Acceptance towards social network information system for earlier detection of Influenza outbreak

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ABSTRACT

Introduction: Influenza outbreak causes high economic burden to Malaysia and other countries in South East Asia. Scientists have found a relatively new way to detect influenza outbreaks early thus reducing the burden of disease by early intervention. This new technology is a social network information system which uses Facebook or Twitter data to detect potential influenza cases. Such system is good to be developed by the Malaysian government as it can detect influenza outbreaks three weeks earlier than the normal pathway. However, to implement this we require good evidence that the development will be accepted by potential users.

Objective: This study was looking at the acceptance towards using social network information system among public health workers.

Materials and Method: This study was done on 205 Malaysian One Health University Network (MyOHUN) members through email and physical survey.

Results: Results show that 62.4% public health workers accepted the use technology. The acceptance was shown to be associated with performance expectancy ($p<0.05$). However, unlike the very famous Unified Theory of Acceptance and Use of Technology (UTAUT) model, the acceptance of social network information system was not associated with effort expectancy, social factors, facilitating conditions and socio-demographic factors. Therefore, it is suggested that social network information system be developed by the authorities in Malaysia, and be developed in a way that the system could strongly increase performance in detection of outbreak earlier than the current normal pathways. As such the system to be accepted and used, it must be sensitive, specific and be able to detect influenza outbreak early

Conclusion: The development of social network information system is feasible as it is highly accepted and it's potential to improve early detection of influenza outbreak.

KEYWORDS:
Social network information system, early detection, Influenza outbreak

INTRODUCTION

Recently, computer scientists have found ways to use social network data to provide a much earlier warning of potential outbreaks of influenza to warn workers in diseases the field of surveillance. Computer scientists collect data from social network provider such as Twitter and Facebook and process those data to eventually produce information that can alert epidemiologists about potential outbreaks two to four weeks earlier than the formal surveillance system could offer.[1]

As the social network information is able to locate the potential outbreaks, the surveillance staff can be instructed to examine animals (including birds and pigs) in the location indicated by the social network information.[2] This earlier checking of animals in affected areas will allow for: the killing of birds and pigs at the affected area quickly; reduce the overall extent of influenza thus preventing potential pandemic events; and to plan for vaccination of human and animals early, thus reducing the influenza spread.[3,4]

The development of social network information system for the purpose of disease surveillance is actively ongoing in developed countries including the United States of America, Canada, the United Kingdom and Japan. Most of the research on social network application in influenza surveillance however is done in North American countries (The United States of America and Canada).[5]

Developing social network information system for disease surveillance by the Malaysian government should not be initiated without the input from the end users who will be finally using it on a day-to-day basis. This is to make sure that the government does not invest in the failing project if it turns out that the workers will not accept to use the social network information system.

Assessing acceptance is really important to decide whether developing the social network in Malaysia will be useful. Doing acceptance measurement in this case is similar to doing a market research prior to developing and introducing a new product.[6] Without an appropriate feedback from the potential users, a company might over-value their products just to know at the end that their products are not adopted by users.

Development of a new technology is expensive.[7] To develop a social network information system requires continuous recruitment (and payment of salary) of several professional computer scientists, expert statisticians, medical epidemiologists and other support staff are needed. Hardware includes servers that costs around MYR 30,000 and

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warehouse rent that costs around MYR 1500 per month. Before a large capital is invested into such development, an acceptance study such as this one should be done so that the probability of investment loss is reduced.

The aim is to determine the rate of public health workers who accepted to use social network information system for the purpose of influenza detection; to assess the association between (a) socio-demography and acceptance; (b) performance expectancy and acceptance; (c) effort expectancy and acceptance; (d) social factors and acceptance; (e) facilitating conditions and acceptance; (f) system-specific knowledge and acceptance; among public health workers.

MATERIALS AND METHODS

Unified Theory of Acceptance and Use of Technology (UTAUT) model is the guide of our study design (Venkatesh, 2003).[8] In the original UTAUT model, there are four main effects that affect acceptance: performance expectancy (PE), effort expectancy (EE), social factors (SF) and facilitating conditions (FC). The original UTAUT model also has four effect modifiers: gender, age, experience and voluntariness.

