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SOCIAL MEDIA-BASED CIVIC ENAGEMENT FOR DENGUE PREVENTION IN ASIA

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Introduction

Dengue is a vector-borne infectious disease that has historically posed continued threats to populations living in both developed and developing countries. Dengue affects more than 50 million people in the world every year, in particular countries in the Asia-Pacific region that share more than 70% of the disease burden. The island nation of Sri Lanka has been grappling with severe dengue outbreaks recently, recording 40,000 cases in 2012 with dengue-related mortalities peaking in the last four years (Tam et al., 2013). The island country can, however, address the crippling dengue problem through an opportunity offered by the deep penetration of mobile phone services and the low cost of mobile services in comparison to most other countries. According to the International Telecommunications Union report (2013), Sri Lanka boasts greater mobile-cellular penetration than world averages (and countries in the Asia-Pacific) and is ranked 14th (among the lowest) in terms of service pricing.

This paper describes a socially mediated smartphone/tablet-based intervention called Mo-Buzz for dengue prevention in Sri Lanka, designed by researchers at Nanyang Technological University's Center of Social Media Innovations for Communities (COSMIC). The narrative commences with summary descriptions of two formative studies and their impact on intervention design. We then discuss the role and challenges of trans-disciplinary, trans-sector collaborations in designing public health interventions that are conceptually pivoted on the notion of civic engagement. The paper concludes with reflections on implications of our intervention for health-related civic engagement research initiatives and next steps in terms of evaluation and scaling up.

Formative Study 1: Needs Assessment of Public Health Inspectors in Colombo

Study Description

In order to understand the landscape surrounding the disease and its control by the authorities in the capital of Colombo, we worked with the Colombo Municipal Council (CMC) to conduct needs assessment among 29 public health inspectors (PHIs) constituting more than half of the entire PHI workforce in the city. Colombo was chosen as the study site as it serves as not only the political capital of Sri Lanka, but also the epicenter of the national dengue epidemic. Dengue usually originates from Colombo, possibly due to urban congestion and dense population, and then spreads to other parts of the island nation.

The aim of this research was to gain an in-depth understanding of three specific areas of work that are assigned to PHIs: reporting dengue cases, monitoring dengue breeding sites and spread of the disease, and educating the affected communities on protecting themselves from dengue. For each of these tasks, our objective was to identify process, challenges and needs. The needs assessment was conducted using a mixed-methods approach comprising, a quantitative paper-based short survey and in-depth qualitative interviews.

The 15-minute survey was mainly designed to capture the demographic profile of the respondents and their preferences as regards the use of mobile-based technologies for executing work-related tasks. The in-depth interviews lasted between 30 to 60 minutes and touched on various themes: role & responsibilities of PHIs with respect to dengue, the dengue burden in

Colombo, dengue prevention & control processes and mechanisms, technology use & preferences, and client interaction, trust and satisfaction.

Summary Findings

Quantitative survey. Our demographic analysis (Table 1, pg. 14) showed that the entirely male sample was composed of nearly 55% in the 21-30 age group, and the rest between 31-40 years old. All but one PHI were Sinhalese, and nearly 86% of them had acquired a diploma. Nearly 45% of them had worked as a PHI for less than a year, nearly 21% between 1-5 years and nearly 34% for more than five years.

In terms of technology preferences (Table 2, pg. 14), while nearly 90% and 62% of PHIs had used simple mobile phones and smartphones respectively, only 35% had used mobile apps and only 28% had used a tablet before. However, despite lack of previous experience, the perceived ease-of-use of mobile apps and tablets were high, with mean scores of 3.65 and 3.55 on a 5-point scale respectively. Similarly, the perceived usefulness of mobile apps and tablets in collecting dengue information was high, with a mean of 3.52 and 3.87 on a 5-point scale respectively.

In-depth interviews. As mentioned earlier, the interview focused on the process, challenges and needs pertaining to a) reporting of dengue cases, b) monitoring dengue spread and c) disseminating health education.

