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## Original Research

# Influence of country of study on student responsiveness to the H1N1 pandemic

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## SUMMARY

**Objectives:** University students, both travelling abroad on holiday or exchange students entering a country, can serve as mobile carriers of infectious diseases during a pandemic, and thus require special attention when considering preventive measures. The objectives of this study were to evaluate student compliance and opinions on preventive measures of a university before and during an H1N1 influenza pandemic, and to explore environmental and behavioural factors that might contribute towards compliance.

**Study design:** Cross-sectional, self-administered questionnaire.

**Methods:** Local and foreign students attending an international summer school programme were invited to participate in a self-administered survey.

**Results:** Respondents complied with most of the preventive measures, excluding website viewing and mask wearing. Significant differences in compliance and perceived necessity were found amongst students from Singapore, Hong Kong and the USA. Singaporean students were significantly more likely to comply with all measures and consume antiviral medication in response to the pandemic than students studying in the US.

**Conclusions:** Students' responses towards university pandemic measures were largely positive, but sensitivity towards these measures varied between groups by country of study. This should be considered in further comparative studies.

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## Introduction

At the start of the H1N1 influenza pandemic in 2009, parallels were immediately drawn with the recent severe acute respiratory syndrome (SARS) epidemic, and Hong Kong's public health response was notably more draconian than in other locales. Whilst other countries' public health strategies were immediately focused upon mitigating the effects of a potential worldwide pandemic, Hong Kong's authorities initially

directed efforts towards disease containment and preventing community-wide spread. This was exemplified by the stringent quarantine of 300 guests at the hotel of the H1N1 influenza index case in the city.<sup>1,2</sup> Such an action was applauded by the public, who were shown to be adopting enhanced hygiene behaviours, continuously informed by daily press updates.<sup>3</sup> By June 2009, however, it was clear that community spread had occurred, and the Government moved into the mitigation phase of handling the pandemic with the objective

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of minimizing spread and reducing the potential disruptive effect of H1N1 influenza in the community.

One of the major means of H1N1 influenza transmission in the Hong Kong community was students coming home for the summer holiday from high-prevalence countries. Exchange students also served as a potential source of transmission. The Chinese University of Hong Kong was expecting students from a large number of countries to attend its international summer school programme. Due to the high-risk environment of the university, and pressure to comply with government recommendations during the containment phase, the Committee for Health Promotion and Protection (CHPP), established after the SARS outbreak, adopted a proactive approach to the potential risk of H1N1 influenza based upon the experience of SARS. All incoming students were informed of the community outbreak in Mexico and the USA, best practices in protective behaviours, and Hong Kong's first case on 1 May 2009. They were signposted to the CHPP website for further advice, and asked by summer school staff to record their daily temperatures on a health declaration form in the 7 days prior to their arrival on campus.<sup>4,5,6</sup> Upon arrival, the orientation programme included an update on H1N1 influenza in Hong Kong and a detailed description of campus-based precautionary measures. Such measures included temperature checkpoints that were set up outside classrooms and hostels with staff equipped with temperature guns, and the provision of free emergency safety packs containing face masks and disinfectant alcohol solution.

One week after the commencement of summer school, the first case of H1N1 influenza was confirmed among the summer school students, which eventually led to the suspension of classes after the third confirmed case. The summer school staff and the university's health centre held informational sessions the following day to alleviate student concerns about the outbreak. The antiviral medication Tamiflu was offered to all summer school students, and online courses were implemented for 1 week in order to minimize interpersonal contact. Seven additional cases were confirmed before the end of the 5-week summer school. All 10 cases, upon confirmation, were immediately isolated in either the school clinic or a quarantined section of the students' living quarters. The affected students were released after a 7-day isolation period.

These changing circumstances gave the authors the opportunity to assess compliance with precautionary advice prior to arrival at the summer school, as well as compliance with preventive measures during the summer school after confirmed cases of H1N1 influenza were reported among the summer school students. The objectives of this study were to evaluate student compliance and opinions on the university's preventive measures both prior to arrival and during an H1N1 influenza pandemic, and to explore various factors, both environmental and behavioural, that might contribute towards compliance with such measures.

