An Analysis of the Results from Rapid Dengue Blood Screening Pilot Trial for Taiwan Taoyuan International Airport Arrivals

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Abstract

Taiwan CDC statistics show that imported dengue fever (DF) cases have on average increased by 46.07% annually in the recent 3 years. To shorten the time to detect probable DF cases in arriving passengers, Taiwan CDC implemented the Rapid Dengue Blood Screening (RDBS) Pilot Trial for Taiwan Taoyuan International Airport in 2008, in an attempt to accelerate the DF quarantine process. The aim of this study is to investigate passenger acceptance of and satisfaction with RDBS as a reference for decision-making.

Both self-administered surveys and phone interviews were conducted with inbound passengers receiving RDBS. Passengers were asked to complete a questionnaire containing five-level Likert items to measure their level of RDBS acceptance, and 3 open-ended questions are included for them to comment on RDBS. Data were analyzed with SPSS 10. The

total number of valid samples is 300.

Results indicate that among the respondents, only 17.67% have heard of RDBS; 82.67% approve RDBS at international airports; 62.38% recommend that the waiting time for the test should be limited to 10-20 minutes; 61.67% express their will to cooperate with the quarantine policy; 62.45% are satisfied with the professional practice and overall service of health personnel; and 42.22% are satisfied with the privacy of examination environment although the examination environment and equipment need immediate improvement.

Summarizing the above results, passengers are satisfied with international airport RDBS and its quality. However, RDBS should be better publicized, and supportive policies should be established to encourage RDBS-positive cases to comply with medical or quarantine arrangements. Examination environment privacy should be improved to enhance the service quality of quarantine agencies and the image of international airports.

Introduction

As one of the most important vector-borne infectious diseases, dengue fever (DF) featuring acute virulent fever is transmitted to humans by the mosquitoes *Aedes aegypti* or *Aedes albopictus* and spreads widely in the subtropical areas, including parts of Asia, Latin America, Africa, northern Australia, and some Pacific islands [1,2]. Over 250 million people in the world are exposed to the threat of DF infection, and about 100 million people are infected every year. According to the literature, the first DF case in Taiwan was reported in 1870, and a number of large-scale

epidemics broke out in the 1990s. Today, widespread DF is increasingly severe in the Western Pacific, making it a main public health concern [3,4].

According to Taiwan CDC statistics, the number of imported DF cases increased from 107 to 226 during 2006-2008, with an annual increase of 46.07% on average. Major countries of importation are Southeast Asian countries, including Vietnam, Indonesia, the Philippines, Thailand, Cambodia, Burma, and Malaysia [5].

The dengue virus (DEN) has four closely related serotypes, and the DF incubation period is about 3-8 days, or 14 days at the longest. Major symptoms include fever, headache, myagias, arthralgias, retro-orbital pain, rash, hemorrhagic manifestations, and leucopenia. Severe complications include dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) [6]. Currently, the following three laboratory assays are applied to RDBS, including viral isolation, real-time reverse transcriptase-polymerase chain reaction (RT-PCR), and IgM and IgG capture (ELISA). Viral isolation and RT-PCR are often applied to confirm cases in the acute stage (one week within infection) when DEN is still found in the serum; while ELISA is usually performed on cases at the recovery stage; i.e. longer than one week from infection [7,8].

Under the present quarantine policy, suspected cases must take a blood test upon arrival. According to Taiwan CDC statistics, during 2006-2008, of all import DF cases, 273 cases were infected with DF before (or on the same day of) arriving in Taiwan Taoyuan International Airport, and 183 DF-positive cases were confirmed by the airport fever quarantine station, with a quarantine rate of about 67%, indicating a success of Taiwan's airport DF quarantine. Also, all 3 assays should be

performed on suspected cases as the condition varies, i.e. at different stages. Therefore, the quarantine period will range from 8 hours to 7 days. Together with the time for specimen transportation, administration, examination report announcement and delivery, a suspected case may receive the examination results in about 7 days on average. As there is no reference for the public health authority to take any active quarantine action during this lapse period-such as spraying insecticide to kill mosquitoes in the environment-except voluntary concern for individual cases, this provides an opportunity for increased disease spread when a DF-positive case is at the communicable stage. For this reason, finding how to enhance the efficiency of first-line DF quarantine has become a prime mission for the competent authorities.