In terms of reporting, the PHIs described the circuitous nature of the current reporting process that involved multiple communication links between the hospitals, the Colombo Municipal Council (CMC) and the Ministry of Health (MoH). This arduous process, replete with opportunities for information mismanagement and miscommunication, implied that the normal time taken to report dengue cases could be as long as 7-10 days. Although the PHIs were equipped with standalone GPS devices provided by the World Health Organization (WHO) that could help to send GPS coordinates, problems with connectivity and accuracy, and the sheer physical inconvenience caused by carrying this heavy device, made it cumbersome for PHIs to use. Finally, the governmental paper-based forms required for notification and form filling was tedious and could take between 30-60 minutes to fill each one. In light of these processes and challenges, the PHIs alluded to the need for a digitized reporting system and a GPS system with greater sensitivity.

In terms of monitoring disease spread, the PHIs reported that existing mapping of dengue in Colombo was largely reactive. This meant that the CMC was mapping dengue cases to geographical areas within the city *after* the outbreak had occurred. In addition, the mapping was done on a paper map using traditional pin-mapping techniques. Apart from the tacit knowledge about disease spread in Colombo gained from years of experience, the public health system was bereft of a scientifically designed system that could predict the spread of the outbreak.

An important component of dengue monitoring and control in Sri Lanka is the use of evidence to penalize offenders who fail to treat mosquito breeding sites. PHIs explained that the lack of a portable meant that they were unable to gather photographic evidence, thereby impeding their ability to initiate action. Lastly, PHIs described their challenges in collecting data from residents, as those especially living in upper market areas failed to cooperate with the PHIs in providing the information needed.

These processes and challenges were mapped to the need for proactive surveillance mechanisms through predictive mapping of dengue outbreaks and hotspots. The PHIs also expressed a need for portable cameras to help them gather photographic evidence, and a device that would reinforce their social importance while gathering data from community members.

In terms of education, the PHIs explained that existing modes of dengue education were implemented through the use of traditional media such as pamphlets and films, many of which contained contents that were not updated for a long period of time. Because of the use of outdated modes of health communication, the educational process was time consuming and often tested the patience of the audience (the community members). The lack of persuasive strength of these educational materials meant a minimal influence on attitudes and beliefs regarding the practice of personal protective behaviors against dengue, and the failure to translate any positive attitudes into behavioral performance. These processes and challenges suggested the need for more engaging forms of dengue education with attractive graphic components and multimedia. Equally important was the need to update the contents in educational materials.

Intervention Design: Mo-Buzz for PHIs

Findings from the needs assessment pertaining to the three main areas of dengue prevention and control informed our design of a social media based system called Mo-Buzz. Mo-Buzz is being made available to PHIs on Samsung tablets and comprises four distinct components.

The *digital surveillance* component offers the PHIs digitized dengue investigation forms that are pre-loaded on portable tablet computers for PHIs. This easy-to-use interface ensures a greater motivation for PHIs to complete filling every part of the form; once the form is filled, the PHIs can send the report to the CMC using the click of a button. Reports from various PHIs are aggregated on a backend database for the authorities to view and summarize. This component drastically reduces the reporting time of dengue cases from 7-10 days to a few hours.

The *dynamic monitoring* component offers PHIs a simple form to report breeding sites. This form includes a feature that enables the PHIs to take a picture or video of a breeding site, which is automatically geo-tagged, and can be sent to the CMC with the click of a button.

The *health communication* component offers all the CMC's health education materials in a tablet form. PHIs can use the tablets to deliver dengue education to the public, thereby generating greater attention and greater respect from the lower/middle and upper strata of the society respectively. Future versions of the application are expected to include an interactive educational module that can attract audience participation in health educational sessions in community contexts.

Lastly, the *predictive surveillance* component uses algorithms and simulations to generate predictions of dengue outbreaks in Colombo that are made available to the PHIs and CMC in the form of hotspot maps. This component helps the public health authorities to plan the allocation of their preventive resources well ahead of time and minimize harm caused to the communities.