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## Methods

Self-administered questionnaires were distributed at the end of the lecture sessions to all students attending over 20 classes

on Day 24 of the summer school. Trained research staff outlined the purpose of the questionnaire and instructions for its completion before dissemination. Written consent stating assurance of anonymity and voluntary participation was sought.

## Measures

The questionnaire was constructed using questions from a previous study and questions derived from the CHPP guidelines on the web.<sup>5,6</sup> Some items were modified in discussion with campus staff responsible for the planning and maintenance of the summer school to ensure comprehensiveness and appropriateness. The questionnaire consists of questions related to preventive behaviours before the students' arrival in Hong Kong as well as after the confirmation of campus cases. Students were also asked about their view on the necessity for precautionary measures and procedures after confirmed cases, along with their self-reported compliance with such measures.

## Data analysis

Data were analysed using Statistical Package for the Social Sciences version 16.0 (SPSS Inc., Chicago, IL, USA). In addition to descriptive results, Pearson's Chi-square tests were performed to identify statistically significant differences ( $\alpha = 0.05$ ) in behavioural and attitudinal responses within subgroups based on country of study. Respective odds ratios (OR) were also reported. Exploratory factor analyses were performed to extract factors that represent before-arrival behaviour and perceived necessity of measures. Factor loadings and respective Cronbach's alpha coefficients are displayed in Table 1. These factors and demographic items served as potential predictors for subsequent logistic regressions against students' likeliness to comply with all preventive measures and to consume Tamiflu, selected to reflect adherence to contingency measures.

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## Results

In total, 24 students withdrew from the programme before the start date of 30 June 2009 due to concerns about influenza. Among the 371 students who attended classes, nine refused to participate in the study and three did not complete the questionnaire, resulting in a response rate of 96.8% ( $n = 359$ ).

## Demographics

Students attending the summer school mainly came from Asian countries. Singaporean residents comprised the largest group (26.5%), followed by those studying in the USA (25.1%) and Hong Kong (23.1%), while 25.3% came from 19 other nations, such as China, Canada and Ireland. Of the students, 26.2% were over 23 years of age (median age 21 years). Gender distribution was balanced (51.8% males, 48.2% females). Of all students, 40.7% were legal residents of Hong Kong, but some (45.9%) within this group were studying outside Hong Kong.

**Table 1 – Factor analysis of before-arrival guidelines and perceived necessity of measures.**

	Factor loading
<b>I. Guidelines prior to arrival</b>	
Factor 1: Visited websites of health organizations (Cronbach's alpha = 0.918)	
Visited the Centers for Disease Control and Prevention website	0.849
Visited the World Health Organization website	0.848
Visited the Hong Kong Centre for Health Protection website	0.929
Visited CUHK's Health Promotion and Protection website	0.869
Factor 2: Offline, practice-based guidelines (Cronbach's alpha = 0.660)	
Washed hands with soap/disinfected them with alcohol solution	0.645
Checked and recorded daily temperature on the health declaration form	0.594
Kept a surgical face mask to hand at all times	0.592
Checked if covered by medical insurance and kept emergency contact numbers	0.702
Searched for and updated the emergency contacts in Hong Kong	0.531
<b>II. Perceived necessity</b>	
Factor 1: Temperature checkpoints (Cronbach's alpha = 0.817)	
Filling out health declaration forms	0.874
Requesting self-administered daily temperature checks prior to arrival	0.839
Checking temperature at the hostel and classrooms	0.664
Factor 2: Contingency measures (Cronbach's alpha = 0.852)	
Providing the choice to withdraw from the programme due to A(H1N1)	0.557
Providing safety packs for all students	0.702
Using online learning methods to continue classroom activities	0.687
Isolating students confirmed to have human swine flu	0.801
Quarantining close contacts of confirmed cases	0.780
Offering informational sessions about human swine flu with experts	0.617
Offering Tamiflu to students on a voluntary basis	0.528
CUHK, Chinese University of Hong Kong.	