Figure 1 below is a modified UTAUT model. Main effects: it consists of five main effects which includes system-specific knowledge in addition to the other main effects in the original UTAUT model (PE, EE, SF and FC). Effect modifiers: instead of having separate variable for age and gender as effect modifiers in our model, we simplified them as socio-demographic factors. Socio-demographic factors consist of not only age and gender but also race, education, income and work experience. Unlike original UTAUT model, we excluded experience and voluntariness from our framework due to irrelevance.

We removed experience of use from our study: the experiment done by Venkatesh was involving measurement in three different time. Due to measuring three times, the experience measured are increasing from the first until the third measurement. This increase in experience are regressed together with other variables to see its effect on acceptance. However, our study only involves one time measurement, and for that reason, the experience is not able to be measured in our study.

Voluntariness of use is removed from the original UTAUT model in this study because this study only measures mandatory usage of technology (technology obligated by management in organization) and has nothing to do with individual oriented technology.

In our study, the dependent variable is acceptance (intention to use), while the actual usage (AU) - as in UTAUT model - is not included in our study as dependent variable because the actual use of such technology is still impossible. Due to the exclusion of AU dependent variable from our study, facilitating conditions (FC) becomes unfit for this study. This is because based on original UTAUT model, FC only has direct effect on AU and no effect on acceptance (intention to use). However, despite it being irrelevant, we still retain the FC variable to be to be regressed against acceptance (intention to use) because we like to see if it has effects on acceptance.

The study was done by sending questionnaires through email to Malaysia One Health University Network (MyOHUN) members across Malaysia (including East Malaysia). The study design used is cross sectional. The reason for MyOHUN as target population is that MyOHUN members are involved directly or indirectly in zoonotic disease prevention. Thus, the result of this study could at some extent be generalized to the general Ministry of Health CDC workers involved in preventing zoonotic diseases in Malaysia.

Currently, it is difficult to make CDC workers as target population because the information of CDC workers are more difficult to obtain and it is less likely to isolate those who work in preventing zoonotic disease from those who are not. As our outcome is to assess the acceptance to use social network technology in preventing influenza, it is less valid to include those who do not involve in zoonotic disease prevention in the study. Thus, to filter out those who do not involve in zoonotic disease prevention, we decided to use MyOHUN members as target group as it consists of only those involved in zoonotic disease prevention.

Sample size calculation was derived from prevalence sample size formula (Naing et al, 2006).[9] Among the 500 MyOHUN members, 300 public health workers was selected through simple random sampling method. The questionnaires were emailed to the selected prospective respondents. Respondents answered the questions at Google form and data is automatically registered to Google database. The respondents were reminded not to share the Google Form with other people to prevent duplicates and fake answers and abuse by non-respondents.

Data collection and strategy

Respondents were explained about the structure of the system, its processes, the input required and the outcome from the system. Information sheets were given to the respondents before they answered the questionnaire. Respondents were also given the chance to ask the surveyor team members in case they have any enquiry regarding the system. Answers were standardized as surveyors were briefed of the system during a workshop.

Survey duration lasted for 1 month. At the beginning of the survey, three surveyors were given all the materials (information sheets, survey tools and consent forms in digital). The three surveyors approached all the respondents either through emails, Whatsapp application or during face-to-face meeting. The survey materials were distributed and surveyors answered questions when asked for any further information. All answers were standardized.

Study tools and validation

Respondents were asked a question whether they will accept to use the proposed technology. The answer in form of 'yes' or 'no' (categorical, dichotomous) was given. Respondents' expectancy on improvement in performance, effort, social and facilitating conditions were measured by using UTAUT-based questionnaire which has been validated for use in Malaysia.