Formative Study 2: Receptivity Assessment of Mo-Buzz among General Public

Study Description

Based on positive feedback from PHIs on Mo-Buzz, we were requested to launch a similar version among the general population. Before doing so, we conducted a rapid community survey to assess the potential receptivity to such an innovation by the general public. Using a convenience sampling approach the survey targeted potential users of our mobile applications, in other words individuals with access to smartphones and internet connectivity. Using the auspices of our field collaborations, we conducted the survey in several locations including the official headquarters of People's Bank and Mobitel (the largest telecommunications operator in Sri lanka), Mobitel outlets (in Magestic City Shopping Mall and Liberty Plaza Shopping Mall), Ratmalana Technical College and the Sri lanka Rupavahini Corporation.

Our 10-minute survey questionnaire was structured in the following format: demographic variables followed by a brief description of the functionalities of Mo-Buzz, and culminating with questions that capture the core Protection Motivation Theory (PMT) constructs (perceived severity, perceived susceptibility, perceived response efficacy and perceived self-efficacy) (Milne, Orbell, & Sheeran, 2002). Demographic variables captured were age, gender, marital status, ethnicity, income and education. The presentation of Mo-Buzz's functionalities included a brief description of how the general public could use it, were it to be launched in the future. All PMT constructs were adapted from Milne, Orbell and Sheeran (ibid).

Preliminary Findings

Respondent profile (Table 3, pg. 15). A total of 513 individuals participated in the survey. Overall, our study sample comprised nearly 55% male and 45% female participants. Roughly consistent with the generic Sri Lankan population, the ethnic distribution of our sample comprised an overwhelming majority (~ 71%) of Sinhalese with the Tamils and others accounting for the rest. Age-wise distribution showed that that the 30-40 year age bracket found greatest representation (~ 43% each) with the 18-30 and 31-40 brackets being nearly equally represented (~25% each).

Nearly 35% of our participant pool had been educated at the university-level or above, while nearly 47% had received a certificate or diploma. In terms of monthly household income, our participant profile was nearly equally distributed with ~28% of participants belonging to the

Sri Lankan Rupees (SLR) 25,001-50,000, ~25% to the 50,001-75,000 bracket, and ~25% each to the ≤ 25,000 and ≥ 75,000 brackets.

PMT constructs (Table 4, pg. 15). On a 5-point scale, simple means analysis of theoretical constructs showed that study respondents reported high perceived severity of dengue (M=4.11, SD=0.52) but lower perceived susceptibility to dengue (M=3.75, SD=0.72). Perceived self-efficacy to use a smartphone based dengue prevention application (M=4.03, SD=0.53) and perceived response efficacy of such a system (M=4.07, SD=0.75) were high. Intention to use Mo-Buzz (M=4.06, SD=0.45) was high, reinforcing our decision to adapt the PHI version and design a similar system for the general public.

Participatory Intervention Design: Mo-Buzz for the General Public

Based on the high potential receptivity to the system as seen from the survey results and consistent with the participatory nature of social media interventions, we adapted the PHI system to design a civic-engagement based system u for the general public to use on their smartphones. This holistic, integrative system is composed of three specific components:

The predictive surveillance component (similar to the PHI version) predicts dengue outbreaks at different time intervals in the future and disseminates this information to the general public in the form of hotspot maps on their smartphones. This information is intended to alert the public about an impending outbreak with a view to persuading them to undertake personal protective behaviors such as draining pots and pans, maintaining hygienic conditions in their home, and wearing long sleeved clothing.

The civic engagement component uses a novel, nimble crowdsourcing technology to empower the general public to report dengue breeding sites and dengue-related symptoms that they might be experiencing. Similar to the PHI version, the general public can thus strengthen to public health monitoring and surveillance efforts, by contributing real-time pictures and/or videos of breeding sites that can be captured using the Mo-Buzz application. The geo-tagged pictures can be reported to the health authorities with the click of a button. Similarly, by reporting dengue symptoms, the general public is constantly apprising health authorities of where and when dengue is or might be spreading, reducing the latter's epidemiological task burden. Using a novel approach to encourage the general public to partake in the responsibility to maintain a healthier society, our civic engagement component is among the first to use social media to link the general public to health authorities and be chronicled in public health scholarship.

The health communication component is aimed at using the power of interactive messaging strategies using smartphone affordances to create awareness about dengue and persuade users to practice behaviors that might reduce his/her risk of being infected by dengue. The static module in this component is comprised of a detailed, graphics-based information module on dengue and a short animation film that promotes personal protective behaviors using the concept of entertainment-education. The dynamic component uses the concept of tailored communication to disseminate messages based on the kind of report (symptoms or breeding sites) sent by the user.