### Compliance with recommended actions prior to summer school

Among 359 respondents, 72.1% had either come from another country or were returning home. These students responded to questions about precautionary measures they had been recommended to take before their arrival in the city. The majority (88.8%) of these students complied 'sometimes or always' with guidelines on hand washing and disinfection, and two-thirds (65.6%) complied with daily temperature checks for 7 days prior to arrival. In comparison, only a minority of respondents had used online resources to seek information on H1N1 influenza. Websites used included the US Centers for Disease

Control and Prevention (22.9%), the World Health Organization (24.8%), the Centre for Health Protection of Hong Kong (19.8%) and the CHPP (22.9%). Less than one-third (31.8%) of respondents kept a surgical face mask to hand, less than half (44.8%) had checked their medical insurance coverage and information, and only 37% had identified a contact in case of an emergency (37.0%).

### Compliance with preventive guidelines during summer school

The majority of students attending classes ( $n = 359$ ) complied with classroom-related precautionary measures, namely having their temperature checked before entering the classroom (94.4%) and sitting in the same seat (92.2%). Most also washed their hands or disinfected them regularly (89.1%). Of all students, 64.6% measured and recorded their own temperature for the first 7 days, and compliance was highest (85.3%) among those who also reported having recorded their daily temperature prior to arrival. Other preventive measures showed lower compliance, with only 46.5% carrying a safety pack provided by the university, 47.9% wearing a face mask in crowded places, and 38.7% carrying the emergency contact card issued by the university. Only one-fifth of all students complied with all preventive measures.

### Attitudes towards university infection control measures

Most students viewed the university's pandemic control measures in a positive light. These measures consisted of filling out daily health declaration forms (61.6%), self-administered daily temperature checks prior to arrival (63.8%), temperature checks at hostels and classrooms (75.2%), providing the choice to withdraw from the programme without penalty (71.0%), and providing safety packs (73.0%). The majority of students who complied with self-administered temperature checks (71.8%) agreed that this particular measure was necessary. Contingency measures implemented upon the outbreak within the student body, such as isolating confirmed cases (84.9%), isolating those in close contact with confirmed cases (76.9%), delivering online courses (69.4%), offering informational sessions (71.9%) and offering Tamiflu (71.6%), were supported by most respondents. Once cases were confirmed, 58.5% of all students attended the informational sessions held. Almost half of all students (47.6%) picked up Tamiflu which was prescribed without cost. Among those who obtained Tamiflu, 70.2% took the drug.

### Differences in behaviours and attitudes by country of origin

Significant differences in behavioural practices and perceived need for precautionary measures were found amongst students studying in the different countries, as shown in Table 2. Students studying in Hong Kong were statistically less likely than those studying in the USA to measure their own temperature (OR = 0.35), wash their hands frequently (OR = 0.31) and attend informational sessions (OR = 0.25), but were more likely to carry the safety pack (OR = 2.19) and wear a face mask in crowded places (OR = 2.21). Students from Singapore were significantly more likely than US students to

**Table 2 – Association between country of study and differing factors on precautionary measures surrounding a pandemic (n = 359).**

