. It is a different way of thinking. The IT and public health participants think in digital surveillance way, what they can do to help people to track and save: provide education and knowledge so that people can change behaviour. But this is with the assumption that people change their behaviour. A lot of psychological research has found that people don't change behaviour just because of its bad for them. To me, it comes to motivation, and further exploration of motivation mechanism needs to be done.”

“I think one of the things is that there are a lot the times we have apps in our phones, why do we use those apps on our phone? because they have a personal benefit to me. It's value expectancy. Is there strong enough value expectancy in reporting (breeding sites)? I think it's up to us to create the value, which is the important part. We can think of many ways to develop feasible, useful automatic processes with technology, but if people don't use it, it's not going to work. So how do you get people to use it? You have to create value for them to use it. Probably after the technological platform is created, we need to think about how to get people to use it. For eg: public shaming, incentives etc. Maybe not for prototype, but they are going to really develop the whole app then you need to think about how is this going to add value to a persons' life and why will they use it.”

Institutional response: One of the facilitators said “There are 100s of 1000s of search on dengue in the internet, fb, twitter, etc. We will have to offer something to the public for them to use the app. Based on their responses, participants could receive few items. One- Information about dengue in their area, Two- Tool kit to let them know how to inform the authorities, and Three- some kind of incentives: for example: a ‘thank you, you did something good for the society’ statement, updating the application or the respondent with action that is taken: showing them that the report is taken care of and breeding site is cleaned-showing impact, also putting it as a risk zone if it is too much breeding.

Timely action: Another problem that may raise when the software is publicly launched is the need for timely action from the authorities. “If 100 reports are reported in a day, the authorities will need to have a filtering system that is able to go through every complaint”. Participants will only respond if they know that their complaint is checked by someone and the problem is taken care of.

Figure 13: Types of motivators chart

User experience: Ease of access, smooth interface and easy navigations were discussed as part of the app designing. Non-verbal communication through pictures were also discussed to reduce language barrier.

Gamification: Game ideas such as “*Kill mosquitos*” were discussed as part of public engagement conversation. Gamification is a technique commonly applied by bringing game elements to improve public participation (Hamari, 2015; Huotari & Hamari, 2012). Researchers are reporting that by adding proper gamification techniques civic participation can be increased (Hamari, 2015; Ruhi, 2015).

Extrinsic Motivators

The developers and health experts mentioned that incentivising the app (giving out token of appreciation either monetary or otherwise) would be a quick way to get the public to use the app. It would be very expensive to give out monetary incentives to the participants for using the app. Moreover, if the participants only use the app for the incentives, the iteration rate will be drastic once the motivation stops or start sending wrong information to authorities for more incentives. Incentives could also be in terms of points that could be accumulated to get something later on such as a free health check up in the nearby clinic.

Social Motivators

Celebrity endorsements: Celebrity endorsements are cultural in nature. In certain cultures it will work whereas it may not work in other cultures. Previous research has mentioned that celebrity endorsement work successfully in engaging the public, but also emphasises the importance of choosing the right celebrity for the purpose (Erdogan, 1999). Hence, this may be a potential option to consider while publicising the app depending on the country’s cultural aspects. It was interesting to observe that

local participants brought the idea of using superheroes as celebrities for motivating the public to use the application.

Figure 14. Sample picture of superhero-celebrity endorsement developed during the event for motivating the public

Real life anecdotes: Previous research has mentioned that personal stories have the power to motivate the public to prepare for disease prevention. This method of communication is called narrative communication. Personal anecdotes can help to overcome resistance, promote information processing, give social ties, etc. (Kreuter, 2007).

Social media integration: Parallel information dissemination groups were created as part of the education team. The team used social networking sites such as Facebook (Facebook page), twitter account and YouTube videos to teach people how to identify the type of mosquito. The user will also have an option to share information that is provided by the authorities in these pages.

6.4 Comparing Results between Study One and Three

Motivators from Study 1

Intrinsic Motivators

- Gamification
- Recognition
- Institutional Response
- Timely Action
- Trust in Authorities

Extrinsic Motivators

- Rewards: Incentiving

Social Motivators

- Social Media Campaigning
- Campaigns: Use of Celebrity endorsements
- Societal Responsibility
- Political Use of the situation

Motivators from Study 3

Intrinsic Motivators

- Gamification
- Institutional Response
- Timely Action
- Proper Message Framing
- User Experience

Extrinsic Motivators

- Rewards: Incentiving

Social Motivators

- Social Media Integration
- Campaigns: Use of Celebrity endorsements
- Real life Anecdotes

Figure 15. Comparing motivators from study one and three

Comparing the findings between studies one and three, it is significant to observe that there are some overlap between the motivators mentioned. There are also some motivators that are just mentioned in study one or study three. It is important for the health authorities and application developers to know and understand the motivators mentioned by the public in study one. This way, during the application development and maintenance phase, these motivators could also be incorporated to promote app use.

Intrinsic motivators such as recognition and trust in authorities were discussed during the focus group discussion in study one. Participants mentioned that recognition or

acknowledgement of their efforts from government officials directly as a response to them or sharing it in social media would promote application use. Previous studies have reported that recognition is a good motivating factor (Jeppesen & Frederiksen, 2006). Institutional trust was one of the key themes discussed in study one. The participants mentioned that institutional trust can act as a motivator or as a barrier, depending on the public's relationship with the authorities. Public could be afraid how the authorities may deal with the information they have shared and may have doubts regarding confidentiality of the procedure. Reaffirmations on how the issues will be tackled can help to build trust among public. Application developers can also explore the option of creating anonymity of the report. That is even though the system registers who reported the incident, the health authority personnel who takes action against the issue will not have access to who reported it could be one of the solutions to this problem. Once trust is established, this can act as a motivator for better application use.

Social motivators such as social media campaigning, societal responsibility and political use of the situation were mentioned in study one and not considered by app developers and health experts. Participants from study one mentioned that social media based campaigning could give personal touch and could reach more people. They also mentioned that connectivity among friends and daily sociability is perceived through online social space. Participants from Singapore were of the opinion that the public would start using the app if the government asks them to use it as a societal responsibility. These simple motivating strategies can be adopted for application promotion. Health authorities should also be aware of the political and cultural situation in the country before and during the application release. As these kinds of apps may be used to trigger unexpected political turmoil.

Barriers that may prohibit application use is as important as the motivators that will enable application use. In study three, the health experts and app developers did not consider barriers that could restrict application use by the public. Barriers such as bystander effect could be a problem if people think that ‘the issue is reported but is not taken cared off yet’. Limited data connectivity, lack of smart phones, lack of proper GPS coverage, data consumption etc. could be some of the technological barriers that affect the way people view and decide to use the application. Hence it is important to properly plan to tackle the barriers mentioned in study one that may restrict app use. These findings showcase the point of view of the public that the health authorities and application developers missed out. From the findings of study one, health authorities can be well informed with additional factors that they can use for successful launch and run of an application with DMCE element.

6.5 Limitation and Future Studies

The total number of attendees for the event was less than 60 making this a study with small participant pool. Future studies will be planned to build on this knowledge from the workshop. By observing and interviewing more attendees of Epihack, a pattern of what works best can be developed and precisely streamlined.

6.6 Summary

In summary, this chapter reports results based on the evaluation of aspects considered by app developers and health experts while developing an health application with civic engagement. The chapter provides a deep understanding of how professionals plan to motivate the public to take part in DMCE. It also provides information on the factors that developers need to be aware of while developing and maintaining a public participatory app.

CHAPTER SEVEN

CONCLUSION

This chapter summaries the key findings and elaborates on the theoretical and practical implications of the research.

7.1 Summary of Findings

The preliminary study used focus group discussions to understand the general public's opinions and views towards digitally mediated civic engagement (DMCE). It also provided an in-depth knowledge of motivating factors and barriers such as participants' attitude, trust among friends, family and authorities, gamification, social media presence, a token of appreciation such as a thank you note from the government and its influence on their actions. The study also revealed that individuals' relationship with their neighbours and community would also affect their DMCE. The participants mentioned that they felt connected to the society through social media use and exposure. Thus, the preliminary study helped in identifying the key variables of the conceptual model.

The survey study tested the facets of the conceptual model and the results showed that social capital, information gathering attitude, beliefs towards disease protection and media use and exposure had significant associations with individuals' attitude towards DMCE.

The final study used a grounded theory based ethnographic approach during a health hackathon to understand how the theoretical facets are applied in development of real time tools during application development by health application developers and health experts for DMCE. The workshop created an ideal environment for the study because it brought together epidemiologists, doctors, IT participants and health communication strategists who were invested in developing the health app. The

research revealed similar results on motivating factors, barriers, etc., which could be compared with the preliminary study. The health communication participants emphasised on the topic of sustainability and theoretically grounded message development to cultivate behaviour change and provided ideas on how these can be actualized in technological application.

With the three studies, the research objectives were met. The preliminary study and survey study helped us in understanding the public view and use of digitally civic engagement (CE) and how digital communication could play as a facilitator for civic engagement. The results of the workshop study added to understanding of the main motivators and predictors of DMCE that found in the first two studies.

7.2 Theoretical Implications

This research marks one of the first attempts to construct a conceptual model to understand the motivators of civic engagement in health communication contexts. Based on literature, the research combined beliefs towards disease protection variable based on PMT along with social capital variables to create the conceptual model. Building on the foundations of PMT, the research findings showed self-efficacy, response efficacy, knowledge and dengue severity are vital elements that could be used to encourage individuals' preventive behaviours as well as DMCE. Foundations of social capital and trust variables were also shown to be influencing information gathering, information sharing and thus could be used to enhance public view and attitude on civic engagement and gradually motivate DMCE for health. Combining two factors together into the conceptual model provided the desired results. Health communication strategists could use the model to improve public's disease prevention behaviour and civic engagement behaviour at the same time.

7.3 Practical Implications

Using social marketing campaigns, health intervention programs and sustainability motivation messages to promote digitally mediated civic engagement can be planned and assessed based on the proposed conceptual model. Social capital, beliefs towards disease protection based on PMT and trust of the conceptual model can be used to frame messages for campaigns and applications to enhance civic engagement and protection motivation of the public. It could also be useful in the preparation of successful communication tactics. The results indicated that the beliefs towards disease protection variable could help to understand individual's motivation to protect themselves against dengue, as well as aid in the development of effective communication themes.