Civic Engagement in Public Health: A Trans-Disciplinary Challenge

While the conceptual thinking and design of Mo-Buzz offers a novel, holistic approach to dengue prevention and management, the process of designing a civic engagement-based health initiative is fraught with the challenge of integrating the efforts of experts from a variety of domains. The inherent trans-disciplinary nature of research inquiries in health communication has been previously elucidated (Kreps & Maibach, 2008) as the field draws upon theoretical ideas from social psychology, communication, public health and others. The nature of designing mHealth interventions such as Mo-Buzz however propels the intent of the term “trans-disciplinary” in public health research to new levels. For instance, our team comprises experts from social communication, behavioral science, human computer interaction for novel interfaces, mathematics, software engineering, information sciences and psychology. In the absence of a formalized template to synergize the intellectual energies of these varied specialists, our collaboration is shaped organically but efficiently. The collaborative process was highlighted by a process of joint exploration into a new concept, identifying how and where each member could contribute in the development and research process and an implicit understanding of each other’s capabilities.

From a logistical standpoint, some of the challenges, lay in organizing various tasks requiring different skill sets towards achieving a common objective. The more enriching challenge, however, lay in communicating terminologies and concepts to each other, and we found, over time, that we could use the power of metaphors to accomplish the same. The other organizational implication from our experience in trans-disciplinary research may be construed either positively or negatively. At many stages during our system development, we observed that many processes (that could have been arduous) were easily facilitated as the team members trusted the respective expertise of the other, thereby not overstepping boundaries. While this worked in our favor, it might also be important to recognize that such a tendency, if pushed further, could result in an expert’s ideas or inputs being left unchallenged and not critically evaluated. As mHealth interventions expand across geographic frontiers in the future, it is incumbent upon health systems scientists to inquire about and inform the practice of trans-disciplinary research teams.

Civic Engagement in Public Health: A Trans-Sector Collaborative Challenge

The very nature of civic engagement initiatives – where the general public actively participates in efforts traditionally undertaken by governmental authorities – requires collaboration with institutions boasting diverse mandates. The process of conceptualizing, designing and deploying the Mo-Buzz system demanded concerted exertions to integrate with a range of stakeholders at different levels of the public health ecosystem: civic agencies, research institutions, telecommunications companies and policymakers. Our effort was guided by Axelsson and Axelsson's (2006)framework with an emphasis on two forms of inter-organizational integration in public health programs: 1) Cooperation, described as being "based on hierarchical management, but combined with voluntary agreements and mutual adjustments between the organizations involved" (Mintzberg, 1993); and 2) Collaboration, described as being "based on a willingness to work together and…implemented through intensive contacts and communications between the different organizations" (Alter & Hage, 1993).

Our process of cooperation and collaboration was characterized by a range of facilitators and barriers. First and foremost, we learnt that civic agencies and public health authorities might be understandably cautious about sharing dengue-related data required for building the predictive algorithm. However, the level of data confidentiality and the type of agencies facilitating data sharing vary widely between contexts, as does their willingness to consider and buy-in to a new public health innovation. Obtaining such data requires consistent and transparent negotiations with the relevant stakeholders. The key ingredients that catalyzed our success with our Sri Lankan collaborators were a) a detailed communication about our system's capabilities and benefits, and b) a strong assurance about our technological ability to ensure the confidentiality of the data.

Researchers involved in similar innovations in the mobile health (mHealth) space might also encounter a resistance to change if their innovations require a shift in the daily routine tasks of the health systems personnel. In order to address this challenge, an appreciation of the practical micro and macro level challenges that health workers and health authorities encounter on a day-to-day basis needs to be complemented by a readiness to incorporate the new system in a stage-wise or staggered manner.