Factors <sup>c</sup>	USA <sup>d</sup> (n = 90)		Hong Kong (n = 83)			Singapore (n = 95)			Other countries (n = 91)			
	$\chi^2$	% <sup>e</sup>	% <sup>e</sup>	Odds ratio	95% CI	% <sup>e</sup>	Odds ratio	95% CI	% <sup>e</sup>	Odds ratio	95% CI	
<b>Actual compliance</b>												
Measured own temperature for 7 days	30.735	70.4	45.6	0.30 <sup>a</sup>	0.15–0.61	83.0	1.35	0.57–3.22	76.7	1.15	0.55–2.38	
Kept provided safety pack with person	19.747	39.0	58.3	2.07 <sup>b</sup>	1.03–4.17	70.1	3.22 <sup>a</sup>	1.49–6.96	46.4	1.26	0.66–2.42	
Washed/disinfected hands frequently	11.002	94.3	83.8	0.31 <sup>b</sup>	0.10–0.93	94.7	1.14	0.25–5.15	92.0	0.66	0.19–2.29	
Wore face mask in crowded places	14.962	33.3	52.5	1.98 <sup>b</sup>	1.04–3.75	55.3	1.77	0.85–3.66	55.7	2.12 <sup>a</sup>	1.12–4.05	
Attended informational sessions on A(H1N1)	84.240	55.6	25.3	0.25 <sup>a</sup>	0.13–0.49	89.5	5.63 <sup>a</sup>	2.30–13.77	54.9	0.87	0.47–1.63	
<b>Necessity</b>												
Filling out health declaration forms	9.808	56.3	64.4	1.49	0.77–2.89	76.7	3.09 <sup>a</sup>	1.39–6.86	67.9	1.77	0.90–3.50	
Self-administering temperature checks	20.049	55.7	64.0	1.54	0.80–2.96	84.0	5.26 <sup>a</sup>	2.27–12.18	66.2	1.75	0.90–3.41	
Hostel/classroom temperature checking	21.961	70.5	81.8	1.98	0.92–4.25	91.5	5.42 <sup>a</sup>	1.94–15.12	73.8	1.18	0.57–2.44	
Providing safety packs	29.146	73.8	77.0	1.14	0.53–2.44	94.6	5.70 <sup>a</sup>	1.76–18.42	70.9	0.77	0.37–1.61	
Online courses in case of outbreak	28.222	62.4	76.6	1.74	0.85–3.56	90.3	4.04 <sup>a</sup>	1.53–10.69	68.8	1.07	0.53–2.15	
Quarantining close contacts of confirmed cases	20.937	70.1	77.9	1.43	0.68–2.98	95.7	8.33 <sup>a</sup>	2.40–28.92	82.5	1.80	0.83–3.93	
Holding informational sessions on A(H1N1)	21.283	77.0	59.2	0.40 <sup>b</sup>	0.20–0.81	88.2	1.84	0.70–4.82	80.0	1.07	0.49–2.33	
Offering Tamiflu to students	19.173	83.7	60.8	0.29 <sup>a</sup>	0.14–0.63	87.8	1.31	0.48–3.59	77.2	0.63	0.28–1.42	

CI, confidence interval.  
a  $P < 0.01$ .  
b  $P < 0.05$ .  
c Analyses are controlled for age and gender.  
d US students are the reference group.  
e % denotes % of positive responses to item.

carry the safety pack (OR = 3.67), wear a face mask in crowded places (OR = 2.47) and attend informational sessions (OR = 5.63). Students from countries beyond Hong Kong and Singapore were also more likely to wear face masks in crowded places (OR = 2.51) than students studying in the USA.

Students from Singapore were significantly more supportive than US students of precautionary measures, such as quarantining close contacts of confirmed cases (OR = 9.48), instituting online courses in the event of an outbreak (OR = 5.65) and providing safety packs to students (OR = 6.17), but US students were significantly more likely to view holding informational sessions (OR = 2.49) and offering Tamiflu (OR = 3.42) as necessary measures compared with Hong Kong students.

Table 3 provides results of logistic regression modelling to examine students' full compliance with all preventive guidelines during the summer school ( $\chi^2 = 82.02$ ,  $df = 11$ ,  $R^2 = 0.487$ ,  $P < 0.001$ ) and consumption of the antiviral drug Tamiflu ( $\chi^2 = 54.59$ ,  $df = 11$ ,  $R^2 = 0.286$ ,  $P < 0.001$ ). Students studying in Singapore were significantly more likely to comply fully with preventive guidelines during the summer school than US students (OR = 4.59). After controlling for demographic factors, students who complied with guidelines before attending the summer school were more likely to comply fully with similar measures upon arrival (OR = 1.36). In addition,

they were more likely to perceive the necessity for temperature checks as positive, whether self-administered or performed by staff, leading to a higher likelihood of full compliance with summer school measures (OR = 1.48).