The results pointed that using significant variables from the model during software development phase for developing messages and strategies for participant recruitment, prevention behaviours, increased civic engagement and sustainable use of the application will potentially result in personal and community betterment.

Sustainability is an essential component that must be addressed. There are two kinds of sustainability concerns while developing a health application with civic engagement element. Firstly, the stakeholders need to get involved in the project to get proper funding and support. Secondly, public participation will be central element when the mobile app goes public. So, the team should be well prepared to motivate the public for continuous use of the application. The conceptual model provides ample evidence that they can be used for developing and implementing proper messages for the right behaviour change.

Promotion and use of applications with DMCE element should also be looked through policy development angle to provide a safe environment for the public. There are various issues that can arise from a two-way communication application, especially when it involves citizens and the state. To begin with, an environment of trust must exist between the state and citizens for such an application to work. Even with trusted governments, citizens may not like an invasion of privacy and unintended repercussions due to the usage of the application. A solution to this could be to have policy safeguards that favours the users (citizens) of the application. For instance, the application feedback can be made anonymous so that it cannot be tracked back to the user. Similarly, health authorities could perform randomised clean-ups routinely so that general public cannot identify it as a response to a report. Such policies will bring trust to a user that a report made from the application is not going to negatively affect their quality of life.

7.4 Limitations and Future Research

Digitally Mediated Civic Engagement is comparatively a new area of research in health communication. Even though it was found that social capital, trust and coping appraisal variables had positive association with participation in DMCE, the depth of each variable's influence on the dependent variables is unclear. Also, cultural factors, environmental factors and barriers can also be determining factors of civic engagement. Thus, further refinement of information is needed to completely understand the predictors of civic engagement for infectious disease prevention.

One of the key limitations of the preliminary study is the sample size and sample diversity. Fewer than 200 respondents, all college students, majority of them unmarried participated in the study which is not an accurate representation of the general population. For instance, the group does not represent a major age group and

does not cover all the socio-economic groups of the society as the participants were all students. Additionally, the awareness of the focus group about the disease was high and hence the findings of the focus group discussions can be viewed as of the public who are very aware of the disease. This may be considered as another limitation of the study as it is not covering the representative population.

The survey study managed to recruit nearly 1260 participants but only 259 of them were from Singapore. Additionally, participants in the workshop observation study were limited to workshop attendees. More diverse group of participants needs to be recruited and studied to understand the dependent variables in detail. Despite these limitations, this study has offered in-depth knowledge and information on the motivators of DMCE.

Future studies can be planned to understand the depth of the different facets of the model and test social capital, trust, motivating factors and health-belief factors. This thesis only focused on one infectious disease – Dengue. Future studies can test facets of the conceptual model for other infectious diseases such as influenza, zika etc. The thesis only focused on three countries: Singapore, Sri Lanka and India. Future studies should also look into other countries that have similar disease burden. Not all the themes that emerged in the focus group study became part of the conceptual model due to limitation in the number of variables that could be included in the conceptual model. Future studies should include the eliminated themes for e.g. response from the health authorities such as the information generated will be used by the health authorities, recognition for service etc. and test their effects theoretically and practically.

Future studies should also include to gather information on specific sources (e.g. health websites, forums or type of social media platforms) that individuals use to get

their health information. This could have impact on how the participants feel about DMCE for health communication. For example, participants who are more exposed to trusted sources such as official health website or country's official social media health page may be more inclined to share health information with their peers and public compared to individuals who are not exposed to information from trusted sources. The level of information seeking competency among participants could also be explained based on the type of sources they seek information from. This could also have an effect on individuals' DMCE.

Also, randomised stratified sampling can be used to recruit participants for the study. This could provide insights on whether the model could be used for other infectious diseases. Additionally, the study can be expanded to other countries across the globe by collecting data and testing the model.

Another future study would be an analysis of a successfully running civic engagement based health application particularly for infectious disease (e.g.: Flutracker). The systematic analysis of the application design, response time, interface outlook, database structures could be analysed to understand how the system was built. The study could be complimented with a set of qualitative interviews with the application developers and maintenance team to understand the elements they changed and modified over the period of time to motivate public participation in the application. In depth data driven analysis could also be implemented to understand the characteristics of the participants and the factors that motivate them to take part in DMCE.

After understanding the facets from analysis of the application, a third study would be to do an experiment to understand the knowledge of the facets that will help in motivating the public in a practical scenario. Participants need to be recruited, to use

a health application for infectious disease for a controlled period of time to report disease symptoms, mosquito breeding sites etc, in three groups. The participants in the control group will not be exposed to any messages and their use of the application will be observed. The second group of participants will be exposed to messages framed based on social capital and trust variables such as authority response, messages like “thank you for your help” or “the mosquito hotspot is cleaned” etc. and the third group of participants will be exposed to messages framed based on PMT (beliefs towards disease protection). The results of the experiment study will provide knowledge of the facets that will help in motivating the public in a practical scenario.

7.5 Conclusion

One of the main techniques to increase digitally mediated civic engagement (DMCE) is by motivating the public to take part in Civic Engagement (CE) for health communication. Many applications have been developed for societal improvement and betterment and the main element that will make the applications successful is public participation. Promoting the public to take part in DMCE will potentially increase CE and eventually lead to effective use of the right tools. This research was, thus, inspired to understand the factors that influence DMCE in an infectious disease context.

This research identified the factors that will help in motivating the public to take part in DMCE, thereby contributing towards health communication literature. It has studied the effect of social capital and trust variables along with health communication variable in motivating the public to take part in DMCE. The findings of the research suggest that messages constructed based on social capital, trust and beliefs towards disease protection can help to motivate the citizens to take part in DMCE for health communication, and thereby be a useful strategy in increasing public participations.

This research thus, highlights the importance of motivating the public to take part in DMCE for health communication based on theoretical strategies. The strong relationships between the theoretical concepts that were unfolded in this research provide a good foundation for theory based health communication design to motivate public to take part in DMCE. The information gained from this and future studies will result in a better understanding of the underlying mechanisms of the public's attitude towards DMCE. This in turn will provide effective and impactful assistance to public health specialists in formulating campaigns and interventions to increase attention and proactive uptake of DMCE.

Reference

- Aanensen, D. M., Huntley, D. M., Feil, E. J., al-Own, F., & Spratt, B. G. (2009). EpiCollect: linking smartphones to web applications for epidemiology, ecology and community data collection. *PLoS One*, 4(9).
- Acharya, A. S., Prakash, A., Saxena, P., & Nigam, A. (2013). Sampling: Why and how of it. *Indian Journal of Medical Specialties*, 4(2), 330-333.
- Afifi, W. A., & Weiner, J. L. (2004). Toward a theory of motivated information management. *Communication Theory*, 14, 167–190. doi:10.1111/j.1468-2885.2004.tb00310.x.
- Adler, R., & Goggin, J. (2005). What do we mean by “civic engagement”? *Journal of Transformative Education*, 3(3), 236-253.
- A record 62.2 million passengers for Changi Airport in 2017 [Press release]. (2018, January). Retrieved October 19, 2018, from <http://www.changiairport.com/corporate/media-centre/newsroom.html#/pressreleases/a-record-62-dot-2-million-passengers-for-changi-airport-in-2017-2386732>
- Arunachalam, N., Murty, U., Kabilan, L., Balasubramanian, A., Thenmozhi, V., Narahari, D., ... & Satyanarayana, K. (2004). Studies on dengue in rural areas of Kurnool District, Andhra Pradesh, India. *Journal of the American Mosquito Control Association*, 20(1), 87-90.
- Asur, S., Huberman, B. A., Szabo, G., & Wang, C. (2011, July). Trends in social media: persistence and decay. In *ICWSM*.
- Antikainen, M. J., & Vaataja, H. K. (2010). Rewarding in open innovation communities—how to motivate members. *International Journal of Entrepreneurship and Innovation Management*, 11(4), 440-456.
- Ayers, S. L., & Kronenfeld, J. J. (2007). Chronic illness and health-seeking information on the Internet. *Health*, 11(3), 327-347.
- Bagdonis, J. M., Hinrichs, C. C., & Schafft, K. A. (2009). The emergence and framing of farm-to-school initiatives: civic engagement, health and local agriculture. *Agriculture and Human Values*, 26(1-2), 107-119.
- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the academy of marketing science*, 16(1), 74-94.
- Bennett, W. L. (2008). Changing citizenship in the digital age. In W. L. Bennett (Ed.), *Civic life online: Learning how digital media can engage youth* Cambridge, MA: The MIT Press.

- Bernhardt, J. M., Lariscy, R. A., Parrott, R. L., Silk, K. J., & Felter, E. M. (2002). Perceived barriers to Internet-based health communication on human genetics. *Journal of Health Communication*, 7, 325–340.
- Bhattacharya, M. K., Maitra, S., Ganguly, A., Bhattacharya, A., & Sinha, A. (2013). Dengue: A Growing Menace--A Snapshot of Recent Facts, Figures & Remedies. *International journal of biomedical science: IJBS*, 9(2), 61.
- Blaya, J. A., Fraser, H. S. F., & Holt, B. (2010). E-health technologies show promise in developing countries. *Health Affairs*, 29, 244-251.
- Boulos, M. N. K., Wheeler, S., Tavares, C., & Jones, R. (2011). How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX. *Biomed Eng Online*, 10(24).
- Boulos, M. N. K., Resch, B., Crowley, D. N., Breslin, J. G., Sohn, G., Burtner, R., . . . Chuang, K.-Y. S. (2011). Crowdsourcing, citizen sensing and sensor web technologies for public and environmental health surveillance and crisis management: trends, OGC standards and application examples. *International Journal of Health Geographics*, 10(67).
- Boxall, P. and Purcell, J. (2003) "Strategy and human resource management", *Palgrave Macmillan*, Basingstoke.
- Brashers, D. E., Goldsmith, D. J., & Hsieh, E. (2002). Information seeking and avoiding in health contexts. *Human Communication Research*, 28(2), 258-271.
- Brener, N. D., Billy, J. O., & Grady, W. R. (2003). Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: evidence from the scientific literature. *Journal of adolescent health*, 33(6), 436-457.
- Brewer, P. R. (2002). Framing, value words, and citizens' explanations of their issue opinion. *Political Communication*, 19, 303–316. doi: 10.1080/01957470290055510
- Bryant, J., & Zillmann, D. (2002). *Media effects: Advances in theory and research* (2 ed.). Mahwah, New Jersey: Lawrence Erlbau, Associates.
- Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data?. *Perspectives on psychological science*, 6(1), 3-5.
- Calzo, J. P., & Ward, M. L. (2009). Media exposure and viewers' attitudes toward homosexuality: Evidence for the mainstreaming or resonance? *Journal of Broadcasting & Electronic Media*, 53(2), 280-299. doi: 10.1080/08838150902908049
- Cappella, J., & Jamieson, K. (1996). News frames, political cynicism, and media cynicism. *Annals of American Academy of Political & Social Science*, 546, 71-84.