The main facilitating factors that furthered our efforts were not only the enormity of the dengue problem but the enthusiasm, curiosity and urgency to consider mobile phone-based innovations. The potential of mobile phones in transforming the global health landscape has been extensively chronicled by scholars (Boulos et al., 2011; Curioso & Mechael, 2010; Gurman, Rubin, & Roess, 2012; Kay, 2011). As a result, health system stakeholders seem readier than ever to consider innovations that they feel might positively influence public health outcomes; equally so, corporate entities seem willing to partake in such initiatives as involvement in public-private partnerships furthers their corporate social responsibility initiatives.

Conclusions & Next Steps

The design of Mo-Buzz, a socially mediated civic engagement-based intervention for infectious disease prevention, symbolizes the next wave of communication technological innovations impacting public health issues (Lwin et al., 2014). From an epistemological standpoint, it is not difficult to identify how an intervention like Mo-Buzz distinguishes from traditional health communication interventions. The mandate of traditional health communication interventions was largely informed by epidemiological studies that revealed or highlighted the burden and severity of specific public health issues. An intervention like Mo-Buzz blurs the lines between the science of epidemiology and the science of health communication, by interlinking them through social media affordances that can address the demands of both sciences simultaneously.

Moving forward, we foresee such interventions catalyzing greater inter-disciplinary collaborations among scholars and practitioners in these two domains, as such collaborations will only help to generate newer perspectives on public health problem solving and lead to the creation of innovative intervention designs. From a theoretical standpoint, holistic and integrative approaches like Mo-Buzz create new avenues for theory development and testing as social media allows for a range of health framing approaches to be simultaneously tested. Given these opportunities to advance the state of science in health communication and public health, we expect to scale-up the reach of Mo-Buzz to more countries in the developing world grappling with infectious disease pandemics and scope out the innovations to be adapted for other health issues such as influenza, cardiovascular attack alerts and hand-foot-mouth disease.

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Tables (Formative Study 1)

Table 1: Demographic profile of the Public Health Inspectors (PHIs) in Colombo, Sri Lanka

Demographics	*Frequency (N)*	*Percentage (%)*
Gender		
Male	29	100.0
Age		
21 – 30	16	55.2
31 – 40	13	44.8
Marital Status		
Single	20	69.0
Married	9	31.0
Ethnicity		
Sinhalese	28	96.6
Tamil	1	3.4
Highest Education Level		
Grade 12 – 13	3	10.3
Diploma	25	86.2
Bachelor	1	3.4
Years of Experience		
Less than 1	13	44.8
1 – 5	6	20.7
More than 5	10	34.5

N = 29

Table 2: PHI's perceptions about technology use, and perceived usefulness

	Simple Mobiles	*Smart-phones*	*Mobile Apps*	*Tablets*
Have you ever used … ?	26 (89.7%)	18 (62.1%)	10 (34.5%)	8 (27.6%)
How easy is it for you to use … ?	4.77 (.65)	4.35 (.85)	3.65 (1.23)	3.55 (1.22)
I would prefer to collect dengue information through …	2.82 (1.62)	3.54 (1.14)	3.52 (1.37)	3.87 (1.39

N = 29

Tables (Formative Study 2)

Table 3: Demographics profile of survey respondents

Categories	*Frequency (N)*	*Percentage (%)*
Gender		
Male	289	56.34
Female	223	43.47
Age		
18 – 30	126	24.56
31 – 40	220	42.88
41 and above	160	31.19
Ethnicity		
Sinhalese	363	70.76
Muslim	62	12.09
Sri Lanka Tamil	49	9.55
Indian Tamil	30	5.85
Others	5	.97
Marital Status		
Single	148	28.85
Married	278	54.19
Separated / Divorced / Widowed	86	16.77
Highest Educational Level		
Secondary and below	84	16.37
Certificate or diploma	239	46.59
University and above	181	35.28
Monthly Household Income		
Rs 25,000 and below	107	20.86
Rs 25,001 – 50,000	144	28.07
Rs 50,001 – 75,000	130	25.34
Rs 75,001 and above	124	24.17

N = 513

Table 4: Descriptive statistics for constructs in Protection Motivation Theory (PMT)

Constructs	*M*	*SD*
Perceived severity	4.11	.52
Perceived susceptibility	3.75	.72
Perceived self-efficacy	4.03	.53
Perceived response efficacy	4.07	.43
Intention to use Mo-Buzz	4.06	.45

N = 513

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