Knowledge assessment questions was developed and was intended to measure the knowledge of 'Social Network Information in Influenza Prevention' that consists of 10

Table I: Descriptive analysis of acceptance and demography among public health workers

Description	n	Percentage (%)
Acceptance		
No (Did not accept)	77	37.6
Yes (Accept)	127	62.0
Missing value	1	.5
Gender		
Female	102	49.8
Male	103	50.2
Age (years)		
<30	40	19.5
30-39.9	65	31.7
40-49.9	62	30.2
50-59.9	33	16.1
>60	5	2.4
Race		
Malay	160	78
Indian	1	0.5
Chinese	44	21.5
Education		
Diploma	1	0.5
Degree	101	49.3
Master	73	35.6
PhD/DrPH	30	14.6
Income (RM)		
<5,000	22	10.7
5,000-9,999	72	35.1
10,000-14,999	74	36.1
>15,000	31	15.1
Not reporting income level	6	2.9
Experience (years)		
<10	64	31.2
10-19.99	60	29.3
20-29.99	62	30.2
>30	19	9.3

Table II: Score for performance expectancy, effort expectancy, social factors and facilitating conditions

Domains and Items	n	Mean	Std. dev.
Performance expectancy (PE)			
I would find the system useful in my job. (PE1)	204	3.93	1.585
Using the system enables me to detect potential influenza outbreak more quickly. (PE2)	204	3.77	1.573
Using the system increases my productivity (PE3)	204	3.83	1.459
If I use the system, I will increase my chances of getting raise (PE4)	202	3.44	1.435
Effort expectancy (EE)			
My interaction with the system would be clear and understandable (EE1)	204	3.96	1.48
It would be easy for me to become skillful at using the system. (EE2)	204	4.29	1.65
I would find the system easy to use (EE3)	204	4.70	1.52
Learning to operate the system for earlier detection of influenza outbreak is easy for me. (EE4)	204	3.95	1.55
Social Factors (SF)			
People who influence my behavior think that I should use the system for earlier detection of influenza outbreak. (SF1)	201	3.55	1.52
People who are important to me think that I should use the system for earlier detection of influenza outbreak (SF2)	200	3.56	1.56
Facilitating Conditions(FC)			
I have the resources necessary to use social network information system for earlier detection of influenza outbreak.	203	3.27	1.51
A specific person (or group) is available for assistance with social network information system difficulties	203	3.31	1.56

questions. The assessment was tested on 30 people (mostly the medical doctors in HUKM) for its discrimination ratio and difficulty ratio. The difficulty ratio was 0.43 and the discrimination ratio was 0.84. Kuder-Richardson (for internal consistency) index was 0.7.

Those participants included in this study were anyone officially registered with MyOHUN, according to MyOHUN membership record and anyone not officially registered with MyOHUN but had followed MyOHUN activities or programs at least once. Those should be excluded are: (1) administrative staff; (2) non-Malaysians (3) members under 20 years old or more than 65 years old. The exclusion criteria are those who are not currently involved in prevention or education or research in zoonotic diseases.

Ethical approval was granted by Universiti Kebangsaan Malaysia to conduct research from 28th September 2017 - 27th March 2018 (UKM PPI/111/8/JEP-2017-618).

Table III: Association between sociodemographic factors, performance expectancy, effort expectancy, social factors, facilitating conditions and acceptance

Factors	Acceptance		Independent T-test / X^2	p value
	Yes (n% or mean)	No (n% or mean)		
Gender				
Female	32 (31.7%)	69 (68.3%)	3.19	0.08
Male	45 (43.7%)	58 (56.3%)		
Race				
Malay	59 (37.10%)	100 (62.90%)	0.13	0.72
Other races	18 (40%)	27 (60%)		
Education				
Degree/Diploma	38 (37.3%)	63 (62.7%)	0.92	0.63
Master	30 (41.1%)	43 (58.9%)		
PhD/DrPH	9 (31%)	20 (69%)		
Income[a]	9571+5025	10236+3924	0.99	0.33
Age[a]	38.59+10.99	40.47+10.08	1.22	0.22
Experience[a]	13.68+10.38	16.01+8.99	1.64	0.10
PET[a]**	17.08+4.59	11.32	-8.56	< 0.01
EET[a]**	18.45+4.56	14.34+4.85	-6.09	< 0.01
SFT[a]**	8+2.82	5.63+2.56	-5.95	< 0.01
FCT[a]**	7.49+2.69	5.08+2.32	-6.53	< 0.01
Total Marks**	6.81+1.73	5.95+1.97	-3.27	< 0.01