- Case, D. O. (2002). *Looking for information: A survey of research on information seeking, needs, and behavior*. San Diego, CA: Academic Press.
- Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior*, 29(6), 2156-2160.
- Chaffee, S. H., & Schleuder, J. (1986). Measurement and effects of attention to media news. *Human communication research*, 13(1), 76-107.
- Chunara, R., Chhaya, V., Bane, S., Mekaru, S. R., Chan, E. H., Freifeld, C. C., & Brownstein, J. S. (2012). Online reporting for malaria surveillance using micro-monetary incentives, in urban India 2010-2011. *Malaria journal*, 11(1), 43.
- Chunara, R., Aman, S., Smolinski, M., & Brownstein, J. S. (2013). Flu near you: an online self-reported influenza surveillance system in the USA. *Online Journal of Public Health Informatics*, 5(1).
- Cline, R. J., & Haynes, K. M. (2001). Consumer health information seeking on the Internet: the state of the art. *Health education research*, 16(6), 671-692.
- Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, (94) (Supplement), S95-S120.
- Conway, M. M. (1985). Political participation in the united states. Washington, DC: Congressional Quarterly.
- Costa, D. L., & Kahn, M. E. (2003). Civic engagement and community heterogeneity: An economist's perspective. *Perspective on Politics*, 1(01), 103-111.
- Cullinane, P. (2006). Late-life civic engagement enhances health for individuals and communities. *The Journal on Active Aging*.
- Cullinane, P. (2008). Purposeful lives, civic engagement, and Tikkun Olam. *Generations*, 32(2), 57-59.
- Dalton, C., Durrheim, D., Fejsa, J., Francis, L., Carlson, S., d'Espaignet, E. T., & Tuyl, F. (2009). Flutracking: a weekly Australian community online survey of influenza-like illness in 2006, 2007 and 2008. *Communicable diseases intelligence quarterly report*, 33(3), 316.
- Dalton, R. J., & Ong, N. T. (2003). Authority Orientations and Democratic Attitudes in East Asia: A Test of the. In *Asian Values" Hypothesis"*, Centre for the Study of Democracy, University of California, Irvine (www.democ.uci.edu). Presented at the conference "How People View Democracy: Public Opinion in New Democracies", at the Centre for Democracy, Development and the Rule of the Law, Stanford University.
- Davis, J. J. (1995). The effects of message framing on response to environmental communications. *Journalism & Mass Communication Quarterly*, 72(2), 285-299. doi: 10.1177/107769909507200203

- De Choudhury, M., Morris, M. R., & White, R. W. (2014, April). Seeking and sharing health information online: comparing search engines and social media. In *Proceedings of the SIGCHI conference on human factors in computing systems*(pp. 1365-1376). ACM.
- De Vreese, C. H., Boomgaarden, H. G., & Semetko, H. A. (2011). (In) direct framing effects: the effects of news media framing on public support for Turkish membership in the European Union. *Communication Research*, 38(2), 179-205. doi:10.1177/0093650210384934
- El Ouiridi, M., Segers, J., El Ouiridi, A., & Pais, I. (2015). Predictors of job seekers' self-disclosure on social media. *Computers in Human Behavior*, 53, 1-12.
- Erdogan, B. Z. (1999). Celebrity endorsement: A literature review. *Journal of marketing management*, 15(4), 291-314.
- Eysenbach, G., Powell, J., Englesakis, M., Rizo, C., & Stern, A. (2004). Health related virtual communities and electronic support groups: systematic review of the effects of online peer to peer interactions. *Bmj*, 328(7449), 1166.
- FixMyStreet. (n.d.). Retrieved from www.fixmystreet.com/.
- Flanagan, C., & Bundick, M. (2011). Civic Engagement and Psychosocial Well-Being in College Students. *Liberal Education*, 97(2), 20-27.
- Fornell, C., & Larcker, V. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 39–50.
- Fox, S., & Duggan, M. (2012). Mobile health 2012. *Pew Research Center's Internet x0026 American Life Project [Internet]*.
- Fox, S., & Jones, S. (2009). The social life of health information. *Pew research center, Washington, DC, Pew Internet & American Life Project*.
- Fox, S., & Rainie, L. (2002). Vital decisions: How Internet users decide what information to trust when they or their loved ones are sick. *Pew Internet & American Life Project: Online*
- Freifeld, C. C., Chunara, R., Mekaru, S. R., Chan, E. H., Kass-Hout, T., Iacucci, A. A., & Brownstein, J. S. (2010). Participatory epidemiology: use of mobile phones for community-based health reporting. *PLoS medicine*, 7(12), e1000376.
- French, P. E. (2011). Enhancing the legitimacy of local government pandemic influenza planning through transparency and public engagement. *Public Administration Review*, 71(2), 253-264.
- Gerbner, G. (1969). Toward “cultural indicators”: The analysis of mass mediated message systems. *AV Communication Review*, 17(2), 137–148.

- Gerbner, G., & Gross, L. (1976). Living with television. The violence profile. *Journal of Communication*, 26(2), 182-190. doi: 10.1111/j.1460-2466.1976.tb01397.x
- Gerbner, G., Gross, L., Morgan, M., & Signorielli, N. (1980). The “mainstreaming” of America: Violence profile no. 11. *Journal of Communication*, 30(4), 10–29. doi: 10.1111/j.1460-2466.1980.tb01987.x
- Gil de Zúñiga, H., Jung, N., & Valenzuela, S. (2012). Social media use for news and individuals' social capital, civic engagement and political participation. *Journal of Computer-Mediated Communication*, 17(3), 319-336.
- Gitlin, T. (1980). *The whole world is watching: Mass media in the making and unmaking of the New Left*. Berkeley, CA: University of California Press.
- Goldsmith, W. (2001). *Impact*. Courier Corporation.
- Greene, J. A., Choudhry, N. K., Kilabuk, E., & Shrank, W. H. (2011). Online social networking by patients with diabetes: a qualitative evaluation of communication with Facebook. *Journal of general internal medicine*, 26(3), 287-292.
- Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environmental Research*, 80(2), S230–S245.
- Grimes, A., Landry, B. M., & Grinter, R. E. (2010, February). Characteristics of shared health reflections in a local community. In *Proceedings of the 2010 ACM conference on Computer supported cooperative work* (pp. 435-444). ACM.
- Habel, M. A., Liddon, N., & Stryker, J. E. (2009). The HPV vaccine: a content analysis of online news stories. *Journal of women's health*, 18(3), 401-407.
- Halasa, Y. A., Dogra, V., Arora, N., Tyagi, B. K., Nandan, D., & Shepard, D. S. (2011). Overcoming data limitations: design of a multicomponent study for estimating the economic burden of dengue in India.
- Hamari, Juho (2015). "Do badges increase user activity? A field experiment on the effects of gamification". *Computers in Human Behavior*. doi:10.1016/j.chb.2015.03.036.
- Harper, F. et al. 2008. Predictors of Answer Quality in Online Q&A Sites, In Proc. CHI 2008, 865-874. ACM Press.
- Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication monographs*, 76(4), 408-420.
- Hesse, B. W., Nelson, D. E., Kreps, G. L., Croyle, R. T., Arora, N. K., Rimer, B. K., & Viswanath, K. (2005). The impact of the internet and its implications for health care providers: findings from the first health information national trends survey. *Arch Intern Med*, 165, 2618-2624.

- Higgins JPT, Green S (editors, 2003). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration. Available from <http://handbook.cochrane.org>.
- Hill, S., Merchant, R., & Ungar, L. (2013). Lessons Learned About Public Health from Online Crowd Surveillance. *Big Data*, 1(3), 160-167.
- Hodgkinson, T. (2008). With friends like these.... The Guardian.
- Ho, S. S., Chen, V. H. H., & Sim, C. C. (2013). The spiral of silence: examining how cultural predispositions, news attention, and opinion congruency relate to opinion expression. *Asian Journal of Communication*, 23(2), 113-134.
- Ho, S., & Niederdeppe, J. (2008, May). Mass media exposure, trust, social networks, and online health information seeking among Internet users. In *annual convention of the International Communication Association, Montreal, Canada*.
- Howe, 2006. Crowdsourcing: A definition. *Crowdsourcing: Tracking the rise of the amateur*.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal*, 6(1), 1-55.
- Huotari, K., & Hamari, J. (2012). "Defining Gamification – A Service Marketing Perspective" (PDF). Proceedings of the 16th International Academic MindTrek Conference 2012, Tampere, Finland, October 3–5.
- Hawkes, C. (2007). Regulating and litigating in the public interest: regulating food marketing to young people worldwide: trends and policy drivers. *American journal of public health*, 97(11), 1962-1973.
- Infocomm Media Development Authority. (2018, January). *Mobile Penetration Rate*. Retrieved from <https://data.gov.sg/dataset/mobile-penetration-rate>
- Jain, S., & Chugh, T. D. (2011). An overview of malaria burden in India and road-blocks in its control. *J Clin Diagnostic Res*, 5, 915-916.
- Jeppesen, L. B., & Frederiksen, L. (2006). Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments. *Organization science*, 17(1), 45-63.
- Johnson, J. D., & Meischke, H. (1993). A comprehensive model of cancer-related information seeking applied to magazines. *Human Communication Research*, 19(3), 343-367.
- Joreskog, K. G., & Sorbom, D. (1996). *LISREL 8: Users reference guide*. Chicago: Scientific Software International.
- Kahlor, L. (2010). PRISM: A planned risk information seeking model. *Health Communication*, 25, 345–356. doi:10.1080/10410231003775172.