DEN contains 7 nonstructural protein genes. The NS1 protein will dissolve into the cell surface and stay in serum at the acute stage. Therefore, by detecting the NS1 antigen reaction in serum, we can identify DF infection [9]. According to the research data of quick NS1 tester manufacturers, there are two types of NS1 testers, the Platelia Dengue NS1 Ag (Bio-Rad Laboratories and La Coquette in France) and the Pan-E Dengue Early ELISA (Panbio Diagnostics, Brisbane, Australia). Particularly, the former has a sensitivity of 81-92.9% and a specificity of about 100%, making it a potential tester for first-line DF quarantine [10,11]. NS1 antigen detection needs neither complicated procedures nor excessive instruments, and quarantine personnel may correctly operate the examination after adequate training. Furthermore, it does not need a large space and can display the results in about 30 minutes. Therefore, Taiwan CDC has chosen the Dengue Virus NS1 Antigen Rapid Tester in the RDBS

pilot trial at Taoyuan International Airport.

In addition to providing suspected cases with real-time information, RDBS can alert the public health authorities to take aggressive quarantine and isolation actions. The aim of this study is to investigate the passenger's RDBS acceptance levels and comments as well as to assess passenger satisfaction with the border quarantine service in order to provide a reference for establishing policies to enhance the efficiency of imported DF control and the quality of quarantine service.

Materials and Methods

1. Questionnaire design

The 5-level-Likert-item questionnaire (including basic demographic items) used in this study was developed based on the literature related to medical service quality [12] and reviewed by one commanding officer of the community medical network and 3 professors from relevant fields. The five levels represented "strongly disagree", "disagree", "neither agree nor disagree", "agree", and "strongly agree" are coded by numbers 1-5. Respondents were asked to indicate which of the five given levels best reflects their feelings.

2. Samples

Samples were selected from suspected cases coming from dengue-prevailing regions as announced by Taiwan CDC at Taoyuan International Airport during August 23-October 23, 2008, and fulfilling the following criteria: confirmed with fever ($\geq 38°C$ measured from the ear), having received dengue blood tests, and capable of communicating in Chinese. Samples aged over 20 who can communicate in Chinese were asked to answer the self-administered questionnaire; and samples aged

under 20 were asked to answer the questionnaire through their accompanying guardians or relatives aged over 20 who can communicate in Chinese.

3. Conducting the survey

The survey included an onsite questionnaire followed by a phone interview after the quarantine. Colleagues explained to the respondents the survey process, the purpose and examination methods of RDBS, and the objective of this study. The survey was conducted without disclosing the basic data of the respondents and with the consent of respondents. Quarantine personnel conducting the onsite survey had participated in the pre-RDBS meetings with a full understanding of this pilot trial to ensure survey consistency. The phone interviews were conducted by a responsible person to ensure interview consistency.

4. Content of questionnaire

The questionnaire contains eight sections to assess the respondent's cognition, feelings, and opinions of RDBS in addition to the routine dengue blood tests. These include information exposure, screening policy cognition, satisfaction, infection knowledge, professional attitude, environment, and equipment.

5. Data analysis

Data were analyzed with SPSS 10. The questionnaire's Cronbach's α is 0.8001 (i.e. it is reliable). The validity is KMO=0.752>0.6, Bartlett=3854.094, and significance α=0.000 (i.e. it complies with the standard α<0.001). This indicates that the questionnaire is valid. In addition to revising the questionnaire items according to the expert recommendations, a semantic pretest was conducted before the survey was administered to ensure that the content of the questionnaire meets the research needs (i.e. the questionnaire content is valid) [13-14].