[a] Independent T-test
**Significant

Table IV: Multiple Logistic Regression using Enter method

Factors	Wald	p value.	OR (95% CI)
Gender(1)	.18	.67	0.85 (0.40 - 1.80)
Age	.29	.59	0.99 (0.96 - 1.03)
EET	.78	.38	1.05 (0.94 - 1.17)
SFT	1.00	.32	0.89 (0.71 - 1.12)
FCT	3.25	.07	1.22 (0.98 - 1.52)
TotalMarks	1.92	.17	1.15 (0.94 - 1.41)
PET [categorical]	17.88	.01	
PET [score 13-15]**	14.91	.01	7.94 (2.77 - 22.72)
PET [score 16-18]**	7.39	.01	4.99 (1.56 - 15.92)
PET [score > 19]**	10.88	.01	22.97 (3.57 - 147.91)
Constant	3.36	.07	0.08

*Significant factor at p value <0.05

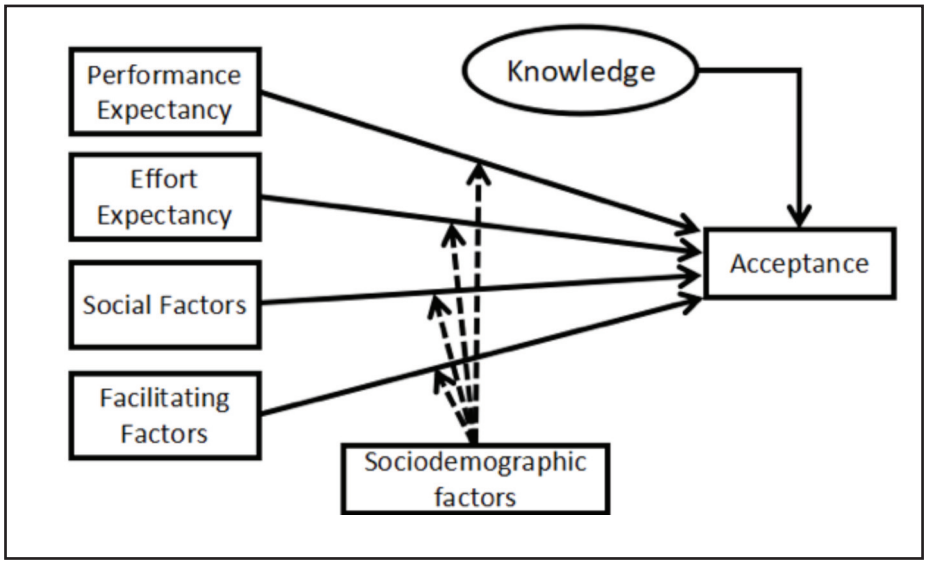

Fig. 1: Modified UTAUT model .

RESULTS

This cross sectional study was conducted among MyOHUN members nationwide. The data was obtained through Google Docs self-administered questionnaires. Response rate was 68.3% (205 out of 300 individuals responded to the research team's invitation).

At the onset of the study only about 180 individuals responded to the emails we sent to a list of 300 MyOHUN members (60% turnout ratio). To fulfil the minimum sample size of 196, we invited additional MyOHUN members who had attended seminar (Table Top Exercise) organized by MyOHUN to answer our survey form. We ended up with sample size of 205 respondents which satisfactoryily enough minimum sample size of 196 required for our study.[10]

This study shows that, 62.4% of public health workers accepted to use social network information system while a minority of 37.6% did not accept to use the technology. Among the respondents, one person did not answer the question which led to missing of 0.5% of data.

Among those who accepted to use the proposed technology, 78.8% were Malays, 20.5% Chinese and 0.8% Indians. Among them, 54.0% are female. Most of them (69.0%) works in Public Health while 8% of them are veterinary workers. Among those who accepted, 50.0% owns degree in any field, 34.0% has masters and 16.0% has PhD/DrPH. Most of those who accepted worked daily with influenza detection both in the office and field (58.0%) while 32.0% has not involved in both office and field work. Most of those who accepted to use the proposed technology is in the age group of 30 to 40 years old (37.8%) and had experience less than 10 years (37.8%).