- Kakkar, M. (2012). Dengue fever is massively under-reported in India, hampering our response. *BMJ: British Medical Journal (Online)*, 345.
- Kapucu, N. (2011). Social capital and civic engagement. *International Journal of Social Inquiry*, 4(1), 23-43.
- Kanhere, S. S. (2011). *Participatory Sensing: Crowdsourcing Data from Mobile Smartphones in Urban Spaces*. Paper presented at the 12th IEEE International Conference on Mobile Data Management (MDM), Sweden.
- Kawachi, I., Subramanian, S. V., & Kim, D. (2008). *Social capital and health* (pp. 1-26). Springer New York.
- Khanna, P. M. (2008). Icyou: how social media is the new resource for online health information. *The Medscape Journal of Medicine*, 10(5), 113.
- Khawaja, M., Tewtel-Salem, M., Obeid, M., & Saliba, M. (2006). Civic engagement, gender and self-rated health in poor communities: evidence from Jordan's refugee camps. *Health Sociology Review*, 15(2), 192-208.
- Kittur, A., Chi, E., Suh, B. 2008. Crowdsourcing User Studies With Mechanical Turk. In
- Kortum, P., Edwards, C., & Richards-Kortum, R. (2008). The impact of inaccurate Internet health information in a secondary school learning environment. *Journal of medical Internet research*, 10(2).
- Koch-Weser, Susan, Kavita Karan and K. Viswanath. (2008). "Social Capital and Communication in Health." *The International Encyclopedia of Communication*. Donsbach, Wolfgang (ed). Blackwell Publishing, Blackwell Reference Online. 22 September 2014
http://www.communicationencyclopedia.com.ezlibproxy1.ntu.edu.sg/subscriber/tocnode.html?id=g9781405131995_yr2011_chunk_g978140513199524_ss55-1
- Korda, H., & Itani, Z. (2013). Harnessing social media for health promotion and behavior change. *Health promotion practice*, 14(1), 15-23.
- Kreuter, M. W., Green, M. C., Cappella, J. N., Slater, M. D., Wise, M. E., Storey, D., ... & Hinyard, L. J. (2007). Narrative communication in cancer prevention and control: a framework to guide research and application. *Annals of behavioral medicine*, 33(3), 221-235.
- Krueger, R. A., & Casey, M. A. (2000). Overview of focus groups. *Focus groups: a practical guide for applied research*, 3-19.
- Lakhani, K. R., & Wolf, R. G. (2005). Why hackers do what they do: Understanding motivation and effort in free/open source software projects. *Perspectives on free and open source software*, 1, 3-22.

- Lee, K. S., Lai, Y. L., Lo, S., Barkham, T., Aw, P., Ooi, P. L., ... & Ng, L. C. (2010). Dengue virus surveillance for early warning, Singapore. *Emerging infectious diseases*, 16(5), 847.
- Levina, M., Waldo, C. R., & Fitzgerald, L. F. (2000). We're here, we're queer, we're on TV: The effects of visual media on heterosexuals' attitudes toward gay men and lesbians¹. *Journal of Applied Social Psychology*, 30(4), 738-758. doi: 10.1111/j.1559-1816.2000.tb02821.x
- Lindquist, A. M., Johansson, P. E., Petersson, G. I., Saveman, B.-I., & Nilsson, G. C. (2008). The use of the Personal Digital Assistant (PDA) among personnel and students in health care: a review. *Journal of Medical Internet Research*, 10.
- Luengo-Oroz, M. A., Arranz, A., & Frean, J. (2012). Crowdsourcing malaria parasite quantification: an online game for analyzing images of infected thick blood smears. *Journal of medical Internet research*, 14(6).
- Lwin, M. O., & Saw, S. M. (2007). Protecting children from myopia: a PMT perspective for improving health marketing communications. *Journal of health communication*, 12(3), 251-268.
- Lwin, M. O., Vijaykumar, S., Fernando, O. N. N., Cheong, S. A., Theng, Y. L., Foo, S., Rathnayake, V. S., & Lim, G. (2012, November). *Social media solutions for dengue prevention in Asia*. Poster presented at the Singapore International Conference on Dengue and Emerging Infections, Singapore.
- Lwin, M. O., Vijaykumar, S., Fernando, O. N. N., Cheong, S. A., Rathnayake, V. S., Lim, G., ... & Chaudhuri, S. (2013). A 21st Century Approach to Tackling Dengue: Crowdsourced Surveillance, Predictive Mapping & Tailored Communication. *Acta tropica*.
- Manchanda, R., & Silver-Isenstadt, J. (2010). A prescription for a healthier democracy: The role of health care in civic participation. *National Civic Review*, 99(2), 48-53.
- Martinez, I. L., Crooks, D., Kim, K. S., & Tanner, E. (2011). Invisible civic engagement among older adults: Valuing the contributions of informal volunteering. *Journal of cross-cultural gerontology*, 26(1), 23-37.
- McNab, C. (2009). What social media offers to health professionals and citizens. *Bulletin of the World Health Organization*, 87(8), 566-566.
- Melkote R. S. & Steeves L. H. (2001). *Communication for development in third world: theory and practice for empowerment*. London Sage Publications.
- Mishra, A. C., Chadha, M. S., Choudhary, M. L., & Potdar, V. A. (2010). Pandemic influenza (H1N1) 2009 is associated with severe disease in India. *PloS one*, 5(5), e10540.
- Napoli, P. M. (2001). *Foundations of communications policy: Principles and process in the regulation of electronic media*. Hampton Pr.

- Narayan, D., & Cassidy, M. F. (2001). A dimensional approach to measuring social capital: development and validation of a social capital inventory. *Current sociology*, 49(2), 59-102.
- Nelson, T. E., Clawson, R. A., & Oxley, Z. M. (1997). Media framing of a civil liberties conflict and its effect on tolerance. *American Political Science Review*, 91(3), 567–583.
- Neuman, W. L. (2014). *Social Research Methods: Qualitative and Quantitative Approaches: Pearson New International Edition*. Pearson Education Limited
- Nov, O., Arazy, O., & Anderson, D. (2011, February). Dusting for science: motivation and participation of digital citizen science volunteers. In *Proceedings of the 2011 iConference*(pp. 68-74). ACM.
- Ng, T. P., Pwee, T. H., Niti, M., Goh, L. G. (2002) Influenza in Singapore: assessing the burden of illness in the community. *Ann Acad Med Singapore*. 2002; p31:182–8 [PubMed]
- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health promotion international*, 15(3), 259-267.
- Ocampo, A. J., Chunara, R., & Brownstein, J. S. (2013). Using search queries for malaria surveillance, Thailand. *Malaria journal*, 12(1), 390.
- Paul, S. A., Hong, L., & Chi, E. H. (2011, July). Is Twitter a Good Place for Asking Questions? A Characterization Study. In *ICWSM*.
- Pew Internet & American Life Project. (2011). *Health topics*. Retrieved April 22, 2013, from <http://pewinternet.org/Reports/2011/HealthTopics.aspx>.
- Piotrow, P.T., Kincaid L.W. & Rinehart W. (1997). *Health communication: Lessons from family planning and reproductive health*. Praeger, JHS.
- Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual Review of Sociology*, (24) (1), 1–24.
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, 36(4), 717-731. 103
- Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19–22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948. [cited 2012 Jul 21]. Available from: <http://www.who.int/about/definition/en/print.html>
- Price, V., Nir, L., & Cappella, J. N. (2005). Framing public discussion of gay civil unions. *Public Opinion Quarterly*, 69(2), 179–212. doi: 10.1093/poq/nfi014

- Putnam, R. D. (1993). The prosperous community: Social capital and public life. *American Prospect*, (13) , 35–42.
- Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon and Schuster.
- Quinn, P. M. (2002). Qualitative research and evaluation methods. *California EU: Sage Publications Inc.*
- Report. Retrieved June 10, 2002 from http://www.pewinternet.org/reports/pdfs/PIP_Vital_Decisions_May2002.pdf.
- Resnick, P. (2001). Beyond bowling together: Sociotechnical capital. *HCI in the New Millennium*, 77, 247-272.
- Reips, U-D,. & Birnbaum, M.H. (2011)Behavioral research and data collection via the Internet. In: Proctor RW, Vu K-PL, eds. *Handbook of human factors in Web design. 2nd ed. Mahwah, New Jersey: Lawrence Erlbaum Associates*; 563–85.
- Rodgers, S., & Chen, Q. (2005). Internet community group participation: Psychosocial benefits for women with breast cancer. *Journal of Computer-Mediated Communication*, 10(4), JCMC1047.
- Rogers, E. M. (1962). *Diffusion of Innovations*. The Free Press. New York.
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change1. *The journal of psychology*, 91(1), 93-114.
- Roundy, L. (n.d.) *What Is Civic Participation? - Definition & Examples*. Retrieved from <https://study.com/academy/lesson/what-is-civic-participation-definition-examples.html>
- Rowe, G., & Frewer, L. J. (2004). Evaluating public-participation exercises: a research agenda. *Science, technology & human values*, 29(4), 512-556.
- Ruhi, U. (2015). Level up your strategy: Towards a descriptive framework for meaningful enterprise gamification.
- Sauermann, H., & Franzoni, C. (2015). Crowd science user contribution patterns and their implications. *Proceedings of the National Academy of Sciences*, 112(3), 679-684.
- Shepard, D. S., Halasa, Y. A., Tyagi, B. K., Adhish, S. V., Nandan, D., Karthiga, K. S., ... & INCLEN Study Group. (2014). Economic and disease burden of dengue illness in India. *The American journal of tropical medicine and hygiene*, 91(6), 1235-1242.
- Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and non-experimental studies: new procedures and recommendations. *Psychological methods*, 7(4), 422.