Male students were more likely to take the provided Tamiflu than female students (OR = 2.43) and students studying in Singapore were more likely to take Tamiflu (OR = 2.68) than US students. After controlling for demographic factors, students who had complied with before-arrival guidelines (OR = 1.19) and who perceived the need for contingency measures, such as isolating confirmed cases and offering prophylaxis (OR = 1.16), were more likely to take Tamiflu.

## Discussion

This study investigated compliance with preparedness measures and response to an outbreak of influenza H1N1 influenza amongst summer school students from abroad at an early stage of the pandemic. Prior to arrival on campus, most summer school students reported complying with a number of infection control measures, such as hand washing and temperature checks, but they were less likely to seek

**Table 3 – Associations between compliance of university students with preventive guidelines and affecting factors.**

Factors	Complete compliance		Tamiflu consumption	
	Odds ratio	95% CI	Odds ratio	95% CI
Gender	<i>n</i> = 198; <i>R</i> <sup>2</sup> = 0.49		<i>n</i> = 226, <i>R</i> <sup>2</sup> = 0.29	
Female	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>
Male	1.10	0.46–2.65	2.43 <sup>a</sup>	1.26–4.71
Age (years)				
17–20	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>
21–22	1.11	0.33–3.77	0.48	0.21–1.06
≥23	0.82	0.20–3.34	0.51	0.19–1.38
Country of study				
USA	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>
Hong Kong	1.24	0.14–11.06	0.33	0.07–1.58
Singapore	4.59 <sup>b</sup>	1.13–18.68	2.68 <sup>b</sup>	1.04–6.91
Other	2.80	0.72–10.89	1.52	0.65–3.59
Hong Kong residency				
No	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>	— <sup>c</sup>
Yes	0.56	0.12–2.69	0.46	0.17–1.29
Compliance with guidelines prior to arrival				
Viewing health organization websites	1.21 <sup>a</sup>	1.05–1.39	0.95	0.85–1.06
Offline, practice-based guidelines	1.36 <sup>a</sup>	1.15–1.61	1.19 <sup>a</sup>	1.07–1.33
Opinions on necessity of measures				
Temperature checkpoints	1.48 <sup>a</sup>	1.12–1.97	0.79 <sup>a</sup>	0.67–0.94
Contingency measures	1.00	0.87–1.15	1.16 <sup>a</sup>	1.05–1.29

CI, confidence interval.

a *P* < 0.001.b *P* < 0.05.

c Reference.

additional information about H1N1 or to think of needing emergency coverage, and only one-third had ready access to face masks, mirroring findings from previous studies.<sup>7,8,9</sup> At the summer school, the students were generally compliant with and supportive of the measures being taken when the first case occurred, despite the inconvenience of online classes and curtailment of student activities. This finding is reassuring to university authorities with responsibility for student welfare, implying reasonable compliance by all students with the steps that were taken. However, different response patterns were observed dependent on country of study. Singapore, Hong Kong and US students each comprised approximately one-quarter of the summer school students, although nearly half (40.7%) of all students were of Hong Kong origin. Each of these three countries of study had taken a different approach to the threat of the pandemic, which was in its earlier stages at the time of the summer school. Both Hong Kong and Singapore had adopted containment strategies, influenced by factors such as their experiences of SARS, the global nature of their cities, pneumonia being a primary cause of death amongst citizens, and the ever-present threat of avian flu to their relatively small and highly mobile populations.<sup>10,11</sup> At this stage of the pandemic the Singaporean strategy on pandemic response was more rigorous than that of Hong Kong, but both were more stringent than that of the USA. Since SARS, the Singaporean Government had developed plans to enforce community mitigation measures against emerging infections. A centralized, structured pandemic preparedness regime has been constructed which includes

the designation of pandemic preparedness clinics throughout the country, the establishment of contact tracing and quarantining guidelines, and widespread dissemination of health promotion materials related to preventing spread of influenza.<sup>12,13</sup> Such measures were also planned and implemented within Hong Kong.<sup>14</sup> The different behavioural responses mirrored those of the SARS period to some extent when, despite disruptions to daily life, there was widespread support amongst the population for the policies and contingency measures, although Singapore based students demonstrated a higher frequency of self-administered preventive measures than Hong Kong based students during that period.<sup>15</sup>