For test of associations, gender, race and education level are in the form of categorical data. This combination with acceptance leads to a chi-square test. For test of associations for income, age and experience however, the data is in continuous form. This combination with acceptance leads to the use of independent Student's t test. From the tests done between gender, race, education, income, age and experience with acceptance, it was found out that they are all not significantly associated to acceptance with none of them have p value less than 0.05.

The table shows the significance of PET variable. Those with PET score of 13 to 15 is 7.93 more likely to accept the proposed technology compared to those with PET score of less than or equals to 12. Those with PET score of 16 to 18 is 4.99 more likely to accept compared to those with PET score of less or equals to 12. Those with PET score of more than 19 has the largest likelihood to accept the proposed technology (22.97 more likely to accept compared to those with PET score of less or equals to 12). Other variables were not significant with 95% confident interval crosses 1. The analysis also shows no interactions between variables.

DISCUSSION

The study shows that acceptance towards social network information system among MyOHUN members were more than 60%. Such percentage suggests that the majority of public health workers agreed to use the technology. Although not all of them agreed to use the technology, the percentage of acceptance can be made higher when the system is further structured according to the preference of users during its development.

The acceptance among MyOHUN public health workers were high enough when compared to the another study done recently on COVID 19. In a study by Anna Wnuk et al (2020),[11] when the respondents were asked to rate between 1 (strongly disagree) to 7 (strongly agree) whether they accept the implementation of social media surveillance for COVID 19. The average score resulted is 4.31 out of 7 (61.5%). The percentage of acceptance was similar to what we found in our study. However, we need to take precaution as both studies use different data form (continuous numerical versus categorical data)

Sociodemographic factors were found not to be associated with this acceptance. None of the factors (age, experience, income, gender, race and education) has p value less than 0.05 in the Student's T-test or Chi-square. Sociodemographic factors other than age and gender were not included in Multiple Logistic Regression to make analysis easier and they also were previously were found to be not significant by Venkatest in his UTAUT model. The two sociodemographic factors included in Multiple Logistic Regression (gender and age) were mentioned by UTAUT model to act as effect modifier or interactions.

However, after Multiple Logistic Regression was done, both gender and age was found to have no significant interactions with the main effects. This could possibly be due to the very specific target population (MyOHUN members) and very specific technology (social network information system) in this study. Unified Theory for Acceptance and the Use of Technology (UTAUT) model on the other hand was made based on general acceptance of any technology and used to predict acceptance in general population. Due to this fact, the UTAUT model predicted interaction between both gender and age to acceptance were not repeatable in this study.

Performance expectancy was found to be significant in simple logistic regression and multiple logistic regression. It was found out that performance expectancy is the only main effect that remained significant after running Multiple Linear Regression test. The importance of performance is so great due to the nature of job in the field of epidemiology and outbreak detection.

Public health workers consisted of health professionals who deal with influenza detection daily both in the office and in the field. Due to very demanding tasks, the professionals need to be very efficient in their jobs. As efficiency means producing greatest output with minimum input, their acceptance towards the technology also shaped in the way that only the technologies that increase their performance are accepted, while the technologies not effectively increasing performance are not accepted.

Our study also found that the higher the expectancy one has on the improvement of their performance after using social network information system, the more they are willing to accept it. This is explained by the value theory. As

performance increases, more output is produced by less input thus producing values through saving of costs. As saving of costs (in terms of money, time and labour) translates into profit, the willingness to pay for goods/service that enhances performance increases.[12] As willingness to pay is directly proportional to the probability of acceptance, the more the performance expectancy one has on social network information system, the more the likelihood of accepting it.

Effort expectancy, social factors, facilitating conditions and knowledge of social network information system was initially found to be significant using the Student's T-test and Simple Logistic Regression. However, as the variables were regressed together with other variables in Multiple Logistic Regression, the variables were found not to be significant. This suggested that the variables (effort, social factors, facilitating conditions and knowledge) are confounding factors.