- Sillence, E., Briggs, P., Harris, P. R., & Fishwick, L. (2007). How do patients evaluate and make use of online health information?. *Social science & medicine*, 64(9), 1853-1862.
- Singapore smartphone penetration (share of population) 2015-2022 | Statistic. (n.d.). Retrieved from <https://www.statista.com/statistics/625441/smartphone-user-penetration-in-singapore/>
- Skoric, M. M., & Poor, N. (2013). Youth engagement in Singapore: The interplay of social and traditional media. *Journal of Broadcasting & Electronic Media*, 57(2), 187-204.
- Smartphone adoption in India: Going beyond age and income barriers. (2017, February 01). Retrieved from <https://www.vserv.com/smartphone-adoption-india-going-beyond-age-income-barriers/>
- Sood, S., & Nambiar, D. (2006). Comparative cost-effectiveness of the components of a behaviour change communication campaign on HIV/AIDS in North India. *Journal of Health Communication*, 11, 143-162.
- Strömbäck, J., & Shehata, A. (2010). Media malaise or a virtuous circle? Exploring the causal relationships between news media exposure, political news attention and political interest. *European Journal of Political Research*, 49(5), 575-597.
- Thackeray, R., Neiger, B.L., Hanson, C.L., & McKenzie, J.F. (2008). Enhancing promotional strategies within social marketing programs: Use of web 2.0 social media. *Health Promotion Practice*, 9(4), 338_343.
- Thackeray, R., Neiger, B. L., Hanson, C. L., & McKenzie, J. F. (2008). Enhancing promotional strategies within social marketing programs: use of Web 2.0 social media. *Health promotion practice*, 9(4), 338-343.
- Thackeray, R., Neiger, B. L., Smith, A. K., & Van Wagenen, S. B. (2012). Adoption and use of social media among public health departments. *BMC public health*, 12(1), 242.
- The Information Daily. (n.d.). Retrieved from <http://www.neighbourhoodplanner.org.uk/>
- Theobald, E. J., Ettinger, A. K., Burgess, H. K., DeBey, L. B., Schmidt, N. R., Froehlich, H. E., ... & Parrish, J. K. (2015). Global change and local solutions: Tapping the unrealized potential of citizen science for biodiversity research. *Biological Conservation*, 181, 236-244.
- The Social Capital Foundation - encyclopedia article - Citizendium". [En.citizendium.org](http://en.citizendium.org).
- Undurraga, E. A., Halasa, Y. A., & Shepard, D. S. (2013). Use of expansion factors to estimate the burden of dengue in Southeast Asia: a systematic analysis. *PLoS neglected tropical diseases*, 7(2), e2056.

- Uslaner, E. M., & Brown, M. (2005). Inequality, trust, and civic engagement. *American politics research*, 33(6), 868-894.
- Uslaner, E. M., & Conley, R. S. (2003). Civic Engagement and Particularized Trust The Ties that Bind People to their Ethnic Communities. *American Politics Research*, 31(4), 331-360.
- V. Shah, Nojin Kwak, R. Lance Holbert, D. (2001). "Connecting" and "disconnecting" with civic life: Patterns of Internet use and the production of social capital. *Political communication*, 18(2), 141-162.
- Valenzuela, S., Park, N., & Kee, K. F. (2009). Is there social capital in a social network site?: Facebook use and college students' life satisfaction, trust, and participation. *Journal of computer-mediated communication*, 14(4), 875-901.
- Vance, K., Howe, W., & Dellavalle, R. P. (2009). Social internet sites as a source of public health information. *Dermatologic clinics*, 27(2), 133-136.
- Verba, S., Schlozman, K. L., & Brady, H. E. (1995). Voice and equality: Civic voluntarism in american politics. Cambridge, MA: Harvard University Press.
- Viswanath, K., Randolph Steele, W., & Finnegan Jr, J. R. (2006). Social capital and health: civic engagement, community size, and recall of health messages. *American Journal of Public Health*, 96(8), 1456-1461.
- Williams, D. (2006). On and off the'Net: Scales for social capital in an online era. *Journal of Computer-Mediated Communication*, 11(2), 593-628.
- Woo-Young, C. (2005). Online civic participation, and political empowerment: online media and public opinion formation in Korea. *Media, Culture & Society*, 27(6), 925-935.
- Xenos, M., & Moy, P. (2007). Direct and differential effects of the Internet on political and civic engagement. *Journal of Communication*, 57(4), 704-718.
- Xiao, N., Sharman, R., Rao, H. R., & Upadhyaya, S. (2014). Factors influencing online health information search: An empirical analysis of a national cancer-related survey. *Decision Support Systems*, 57, 417-427.
- Zhang, W., Johnson, T. J., Seltzer, T., & Bichard, S. L. (2010). The revolution will be networked: The influence of social networking sites on political attitudes and behavior. *Social Science Computer Review*, 28(1), 75-92.
- Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, 37(2), 197-206.
- .Ceylon Today. from <https://ceylontoday.lk/print20170401CT20170630.php?id=32183>
- .Google Play. From <https://play.google.com/store/apps/details?id=com.veta&hl=en>

- .GSMA. from <https://www.gsma.com/mobileeconomy/india/>
- .Internations Org. from <https://www.internations.org/singapore-expats/guide/29460-safety-security/limitations-of-civil-freedoms-in-singapore-16091>
- . Love Clean Streets. from <http://www.lovecleanstreets.org/>
- . Outbreaks Near Me. from <http://www.healthmap.org/outbreaksnearme/>
- . Prnewswire. From <https://www.prnewswire.com/news-releases/sri-lanka---telecoms-mobile-and-broadband---statistics-and-analyses-300552420.html>

Appendix A: Preliminary study- IRB Approval Letter

Wee Kim Wee School of Communication and Information

Reg. No. 200604393R

28 October 2013

WKWSCl IRB Code: **SAY201314S1-004**

Associate Professor May O. Lwin
CHITRA002 Panchapakesan Kumari Chitra (Special Project)

Subject: WKWSCl Institutional Review Board Approval
Project Title: Public health communication in Singapore: Understanding general beliefs, attitudes, intentions and behaviour towards civic engagement in infectious disease reporting.

I refer to your application for ethics approval with respect to the above project.

The school board has deliberated on your application and noted from your application that your research involves administering face-to-face personal interview on participants and administering focus group interview on participants.

You have also confirmed that informed consent will be obtained from the participants and you have guaranteed the confidentiality of your participants' biodata obtained from them.

The documents reviewed were:

- a) Interview and focus group Question Guide dated 15 October 2013
- b) Consent form _ focus group dated 15 October 2013
- c) Consent form _ interview dated 15 October 2013

The board is therefore satisfied with the bioethical considerations for the project and approves the ethics application under Exemption. The approval period is from 01 November 2013 to 01 December 2013. Please use the WKWSCl IRB Code SAY201314S1-004 for all future correspondence.

The following protocol and compliances are to be observed upon WKWSCl IRB approval

1. All research involving procedures greater than minimal risk on minors (individuals who are less than the legal age of 21 years old) requires IRB approved written Parental Consent and assent from the participant to be obtained before any research protocols can be administered. Minimal risk refers to an anticipated level of harm and discomfort that is no greater than that ordinarily encountered in daily life, or during the performance of routine educational, physical, or psychological examination.
2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.
3. No deviation from, or changes of, the protocol should be initiated without prior written WKWSCl IRB approval of

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www.ntu.edu.sg/sci Email: VD-SCI-RES@ntu.edu.sg

Appendix B: Preliminary study- Informed Consent Form

Public health communication in Singapore: Understanding general beliefs and attitudes towards civic engagement in infectious disease reporting.

Name of Researcher: Chitra Panchapakesan Kumari
Contact Detail of Researcher: chitra002@e.ntu.edu.sg

Thank you for taking time to participate in this focus group discussion.
We appreciate that you can share your personal opinions with us.

The study aims to investigate the attitudes and beliefs towards civic engagement in infectious disease reporting. I shall be grateful, if you could spare about 30 minutes to take part in this focus group discussion. Your valuable participation on the focus group discussion will greatly aid me in understanding the attitudes and beliefs of general public towards civic engagement.

All information you have provided will be kept strictly confidential.

Thanking you in advance for your precious time. ☺

Please let us know if you have any questions about the research.

I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.

I agree to take part in the above study.

Name of the Participant (Optional) _____

Date _____

Appendix C: Preliminary study- Short survey to collect demographic details

Nanyang Technological University, Singapore | Short Survey –Health communication

1. What is your gender?
 - 1 Male
 - 2 Female

2. May I know what your age is? _____years
 - 1 18-20
 - 2 21-30
 - 3 31-40
 - 4 41-50
 - 5 50 and above

3. What is your marital status?
 - 1 Single
 - 2 Married
 - 3 Separated
 - 4 Divorced
 - 5 Widowed

4. What is your ethnicity?
 - 1 Chinese
 - 2 Indian
 - 3 Malay
 - 4 Vietnamese
 - 5 Sri Lankan
 - 6 Other _____

5. What is your highest educational level?
 - 1 No education
 - 2 Grade 1-5
 - 3 Grade 6-9
 - 4 Grade 10-11
 - 5 Grade 12-13
 - 6 Vocational training
 - 7 Certificate
 - 7 Diploma
 - 8 Bachelor
 - 9 Masters
 - 10 Doctorate

6. Are you currently working?

1. Yes

2. No

7. Your job designation is_____

8. What is your housing type (HDB (no of bed rooms), Condominium (no of bed rooms?) , independent house or other)_____

9. What type of mobile phone are you currently using? (Smart phone or Ordinary phone; please provide the model number of the phone you are using)

10. On a scale of 1 to 5 where 5 being very severe and 1 being not at all severe, according to you how severe is dengue in Singapore?

Not at all
severe

1

2

3

4

Very
severe

5

11. Have you ever used the following?

		Ye	No
a.	Internet	1	2
b.	Simple mobile phones (without Internet)	1	2
c.	Smartphones (e.g. iPhone, Samsung Galaxy, and etc.)	1	2
d.	Mobile apps	1	2
e.	Tablets	1	2

12. How easy is it for you to use the following?

		Very difficult			Very easy	
a.	Internet	1	2	3	4	5
b.	Simple mobile phones (without Internet)	1	2	3	4	5
c.	Smartphones (e.g. iPhone, Samsung Galaxy, and etc.)	1	2	3	4	5
d.	Mobile apps	1	2	3	4	5
e.	Tablets	1	2	3	4	5

13. Have you ever done the following?

		Ye	No
Have you ever volunteered?		1	2

14. What type of volunteer activity have you done?

15. Please answer the following questions accordingly

	Ye	No
Are you currently volunteering?	1	2
Have you heard about Public Participation or Civic engagement before?	1	2
Have you heard about Crowd sourcing before?	1	2

16. What have you heard about public participation or civic engagement?

17. What have you heard about crowd sourcing?

~ THANK YOU ~

Appendix D: Preliminary study- Application Screenshot

Mobile App

Report Mosquito Breeding sites

Dengue Hotspot Map

Appendix E: Preliminary study- Focus group questionnaire

Focus group questionnaire modified

Ice breaker questions:

- What type of volunteering activities usually happens in Singapore?
- Do you generally take part in activities that are of public concerns?
- Can you tell me some good reasons for volunteering?
- Why do you think people don't volunteer in general?
- Have you heard about public participation before?
- Have you heard about crowd sourcing? What have you heard about it?
- Do you think we can use public participation for health communication?
- What all ways do you think we can use this for health communication?