Prior to the students' arrival in late June, Singapore remained in a late containment phase, focusing on contact tracing, hospital isolation and home quarantine before the transition to mitigation in early July. Thus, the finding that students studying in Singapore were more likely than US students to wear face masks, carry information in case of need of an emergency contact and attend informational sessions is not entirely unexpected. Wearing face masks is more common in Eastern cultures, which may contribute to the greater likelihood of wearing/carrying a face mask and having an emergency contact amongst Hong Kong students. Overall, those students studying in Singapore were the most compliant with infection control advice, as well as being supportive of precautionary measures and taking Tamiflu. Differing levels of compliance may be related to the specific policy responses of the student's home country. For instance, the health system of the USA, where state health departments exist as autonomous entities from federal-level agencies such as the

CDC and the Department of Health and Human Services, demonstrated a much less uniform and more decentralized response to H1N1. Community response plans for pandemics varied among states in surveillance techniques, home quarantining and community interventions.<sup>16</sup> Attempts to centralize the response system by appointing a director for pandemic preparedness in the executive office were largely ignored in lieu of an assistant secretary of health and human services providing broad recommendations and appropriations towards state health departments, rather than playing a conglomerate role.<sup>17,18</sup> In addition, the close proximity between the initial outbreak in Mexico and the USA meant rapid spread, with a large number of US cases in a short period, forcing the Government to proceed immediately to a mitigation policy in late April, aiming to minimize the effects of infection rather than attempting to target and shut down its spread.<sup>19</sup> Thus, students arriving from the USA are likely to have been exposed earlier to mixed messages of the severity of the H1N1 pandemic, which may partially explain their lower compliance with campus measures, deeming them to be less useful.

While the Hong Kong Government shares a similar system with Singapore in terms of pandemic response, the study results show that Hong Kong-based students were less likely to practice certain measures and perceive contingency measures as necessary compared with students from the USA. Unlike Singapore, the Hong Kong Government transitioned to mitigation on 11 June 2009 upon the first local cases of H1N1 influenza in the city.<sup>20</sup> Daily press updates and information about the virus were displayed in all forms of the media in the city. At the time of the survey on 23 July 2009, the number of influenza H1N1 cases in Hong Kong stood at 2207 with one death.<sup>21</sup> The low mortality rate and the move to mitigation might have, at that time, alleviated concerns about the pandemic within the local population. In addition, local students may have been supported by an extended support network beyond the university, leading to a lesser sensitivity towards its guidance.

This study has some limitations. First, although the events surrounding the study provide a certain degree of representation on how students would react to precautionary measures related to a pandemic, the results may not demonstrate how students would react to a pandemic preparedness plan without the existence of an ongoing pandemic. Although they were visiting a city known to have been affected by several epidemics over the past decades, an examination of the perception of students studying in a locale that had not experienced the full brunt of many large-scale epidemics may yield substantively different results. Other limitations include possible self-reporting bias due to social desirability, and the use of cross-sectional data which does not provide clues of trends. Future studies assessing behavioural compliance with similar preventive measures within a campus setting would provide additional data for comparison.

Lessons from SARS taught universities the need to be proactive and responsive to government policies in managing emerging new diseases. For example, under its Healthy University Initiative CUHK has a designated website and university wide committee. This study shows that students are generally responsive to advice to comply with precautionary measures, and respond well to emergency measures

taken when the disease occurs in their community. However, their response was influenced by their country of study, both for precautionary behaviour prior to the summer school and to response during the outbreak of H1N1. In both cases, students from Singapore were the most compliant and those from the USA were the least compliant. The impact of government policy on student behaviour should be taken into account in the management of future similar pandemic situations.

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Research Ethics Committee of the Chinese University of Hong Kong.

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## Competing interests

None declared.

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