This study was done on a specific population (MyOHUN members) for their acceptance of specific technology which has resulted in different model from a general UTAUT model. While UTAUT model provides a general guide for the acceptance of a technology, it does not specifically developed for the acceptance of social network information system for influenza detection and it does not target MyOHUN members.

This study has resulted in a specific model for the acceptance of social network information system among public health workers. The model is very simple with one independent variable (performance expectancy) and one dependent variable (acceptance). All other variables are excluded by multiple logistic regression due to no main effects and no interactions with acceptance. Acceptance among health professionals is seen as solely affected by performance expectancy. This is logical as these professionals are busy in every day job and would love something that increase their efficiency and performance.

Exclusion of most of UTAUT variables in multiple logistic regression and moderately strong pseudo-R^2 (0.42) means that the model is moderately predictive in determining the acceptance towards the proposed technology. This suggests that there are several other variables that are not explored and included in this study thus causing such pseudo-R2 value. This also means that UTAUT model that has been used to predict general technology acceptance is not the most suitable model to predict the acceptance of social network information system for early detection of influenza among public health workers. This could be due to very specific type of technology and very specific study population.

CONCLUSION

Based on this study the development of social network information system is feasible based on the percentage of people accepting to use the technology. The study also found that the acceptance towards such technology was affected by expectancy towards performance improvement after using the technology. Thus, in order to increase percentage of those accepting social network information system for earlier detection of influenza outbreak, the technology must be developed in a way that really improves performance and increase performance perception.

In order to develop a social network information system that really improves performance of surveillance units, research must be done to find the best filtering method for Twitter and Facebook posts so that the system is sensitive and specific (thus making it more effective). Developers also need to effectively communicate to each surveillance staff on how such technology could increase the performance of its users so that their perception will be good and they are more willing to accept and use the technology. This is because performance expectancy is the sole factor that influence the acceptance to use the technology and its influence is very huge.

It is suggested that the future studies be done by including more variables that are not covered in this study so that more associated variables will be discovered, greater pseudo-R^2 will be produced and more predictive model will be established.

CONFLICT OF INTEREST

All the authors declared no conflict of interest.

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REFERENCES

1. Aramaki E, Maskawa S, Morita M. Twitter catches the flu: detecting influenza epidemics using Twitter. InProceedings of the conference on empirical methods in natural language processing 2011 (1568-76). Association for Computational Linguistics.
2. Broniatowski DA, Paul MJ, Dredze M. National and local influenza surveillance through Twitter: an analysis of the 2012-2013 influenza epidemic. PloS one 2013; 8(12): e83672.
3. Clague B, Chamany S, Burapat C, Wannachaiwong Y, Simmerman JM, Dowell SF, Olsen SJ. A household survey to assess the burden of influenza in rural Thailand. Southeast Asian J Trop Med Public Health 2006; 37(3): 488-93.
4. Humphries-Waa K, Drake T, Huszar A, Liverani M, Borin K, Touch S, et al. Human H5N1 influenza infections in Cambodia 2005-2011: case series and cost-of-illness. BMC Public Health 2013; 13: 549.
5. Wilson K, Brownstein JS. Early detection of disease outbreaks using the Internet. Canadian Medical Association Journal 2009; 180(8): 829-31.
6. Kinnear TC, Taylor JR. Marketing research: an applied approach. McGraw-Hill Companies; 1987.
7. Baker P. From concept to consumer: how to turn ideas into money. FT Press; 2008 Oct 22.
8. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. MIS quarterly. 2003:425-78.
9. Naing L, Winn T, Rusli BN.Practical issues in calculating the sample size for prevalence studies Archives of orofacial Sciences 2006; 1: 9-14.
10. Kish L. Sampling organizations and groups of unequal sizes. Am Sociol Rev 1965; 30: 564-72.
11. Wnuk A, Oleksy T, Maison D. The acceptance of Covid-19 tracking technologies: The role of perceived threat, lack of control, and ideological beliefs. PLoS One 2020; 15(9): e0238973
12. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. Third edition, 2005: 32.