General intentions and behaviour towards civic engagement

We are now going to talk about a mobile app.

Suppose there is an application that will allow the user to report Mosquito breeding sites in Singapore so that the municipality can come and destroy the breeding site.

- Do you think the general public will download and use the application? Why?
- If the application is freely available, Will you use such an application? Why?
- Which category of people do you think will maximum use to the application? Educated/ non-working/ students/ etc

General beliefs and attitude of public towards civic engagement

- Suppose you see a mosquito breeding site and you report it, how efficiently do you think the municipality will respond to it?
- How much trust do you have in your govt. / municipality that if a person reports the mosquito breeding site they will respond to it?
- In your opinion why will the general public participate in such a system? Will the users use the system for helping the authorities or for personal satisfaction?
- Do you believe your participation in such public concerns is individually life enriching?
- Do you believe your participation in reporting mosquito breeding sites is socially beneficial to the community?
- Do you think people will find time to report such breeding spots (as it will not take much time)? Why?
- In your opinion, will these kinds of apps help to reduce the spread of the disease? Why?
- In your opinion, do you think such things should be done as responsibility or volunteering? Why?
- In your opinion, people who find time for sending such reports and helping the authorities will be treated or viewed with respect? Why?
- Do you think, the public will abuse such a system by randomly uploading images? Why? Is there any solution of the problem?

Motivating or facilitating factors

- What factors do you think can act as a motivating factor for the public to use the system?

Vouchers or appreciation notes etc

How do you think proving a virtual cup saying that they made a difference will motivate people to engage with the application?

Barriers

- What reasons do you think are barriers for others for not using the app?
- Some options to be discussed or probed further

Burned out/not enjoyable

Family responsibilities

Health/medical problems

Lack of time

No one asked

Haven't gotten around to it

Haven't heard of anything that interest them

Transportation or expenses

Opportunities don't match interests

Not part of culture

Technological factors

Describe to us about the technologies you use and your preferences.

- How will the technological factors affect the user of the system?
- Which age group do you think will use the system? Why?
- How will technological capability of users affect the system?
- Do you think there will be gender biasness in using the app? Which gender will use the system more? Girls or boys?
- Do girls and boys equally have smart phones in Singapore?
- According to you what will be an appropriate term for this purpose (a person helps authorities to find mosquito breeding sites) – volunteering or civic engagement or something else?

Appendix F: Workshop Observation Study- IRB Approval Letter

IRB-2017-10-022

20 November 2017

Professor May Oo Lwin
Wee Kim Wee School of Communication and Information

NTU INSTITUTIONAL REVIEW BOARD APPROVAL

Project Title: Public health communication through epihacks: Understanding general beliefs, attitudes, intentions and behaviour towards civic engagement in infectious disease reporting.

I refer to your application for ethics approval with respect to the above project.

The Board has considered your application and noted from your application that your research involves collecting behavioral data from participants through interview.

You have also confirmed that informed consent will be obtained from the participants and you have guaranteed the confidentiality of your participants' biodata obtained from them.

The documents reviewed are:

- a) NTU IRB application form dated **09 November 2017**
- b) Participant information sheet and consent form: version 1 dated **09 November 2017**
- c) Data collection form: version 1 dated **09 November 2017**

The Board is therefore satisfied with the bioethical consideration for the project and approves the ethics application under **Expedited** review. The approval period is from **20 November 2017** to **19 November 2018**. The NTU IRB reference number for this study is **IRB-2017-10-022**. Please use this reference number for all future correspondence.

The following protocol and compliances are to be observed upon NTU IRB approval

1. All research involving procedures greater than minimal risk on minors (individuals who are less than the legal age of 21 years old) requires IRB approved written Parental Consent and assent from the participant to be obtained before any research protocols can be administered. Minimal risk refers to an anticipated level of harm and discomfort that is no greater than that ordinarily encountered in daily life, or during the performance of routine educational, physical, or psychological examination.
2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.

Research Integrity and Ethics Office, NTU Institutional Review Board

50 Nanyang Avenue, NS4-05-92A, Singapore 639798, T: (65) 6592-2495, www.ntu.edu.sg

3. Consent forms are important documents therefore they should be stored in the strictest arrangement. Loss of consent form would result in disciplinary action.
4. No deviation from, or changes of, the protocol should be initiated without prior written NTU IRB approval of an appropriate amendment.
5. The Principal Investigator should report promptly to NTU IRB regarding:
 - a. Deviation from, or changes to the protocol.
 - b. Changes increasing the risk to the subjects and/or affecting significantly the conduct of the trial
 - c. All serious adverse events (SAEs) which are both serious and unexpected.
 - d. New information that may affect adversely the safety of the subjects of the conduct of the trial.
 - e. Completion of the study.
6. Continuing Review Request/ Notice of Study completion form should be submitted to NTU IRB for the following:
 - a. Annual review: Status of the study should be reported to the NTU IRB at least annually using the Continuing Review Request/ Notice of Study completion form.
 - b. Study completion or termination: Continuing Review Request/ Notice of Study completion form is to be submitted within 4 to 6 weeks of study completion or termination.
7. All Principal Investigators should comply with existing legislation that would have an impact on the domain of their research.

Professor Lionel Lee
Chair, NTU Institutional Review Board
encl.

Appendix G: Workshop Observation Study- Informed Consent form

Wee Kim Wee School of Communication and Information

INFORMED CONSENT

Please read this consent agreement carefully. You must be 21 or older to participate.

Title of the Project: Public health communication through epihack: Understanding general beliefs, attitudes, intentions and behaviour towards civic engagement in infectious disease reporting.

Purpose of the research: The purpose of this research is to understand the attitudes and beliefs of general public towards civic engagement for infectious disease preparedness. This research is conducted under the supervision of Prof. May O. Lwin at the Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Eligibility: You must be 21 or older to take part in this study.

What you will do in this study: It will take approximately 15-20 minutes to complete. We appreciate that you can share your personal opinions on the subject matter with us.

Risks: There are no anticipated risks associated with participating in this study.

Voluntary Withdrawal: Your participation in this study is completely voluntary, and you may withdraw from the study at any time without penalty. However, it is important to us that you fully answer as many questions as possible. You may skip any questions or procedures, or you may withdraw by informing the project officer that you no longer wish to participate. You will not be questioned in case you decide to withdraw. Your decision to participate, decline, or withdraw participation will have no effect on your status or relationship with the Nanyang Technological University.

Confidentiality: Your participation in this study will remain confidential, and your identity will not be associated with your data. To protect your anonymity, you may use a fictitious name of your choice during the actual focus group discussion, which you will write on a name card to be provided during session. Your responses will not be linked to your real name or other personal identification. All data and consent forms will be stored in safe keeping long-term. Results of this study may be presented at conferences and/or published in print or online media.

Further Information: If you have questions about the study or your rights as a participant in this study, please contact Chitra Panchapakesan chitra002@e.ntu.edu.sg, Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Who to contact about your rights in this study:

You can email the School's Research Integrity Point of Contact at WKWSCl-IRB@ntu.edu.sg or call (+65) 6792 7526.

Thank you so much for your time and effort. We highly appreciate your great help in this research project.

Agreement:

The purpose and nature of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

Signature: _____

Date: _____

Appendix H: Survey Study- IRB Approval Letter

IRB-2016-02-036-01

23 October 2017

Professor May Oo Lwin
Wee Kim Wee School of Communication and Information

NTU INSTITUTIONAL REVIEW BOARD APPROVAL

Project Title: Public health communication: Developing a Theoretical Framework of Civic Engagement for Infectious Disease Preparedness

I refer to your application for ethics approval with respect to the above project.

The Board has deliberated on this application and accepted the change in:

1. Procedures
2. Informed consent
3. End date to 31 April 2018

The Board is therefore satisfied with the bioethical considerations for the project and approves the ethics application.

A handwritten signature in black ink, appearing to read "Lionel Lee".

Professor Lionel Lee
Chair, NTU Institutional Review Board
encl.

Appendix I: Survey Study- Informed Consent form

Please read this consent agreement carefully. You must be 21 or older to participate.

Title of the Project: Public health communication: Developing a Theoretical Framework of Civic Engagement for Infectious Disease Preparedness

Purpose of the research: The purpose of this research is to **understand the attitudes and beliefs of general public towards civic engagement for infectious disease preparedness**. This research is conducted under the supervision of Prof. May O. Lwin at the Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Eligibility: You must be 21 or older to take part in this study.

What you will do in this study: It will take approximately 15-20 minutes to complete. We appreciate that you can share your personal opinions on the subject matter with us.

Risks: There are no anticipated risks associated with participating in this study.

Voluntary Withdrawal: Your participation in this study is completely voluntary, and you may withdraw from the study at any time without penalty. However, it is important to us that you fully answer as many questions as possible. You may skip any questions or procedures, or you may withdraw by informing the project officer that you no longer wish to participate. You will not be questioned in case you decide to withdraw. Your decision to participate, decline, or withdraw participation will have no effect on your status or relationship with the Nanyang Technological University.

Confidentiality: Your participation in this study will remain confidential, and your identity will not be associated with your data. To protect your anonymity, you may use a fictitious name of your choice during the actual focus group discussion, which you will write on a name card to be provided during session. Your responses will not be linked to your real name or other personal identification. All data and consent forms will be stored in safe keeping long-term. Results of this study may be presented at conferences and/or published in print or online media.

Further Information: If you have questions about the study or your rights as a participant in this study, please contact Chitra Panchapakesan chitra002@e.ntu.edu.sg, Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Who to contact about your rights in this study:

You can email the School's Research Integrity Point of Contact at WKWSC-IRB@ntu.edu.sg or call (+65) 6792 7526.

Thank you so much for your time and effort. We highly appreciate your great help in this research project.

Agreement:

The purpose and nature of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.

I agree to take part in the above study.