Results

Of the 1000 copies distributed, 300 copies were valid, and the rest were either not answered or incompletely answered. In terms of the gender distribution of the valid samples, 59.0% are males and 41.0% are females; and most of them are ROC nationals (96.0%). In terms of age distribution, most respondents are aged 21-50 years (21-30: 24.0%; 31-40: 25.3%; and 41-50: 22.7%). In occupation, most respondents are businesspersons (40.7%), and service industry workers and students come second; most students are college students (68.0%). In terms of geographical location, most respondents live in northern Taiwan (64.7%). In terms of travel purposes, leisure (54%), business (26.3%) and family visits (15.3%) are the most common purposes, and only 1.3% are expatriates. In terms of travel duration, the average trip length of nearly 50% of the respondents is 10 days. In terms of destination, Southeast Asian countries are the most common destinations, including Thailand (31.7%), Vietnam (20.0%), and the Philippines (13.0%).

Although all items, except basic personal data, are 5-level Likert items, in order to facilitate statistical analysis, "strongly disagree" and "disagree" have been combined as one negative opinion; and "strongly agree" and "agree" as one positive opinion; i.e. results are presented in 3 levels: disagree, neither disagree nor agree, and agree (Table 1). In terms of exposure to RDBS information, 17.68% of respondents have received relevant information before arrival, and 37.33% received clear information from the quarantine station; i.e. an increase of 19.66%. In terms of screening policy cognition, 82.67% of respondents approve RDBS at airports as it can detect suspected cases right on arrival, and 78.0% believe that RDBS is more efficient in informing them their status of infection when

compared to conventional methods which may take days to get results.

In terms of screening method satisfaction, 85% of respondents are satisfied with RDBS as it uses the same blood sample and no additional blood tests are needed. There are 3 open-ended questions for respondents to comment on the waiting time for getting RDBS results. The findings indicate that 40.5% of respondents are satisfied with the waiting time for the results; 98.84% do not want to wait for the results because they are in a hurry; 1.98% would wait for the results for more than 30 minutes; and 62.38% would wait for the results for 10-20 minutes (Table 2).

In terms of infection knowledge and control and follow-up efficiency, 66% of respondents would collect information on dengue conditions in a destination before departure; 61.76% believe that they would be aware if mosquito vector existed in the place they lived; and 87.67% know that mosquito vectors can transmit dengue after feeding an infected case. However, only 61.67% agree to cooperate with the isolation policy, which involves going to an assigned isolation site during the period of communicability and receiving suitable medical treatment when RDBS results show that they are probable cases. Also, only about 65.33% of the respondents agree to cooperate with the control and follow-up measures and receive early medical assistance to facilitate follow-up by health personnel (Table 1).

In terms of satisfaction with the professional attitude of quarantine personnel, 62.45% of respondents are satisfied on average, and 37.33% are neither satisfied nor unsatisfied. In terms of examination environment and equipment (including space, equipment, privacy, etc), only 42.22% of the respondents are satisfied on average, and 57.78% are unsatisfied, particularly noting that the "examination environment lacks privacy" (Table 1).

Table 1. RDBS acceptance and satisfaction statistics (n=300)

Information exposure	Disagree		Neither Disagree nor Agree		Agree	
	n	(%)	n	(%)	n	(%)
You have heard of RDBS before.	16	(5.33)	231	(77.00)	53	(17.67)
You learn about RDBS at the arrival quarantine station.	3	(1.00)	185	(61.67)	112	(37.33)
Screening Policy Cognition	Disagree		Neither Disagree nor Agree		Agree	
	n	(%)	n	(%)	n	(%)
It helps to detect infected cases immediately.	0	(0.00)	52	(17.33)	248	(82.67)
It allows passengers to know if they are infected immediately.	2	(0.67)	64	(21.33)	234	(78.00)
Infection Knowledge	Disagree		Neither Disagree nor Agree		Agree	
	n	(%)	n	(%)	n	(%)
Mosquito vector conditions in the living environment	14	(4.67)	101	(33.67)	185	(61.67)
Mode of transmission	3	(1.00)	34	(11.33)	263	(87.67)
Collection of dengue information in destinations.	14	(4.67)	88	(29.33)	198	(66.00)
Willingness to accept isolation arrangements	4	(1.33)	111	(37.00)	185	(61.67)
Control and Follow-up Efficiency	Disagree		Neither Disagree nor Agree		Agree	
	n	(%)	n	(%)	n	(%)
It facilitates health personnel to follow up.	0	(0.00)	104	(34.67)	196	(65.33)
Personnel Professional Attitude	Disagree		Neither Disagree Nor Agree		Agree	
	n	(%)	n	(%)	n	(%)
Professional skills	0	(0.00)	107	(35.67)	193	(64.33)
Professional response to enquiries	2	(0.67)	122	(40.67)	176	(58.67)
Overall service attitude	0	(0.00)	107	(35.67)	193	(64.33)
Mean		(0.22)		(37.33)		(62.45)
Environment and Equipment	Unsatisfied		Neither Satisfied Nor Unsatisfied		Satisfied	
	n	(%)	N	(%)	n	(%)
Examination venue	0	(0.00)	170	(56.67)	130	(43.33)
Examination equipment	1	(0.33)	170	(56.67)	129	(43.00)
Privacy	5	(1.67)	174	(58.00)	121	(40.33)
Mean		(0.67)		(57.11)		(42.22)
Screening Method Satisfaction	Unsatisfied		Neither Satisfied Nor Unsatisfied		Satisfied	
	n	(%)	N	(%)	n	(%)
Screening methods	2	(0.67)	43	(14.33)	255	(85.00)

Note: Except the respondent 's personal information, the "strongly disagree" and "disagree" options and the "strongly agree" and "agree" options in 5-level Likert items have been combined into "disagree" and "agree" respectively to facilitate statistical analysis. As a result, the options in each item are: "disagree", "neither disagree nor agree", and "agree".

Table 2. Statistics of RDBS result waiting time responses

Examination and Result Waiting Time (n=121)	Unsatisfied		Neither Satisfied Nor Unsatisfied		Satisfied	
	n	(%)	n	(%)	n	(%)
	2	(1.65%)	70	(57.85%)	49	(40.50%)
Reasons for inability to wait for the results (n=197)	Want to Go Home		In a Hurry		Notification Afterwards is All Right	
	n	(%)	n	(%)	n	(%)
	2	(1.02%)	194	(98.48%)	1	(0.51%)
Acceptable Result Waiting Time (n=101)	<10 minutes		11-20 minutes			
	n	(%)	n	(%)		
	6	(5.94%)	63	(62.38%)		
	21-30 minutes		>30 minutes			
	n	(%)	n	(%)		
	30	(29.70%)	2	(1.98%)		

Discussion

An in-depth analysis of the statistical results and phenomena detected during the survey is as follows:

1. In terms of RDBS understanding and information exposure, results of this study indicate that the explanation of quarantine personnel can increase passengers' understanding of and cooperation with RDBS by 19.66% . This suggests that with sufficient time and human resources, onsite education of quarantine policies can significantly enhance passenger cooperation.

2. As a free and required quarantine test, RDBS enables health authorities to take immediate actions, provide further health education, and arrange proper medical treatment for DF cases in order to maintain their personal health, prevent them from transmitting dengue fever to their family and friends, reduce community infection probability, and reduce costs for epidemic investigations, household disinfection, and follow-up work of health authorities for the following reasons: it is efficient, consistent

and accurate as shown in the trial results. During the trail period of June 19-October 23, 2008, a total of 1233 passengers were examined, and 20 were found DF-positive (34 confirmed by lab tests, and the results of 18 cases are consistent with the examination results of the CDC branch), while 1213 were DF-negative (1197 confirmed by lat tests). The RDBS consistency is 90% (18/20) and accuracy is 98.5% (1215/1233). Also, passengers will not need to take a second blood sample because RDBS uses only a small amount of blood sample taken for routine DF examination, and it takes only about 30 minutes for the results to come out. Quarantine personnel can immediately notify the responsible persons of relevant RDBS windows and the health authorities of any DF-positive cases by fax to make further arrangements.