☐ I agree

☐ I disagree

>>

Appendix J: Survey Study- Questionnaire

1/18/2018

Qualtrics Survey Software

Default Question Block

Please read this consent agreement carefully. You must be 21 or older to participate.

Title of the Project: Public health communication: Developing a Theoretical Framework of Civic Engagement for Infectious Disease Preparedness

Purpose of the research: The purpose of this research is to understand the attitudes and beliefs of general public towards civic engagement for infectious disease preparedness. This research is conducted under the supervision of Prof. May O. Lwin at the Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Eligibility: You must be 21 or older to take part in this study.

What you will do in this study: It will take approximately 15-20 minutes to complete. We appreciate that you can share your personal opinions on the subject matter with us.

Risks: There are no anticipated risks associated with participating in this study.

Voluntary Withdrawal: Your participation in this study is completely voluntary, and you may withdraw from the study at any time without penalty. However, it is important to us that you fully answer as many questions as possible. You may skip any questions or procedures, or you may withdraw by informing the project officer that you no longer wish to participate. You will not be questioned in case you decide to withdraw. Your decision to participate, decline, or withdraw participation will have no effect on your status or relationship with the Nanyang Technological University.

Confidentiality: Your participation in this study will remain confidential, and your identity will not be associated with your data. To protect your anonymity, you may use a fictitious name of your choice during the actual focus group discussion, which you will write on a name card to be provided during session. Your responses will not be linked to your real name or other personal identification. All data and consent forms will be stored in safe keeping long-term. Results of this study may be presented at conferences and/or published in print or online media.

Further Information: If you have questions about the study or your rights as a participant in this study, please contact Chitra Panchapakesan chitra002@e.ntu.edu.sg, Wee Kim Wee School of Communication and Information, Nanyang Technological University.

Who to contact about your rights in this study:

You can email the School's Research Integrity Point of Contact at WKWSCl-IRB@ntu.edu.sg or call (+65) 6792 7526.

Thank you so much for your time and effort. We highly appreciate your great help in this research project.

Agreement:

The purpose and nature of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.

I agree to take part in the above study.

- ☐ I agree
☐ I disagree

Country you live in currently

- ☐ India
☐ USA
☐ Other
☐ Singapore
☐ Sri Lanka

Gender

- ☐ Male
☐ Female

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using media such as News paper, TV, radio would enable me to stay connected with my community	☐	☐	☐	☐	☐	☐	☐

<https://wkwsci.co1.qualtrics.com/ControlPanel/Ajax.php?action=GetSurveyPrintPreview>

1/7

1/18/2018

Qualtrics Survey Software

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using media such as News paper, TV, radio would enable me to stay updated of health information	☐	☐	☐	☐	☐	☐	☐
Using media such as News paper, TV, radio would help me find health information	☐	☐	☐	☐	☐	☐	☐
Using media such as News paper, TV, radio would help me connect with people from whom i regularly get health information	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using Internet media (websites, forums, blogs) would enable me to stay connected with my community	☐	☐	☐	☐	☐	☐	☐
Using Internet media (health websites, forums, blogs) would enable me to stay updated of health information	☐	☐	☐	☐	☐	☐	☐
Using Internet media (health websites, forums, blogs) would help me find health information	☐	☐	☐	☐	☐	☐	☐
Using Internet media (health websites, forums, blogs) would help me connect with people from whom i regularly get health information	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using social media would enable me to stay connected with my community	☐	☐	☐	☐	☐	☐	☐
Using social media would enable me to stay updated of health information	☐	☐	☐	☐	☐	☐	☐
Using social media would help me find health information	☐	☐	☐	☐	☐	☐	☐
Using social media would help me connect with people from whom i regularly get health information	☐	☐	☐	☐	☐	☐	☐

Generally speaking, How frequently do you use the following social networks?

	Never	Few times a month	Once a week	2-3 times a week	4 or more times a week	Daily	Few times daily
Facebook	☐	☐	☐	☐	☐	☐	☐
YouTube	☐	☐	☐	☐	☐	☐	☐
LinkedIn	☐	☐	☐	☐	☐	☐	☐
Twitter	☐	☐	☐	☐	☐	☐	☐
Google+	☐	☐	☐	☐	☐	☐	☐
Blog (Blogger, Wordpress...)	☐	☐	☐	☐	☐	☐	☐
Tumblr	☐	☐	☐	☐	☐	☐	☐
Pinterest	☐	☐	☐	☐	☐	☐	☐
Instagram	☐	☐	☐	☐	☐	☐	☐
Forums	☐	☐	☐	☐	☐	☐	☐
Health Websites	☐	☐	☐	☐	☐	☐	☐
Whatsapp	☐	☐	☐	☐	☐	☐	☐

Generally speaking, How frequently do you use the following medias?

	Never	Few times a month	Once a week	2-3 times a week	4 or more times a week	Daily	Few times daily
Newspapers	☐	☐	☐	☐	☐	☐	☐
TV	☐	☐	☐	☐	☐	☐	☐
Radio	☐	☐	☐	☐	☐	☐	☐
Posters	☐	☐	☐	☐	☐	☐	☐
Magazines	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I find it easy to use social media	☐	☐	☐	☐	☐	☐	☐
I find it easy to get social media to do what i want it to do	☐	☐	☐	☐	☐	☐	☐

<https://wkwsci.co1.qualtrics.com/ControlPanel/Ajax.php?action=GetSurveyPrintPreview>

2/7

1/18/2018

Qualtrics Survey Software

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I find my interaction with social media to be clear and understandable	☐	☐	☐	☐	☐	☐	☐
I find social media to be flexible to interact with	☐	☐	☐	☐	☐	☐	☐
I find it easy to become skilful at using social media	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I can be very effective using social media	☐	☐	☐	☐	☐	☐	☐
I can have a positive impact on the lives' of others through social media	☐	☐	☐	☐	☐	☐	☐
I can offer other people important and interesting information by posting on social media	☐	☐	☐	☐	☐	☐	☐
I can find important and interesting information by reading other people's content on social media	☐	☐	☐	☐	☐	☐	☐
I can use social media as an effective way of connecting with others.	☐	☐	☐	☐	☐	☐	☐
I can communicate very effectively using social media	☐	☐	☐	☐	☐	☐	☐

Before answering the next question think of a community you are part of. How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Feel part of the community	☐	☐	☐	☐	☐	☐	☐
Share community values	☐	☐	☐	☐	☐	☐	☐
Talk about community problems	☐	☐	☐	☐	☐	☐	☐
Feel connected	☐	☐	☐	☐	☐	☐	☐
Help resolve problems	☐	☐	☐	☐	☐	☐	☐
Watch out for community members	☐	☐	☐	☐	☐	☐	☐

What kind of community did you think before answering the previous question?

- ☐ Online Community
- ☐ Offline Community

Tell us more about the community you thought about.

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Respondents' voluntary work for nonpolitical groups	☐	☐	☐	☐	☐	☐	☐
Raising money for charity	☐	☐	☐	☐	☐	☐	☐
Attending a meeting to discuss neighbourhood problems	☐	☐	☐	☐	☐	☐	☐
Purchasing products for the social values advocated by the company	☐	☐	☐	☐	☐	☐	☐
Banning a certain product or service because they disagreed with the social values of the company	☐	☐	☐	☐	☐	☐	☐

During the past 12 months how often have you engaged in any of the following activities

	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Every time
Attended a public hearing town hall meeting or city council meeting.	☐	☐	☐	☐	☐	☐	☐
Called or sent a letter to an elected public official	☐	☐	☐	☐	☐	☐	☐
Spoken to a public official in person	☐	☐	☐	☐	☐	☐	☐
Attended a political rally	☐	☐	☐	☐	☐	☐	☐
Participated in any demonstrations protests or marches	☐	☐	☐	☐	☐	☐	☐

<https://wkwsci.co1.qualtrics.com/ControlPanel/Ajax.php?action=GetSurveyPrintPreview>

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1/18/2018

Qualtrics Survey Software

	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Every time
Voted in the last presidential election	☐	☐	☐	☐	☐	☐	☐
Written a letter to a news organization	☐	☐	☐	☐	☐	☐	☐
Participated in groups that took any local action for social or political reform	☐	☐	☐	☐	☐	☐	☐

How often do you use the Internet for the following activities

	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Every time
Make a campaign contribution	☐	☐	☐	☐	☐	☐	☐
Subscribe to a political listserv (e.g.: an electronic mailing list.)	☐	☐	☐	☐	☐	☐	☐
Sign up to volunteer for a campaign/issue	☐	☐	☐	☐	☐	☐	☐
Send a political message via e-mail	☐	☐	☐	☐	☐	☐	☐
Write a letter to the editor of a newspaper	☐	☐	☐	☐	☐	☐	☐
Write to a politician	☐	☐	☐	☐	☐	☐	☐

Please select Number 3 from the list

- ☐ 1
☐ 3
☐ 4
☐ 6
☐ 8
☐ 10

How much trust do you have in the following groups.

	Not at all	Low Trusting	Slightly Trusting	Neutral	Moderately Trusting	Very Trusting	Extremely Trusting
Trust of friends	☐	☐	☐	☐	☐	☐	☐
Trust in people in your village	☐	☐	☐	☐	☐	☐	☐
Trust of people in same clubs	☐	☐	☐	☐	☐	☐	☐
Trust of business owners	☐	☐	☐	☐	☐	☐	☐
Trust of politicians	☐	☐	☐	☐	☐	☐	☐
Trust of family members	☐	☐	☐	☐	☐	☐	☐
Trust of government service providers	☐	☐	☐	☐	☐	☐	☐
Trust of local/municipal government	☐	☐	☐	☐	☐	☐	☐
Trust judges/courts/police	☐	☐	☐	☐	☐	☐	☐
Trust community/ward officials	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The thought of dengue scares you	☐	☐	☐	☐	☐	☐	☐
If you had dengue your life would change for the worse	☐	☐	☐	☐	☐	☐	☐
You feel dengue is a serious disease	☐	☐	☐	☐	☐	☐	☐
Early detection of dengue can save lives	☐	☐	☐	☐	☐	☐	☐
You feel that you are at high risk of getting dengue now	☐	☐	☐	☐	☐	☐	☐
It is possible that you may get dengue in the future	☐	☐	☐	☐	☐	☐	☐
Your living conditions put you at risk for dengue	☐	☐	☐	☐	☐	☐	☐
Regular dengue screening assure you of your health	☐	☐	☐	☐	☐	☐	☐
Regular dengue screenings can save your life	☐	☐	☐	☐	☐	☐	☐
It is convenient for you to go for dengue screening	☐	☐	☐	☐	☐	☐	☐
Removing or draining stagnant water will help to prevent dengue	☐	☐	☐	☐	☐	☐	☐
Regular checking on stagnant water will prevent you from getting dengue	☐	☐	☐	☐	☐	☐	☐
It is convenient to drain stagnant water on your own	☐	☐	☐	☐	☐	☐	☐
It is simple to get local government authorities to remove stagnant water in your vicinity	☐	☐	☐	☐	☐	☐	☐
It is easy for you to spot stagnant water around your home and neighborhood	☐	☐	☐	☐	☐	☐	☐

<https://wkwsci.co1.qualtrics.com/ControlPanel/Ajax.php?action=GetSurveyPrintPreview>

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How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Being alerted of dengue beforehand will help me protect myself from dengue	☐	☐	☐	☐	☐	☐	☐
Reporting dengue breeding sites or dengue symptoms to civic authorities will ensure they take the required action	☐	☐	☐	☐	☐	☐	☐
Information about dengue in this mobile application will help me to protect myself from dengue better	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I am only willing to get a dengue vaccination if I were sure it prevented the dengue	☐	☐	☐	☐	☐	☐	☐
I would get the dengue vaccine to stay healthy	☐	☐	☐	☐	☐	☐	☐
I would rather have a dengue vaccination than get dengue	☐	☐	☐	☐	☐	☐	☐
If my doctor/nurse recommends taking a dengue vaccination, I will take it	☐	☐	☐	☐	☐	☐	☐
I would need to know more about the dengue vaccination before taking it	☐	☐	☐	☐	☐	☐	☐
The dengue vaccination may cause a person to get dengue	☐	☐	☐	☐	☐	☐	☐
I worry about side effects from a dengue vaccination	☐	☐	☐	☐	☐	☐	☐
Dengue vaccinations are unnecessary	☐	☐	☐	☐	☐	☐	☐
Healthy people do not need to get a dengue vaccination	☐	☐	☐	☐	☐	☐	☐

What is the highest amount you are willing to pay for a dengue vaccine for yourself?

How frequently do you practice the following methods?

	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Everytime
Sleep under mosquito nets	☐	☐	☐	☐	☐	☐	☐
Drain stagnant water	☐	☐	☐	☐	☐	☐	☐
Spray insecticide on internal walls	☐	☐	☐	☐	☐	☐	☐
Seal cracks and holes in ceilings	☐	☐	☐	☐	☐	☐	☐
Burn trash around the house	☐	☐	☐	☐	☐	☐	☐
Grow plants such as tulsilemongrass/lavender	☐	☐	☐	☐	☐	☐	☐
Use mosquito repellents such as Tortoise coil, All out, Flit, Baygon etc	☐	☐	☐	☐	☐	☐	☐
Use mosquito repellent ointments such as Odomos, Aujan etc	☐	☐	☐	☐	☐	☐	☐
Fumigate your house using methods such as dhoop	☐	☐	☐	☐	☐	☐	☐
Burn coconut husks	☐	☐	☐	☐	☐	☐	☐
Put wet sand into flower vases	☐	☐	☐	☐	☐	☐	☐
Rear fish in water containers, wells, buckets in the house	☐	☐	☐	☐	☐	☐	☐
Wear long-sleeves clothes	☐	☐	☐	☐	☐	☐	☐
Burn anti-mosquito incense such as Jumbo, Baygon, Vape etc	☐	☐	☐	☐	☐	☐	☐
Use insect killer bat/racket	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I usually know when there is a dengue outbreak in my neighborhood	☐	☐	☐	☐	☐	☐	☐
I know whom to approach if I have a dengue	☐	☐	☐	☐	☐	☐	☐
I know how to protect myself from dengue	☐	☐	☐	☐	☐	☐	☐
I know where to get information about dengue	☐	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with each of the following statements, on a scale of 1 to 7 with 1 being strongly disagree and 7 being strongly agree.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Drink barley tea/teasing barley grass will help to fight dengue fever.	☐	☐	☐	☐	☐	☐	☐

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	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Goldenseal helps clear up the symptoms of dengue fever.	☐	☐	☐	☐	☐	☐	☐
Drinking neem leaves brew will increase blood platelet count and cell count.	☐	☐	☐	☐	☐	☐	☐
Papaya leaves are a natural cure for dengue fever.	☐	☐	☐	☐	☐	☐	☐
Drinking basil leaves tea can help to reduce the symptoms of dengue/prevent outbreak of fever.	☐	☐	☐	☐	☐	☐	☐

Please select Number 6 from the list

- ☐ 2
☐ 1
☐ 7
☐ 6
☐ 19
☐ 25

I intend to gather more information and preventive measures from the following to protect myself from dengue

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Healthcare professionals (e.g. Doctors, nurses)	☐	☐	☐	☐	☐	☐	☐
Personal networks (e.g. Family, Friends, Colleagues)	☐	☐	☐	☐	☐	☐	☐
Traditional media (e.g. Newspapers, TV, Radio, Posters)	☐	☐	☐	☐	☐	☐	☐
Internet Media (e.g. Health websites, forums, blogs)	☐	☐	☐	☐	☐	☐	☐
Social Media (e.g. Facebook, Twitter, WhatsApp)	☐	☐	☐	☐	☐	☐	☐
Download mobile app to get preventive measures and update on Influenza	☐	☐	☐	☐	☐	☐	☐

How likely are you to share health information with your family, friends and peers through the following?

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
Internet Media (e.g. Health websites, forums, blogs)	☐	☐	☐	☐	☐	☐	☐
Social Media (e.g. Facebook, Twitter, WhatsApp)	☐	☐	☐	☐	☐	☐	☐
Mobile phone health application	☐	☐	☐	☐	☐	☐	☐
Word of mouth	☐	☐	☐	☐	☐	☐	☐

How likely are you to share health information with a group you are member and/or public of through the following?

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
Internet Media (e.g. Health websites, forums, blogs)	☐	☐	☐	☐	☐	☐	☐
Social Media (e.g. Facebook, Twitter, WhatsApp)	☐	☐	☐	☐	☐	☐	☐
Mobile phone health application	☐	☐	☐	☐	☐	☐	☐
Word of mouth	☐	☐	☐	☐	☐	☐	☐

How likely are you to share health information with govt. authorities through the following?

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
Internet Media (e.g. Health websites, forums, blogs)	☐	☐	☐	☐	☐	☐	☐
Social Media (e.g. Facebook, Twitter, WhatsApp)	☐	☐	☐	☐	☐	☐	☐
Mobile phone health application	☐	☐	☐	☐	☐	☐	☐
Word of mouth	☐	☐	☐	☐	☐	☐	☐

Age

<https://wkwsci.co1.qualtrics.com/ControlPanel/Ajax.php?action=GetSurveyPrintPreview>

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Religion**Marital status**

- ☐ Married
- ☐ Widowed
- ☐ Separated/ Divorced
- ☐ Never married

Education

- ☐ No formal schooling
- ☐ PSLE or equivalent
- ☐ GCE O/N Level
- ☐ GCE A Level/ diploma
- ☐ Degree/higher education

Approx monthly household income

- ☐ Below USD \$1,000
- ☐ USD 1,000-4,999
- ☐ USD 5,000-9,999
- ☐ USD 10,000-14,999
- ☐ USD 15,000-19,999
- ☐ USD 20,000 and over
- ☐ Don't know
- ☐ Refuse to answer

Ethnicity

- ☐ Chinese
- ☐ Malay
- ☐ Indian
- ☐ Other
- ☐ Sri Lankan

Thank you :)

Appendix K: Workshop study - Interview Questions Guide

General

- Demographic Factors
- Educational Qualification
- Employment status
- Age
- Gender

General Questions about interviewee

- Tell me about your work
- How do you think this can be implemented to help Public health communication
- Is this platform(app, forum, website etc) available in app store/google store etc.
- What are the factors you considered before making the platform
- What are the communication factors you considered before the creation of the platform
- Who where your target participants for the platform
- What are the things you did to promote the use of platform
- In general how would you say general participation is for these kind of platforms
- What type of barriers were you anticipating, faced and solutions
- What type of encouragement/motivation/promotion where you planning to do with the platform
- Who were participants? Where it they mainly get their information from
- Did you study other platforms of this kind before making the product
 - What did you learn from it?
- Do you think the general public will download and use the platform? Why?
- Will you use such an platform? Why?
- Who do you think will maximum use to the application? (What category of people)
 - Educated/ non-working/ students/ etc
- Platform purpose and the user reports a complaint, how efficiently do you think the municipality will respond to it?
- In your opinion why will the general public participate in such a system? Will the users participate in using the system for helping the authorities or for personal gratification?
- Do you believe users' participation in such public concerns is individually life enriching?
- Do you believe user's participation is socially beneficial to the community?
- Do you think people can/ will find time to report <> (as it will not take much time)? Why?
- In your opinion, do such applications help <>? Why?

- In your opinion, do you think such things should be done as responsibility or volunteering? Why?
- In your opinion, people who find time for sending such reports and helping the authorities will be treated or viewed with respect? Why?
- Do you think, the public will abuse such a system by randomly uploading images? Why?

Motivating or facilitating factors

- According to you, what are some good reasons for volunteering or taking part in such an application? Why?
- What factors do you think can act as a motivating factor for the public to use the system?
Vouchers or appreciation notes etc

Barriers

- What reasons do you think are barriers for others to take part in such a system?
- What are reasons do you think may keep you from taking part to such a system?
- Some options to be discussed or probed further
 - Burned out/not enjoyable
 - Family responsibilities
 - Health/medical problems
 - Lack of time
 - No one asked
 - Haven't gotten around to it
 - Haven't heard of anything that interest them
 - Transportation or expenses
 - Opportunities don't match interests
 - Not part of culture

Technological factors

Describe to us about the technologies you use and your preferences.

- Which technologies do you use on a daily basis?
- Which technologies are you most comfortable using? Why?
- Which technologies are you not that comfortable using? Why?
- How familiar and comfortable are you with using the Internet?
- How familiar and comfortable are you with mobile applications?
- How familiar and comfortable are you with tablet devices?