3. Samples were selected from suspected cases who accepted RDBS and who can communicate in Chinese. However, foreign workers, foreign spouses and their children who need to travel to their native countries in Southeast Asia constitute the majority of imported DG cases. Most of them refuse to answer the questionnaire and the phone interview by claiming that DF is a common disease in their native countries. In this case, they will probably not get medical attention voluntarily and follow the physician's order until their disease is healed. From this perspective, it is necessary to step up DF health education to visitors from Southeast Asian countries.

4. Up to 78.0% of the respondents approve RDBS as meaningful as it provides instant results. In the open-ended question on the satisfaction with RDBS result waiting time, however, 98.84% of respondents replied that they cannot wait for the results as they are in a hurry; and

62.38% accept a 10-20-minute waiting time, suggesting that the RDBS lead-time exceeds the passengers' perceived reasonable time. As a result, quarantine personnel need to contact passengers who have arrived in Taiwan and left the airport to get immediate attention. These include those who will not follow the instructions, thus increasing the risk of endemic DF spread.

5. Though there is no legal reference that requires passengers to wait for the RDBS results at the airport for the time being, results of this study indicate that 61.67% passengers agree to cooperate with further arrangements, including isolation, prescribed by the public health authorities when the RDBS results show DF-positive. Therefore, following the existing quarantine standard operating procedures of Taoyuan International Airport, where suspected cases of Classes I and V statutory infectious diseases detected at the airport are admitted to the hospitals with the physician's order, if we can develop testers with a shorter examination time to encourage passengers to wait for the results at the airport, or if relevant supportive policies are established, it seems that immediate hospitalization of highly suspected DF cases will be possible.

6. Results of the study indicate that 87.67% of respondents understand clearly the modes of DF transmission. When compared with the result that 61.67% of respondents would accept isolation arrangements if they suspect they are infected by DF, this suggests that there is at least a 25% difference between infection knowledge and control actions (e.g. isolation or follow-up), and heath education can improve the situation.

7. In terms of professional skills of quarantine personnel and overall service, while modern people often reject some public policies because

they consider them as disruptive, passengers are hesitant or even refuse to cooperate with some airport quarantine measures, including collection of passengers' basic information and travel history, body temperature measuring, and even blood sample taking, as some of these may involve personal privacy issues and invasive medical procedures, even though they may be legally authorized. Therefore, personnel carry out their duties to serve passengers. As a result, more than 60% of respondents are satisfied and even strongly satisfied with the quarantine service. Among all 300 valid copies, only 2 respondents are unsatisfied or strongly unsatisfied with the questions asked by quarantine personnel. This is something encouraging.

8. According to the results, respondents are strongly unsatisfied with the overall examination environment and equipment, with 60% of respondents complaining about privacy protection during the examination, particularly examination site privacy, because they worry whether their conservation with quarantine personnel is overheard. In this case, it will be difficult to collect the full data of their travel history. Unfortunately, the airport quarantine station is shared with other departments, and there is no adequate space. Therefore, spatial re-planning is necessary to meet the privacy needs and to enhance the quality of examination hardware.

Results of this study indicate that passengers can accept RDBS and approve its value for early diagnosis. They are satisfied with the professional service of quarantine personnel, even though the waiting time for test results is considered too long in general. As most passengers are not sufficiently informed about RDBS, more publicity is needed. Given

that over half of the respondents would cooperate with further medical arrangements, including medical attention and isolation, competent authorities might develop supportive policies based on these results to enhance control efficacy. As most respondents are strongly unsatisfied with examination environment privacy, this should be the main concern of improvement in order to enhance the quality of the overall quarantine department and national image.

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