



Demographic and attitudinal determinants of protective behaviours during a pandemic 2011

Scientific Evidence Base Review

Determinants of protective behaviours

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Demographic and attitudinal determinants of protective behaviours during a pandemic

Scientific Evidence Base Review

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At the end of 2009 a review of demographic and attitudinal factors associated with protective behaviours during a pandemic was carried out. This was published in January 2010 (Bish and Michie 2010). This paper represents an update to that review.

This review was commissioned by the Department of Health in October 2010. The document was subsequently reviewed and endorsed by the Scientific Pandemic Influenza Advisory Committee (SPI).

It is anticipated that additional informative studies in this area will be published over the course of 2011 and 2012. The review will therefore be updated periodically to reflect any additions to the scientific literature that might alter any of its conclusions.

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1. Introduction

At the end of 2009 a review of demographic and attitudinal factors associated with protective behaviours during a pandemic was carried out. This was published in January 2010 (Bish and Michie 2010)¹. In November 2010 this review was updated with studies meeting the study inclusion criteria which had been published in the intervening year. This report briefly summarises the original review findings and supplements them with the findings from the updated review (this report should be read in conjunction with the original review).

To reduce the likelihood of infection and transmission of disease during a pandemic it is important to understand factors that influence how people behave. The aim of the original review paper was to bring together evidence of demographic and attitudinal factors associated with protective behaviours during a pandemic and to place these empirical research findings within conceptual frameworks in order to more readily apply them to policy and practice. The aim of the updated review was to establish whether the findings from the original still held.

Bish and Michie (2010) classified the protective behaviours carried out in response to an influenza pandemic into three types: preventive (e.g. hygiene behaviours, mask wearing), avoidant (e.g. avoiding work, complying with quarantine) and management of disease behaviours (e.g. taking medication). These three categories of behaviour are also used in the updated review.

2. Method

Both the original review and the update used the same method. The following search terms were entered into Web of Science and PubMed databases: SARS, avian influenza/flu, H5N1, swine influenza/flu, H1N1, pandemics. In addition, forward searching of the identified references was carried out. Additional references for the original review were provided by the UK's Scientific Pandemic Influenza Advisory Committee (Behaviour and Communications subgroup). Studies were included in the reviews if they reported associations between demographic factors, attitudes and intentions or behaviour. See Bish & Michie (2010) for full inclusion and exclusion criteria.

3. Results

Overview

Bish and Michie (2010) identified 26 papers, comprising 20 studies, which met the study inclusion criteria. All but three lacked an explicit theoretical framework. Nearly all (N=24) were cross sectional in design and therefore not predictive over time. Twenty of the studies were conducted during a disease outbreak, while six studies analysed intentions to behave in the event of an outbreak. Only three studies examined the mediating role of attitudes and beliefs in the relationship between demographic factors and behaviour. Twenty-two of the studies concentrated on factors associated with carrying out preventive behaviours, while 13 focussed on avoidant behaviours and 10 on management of disease behaviours².

In the updated review 24 studies met the inclusion criteria. Twelve of these examined intentions or behaviour regarding having a vaccination against pandemic influenza, and the results of these are reported in a separate evidence based paper (*Bish, Yardley and Michie. Factors associated with uptake of vaccination against pandemic influenza: A review of the scientific evidence*). Of the 12 studies included in this report, eight were carried out during the H1N1 2009 pandemic; three focused on anticipated or actual behaviour during an outbreak of avian influenza and one focused on reported willingness to comply with behaviours in the event of a pandemic outbreak (see Table 1). Eleven were cross sectional in design (two of these consisted of a series of consecutive studies) and one was longitudinal. Only one study was based on an explicit theoretical framework.

The original review found that there were demographic and attitudinal differences in behaviour. For example, being older or female was associated with a higher chance of carrying out the behaviours. There was also evidence that higher levels of perceived susceptibility to and perceived severity of the diseases and stronger beliefs in the benefit of the behaviours were associated with behaviour. In addition, it was found that higher rates of anxiety and more trust in authorities were associated with behaviour.

¹ Bish, A. and S. Michie (2010). "Demographic and attitudinal determinants of protective behaviours during a pandemic: A review." *Br J Health Psychol* 15(Pt 4): 797-824.

² These add up to more than 24 as some studies examined more than one type of behaviour

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The results from the 12 additional studies in the updated review are broadly in line with those found from the original review of 26 studies. Both demographic factors, such as age and educational level, and psychological factors, such as perceptions of risk and beliefs about the efficacy of preventive and avoidant behaviours, are found to be associated with reported intentions and behaviour. These results are described in more detail below.

Association between demographic factors and protective behaviours

Age

The original review found that on the whole older age was associated with a greater chance of carrying out preventive and avoidant behaviours, however some results differed. For example, studies carried out during the 2009 H1N1 influenza pandemic found that younger people were more likely to be compliant. Some studies found that levels of perceived susceptibility to disease mediated the influence of age, with older people perceiving themselves to be more susceptible than younger people did.

The updated review revealed additional findings which are consistent with some of the previous review's findings that being older is associated with preventive and avoidant behaviours. None of the new studies investigated the mediating effects of attitudes on the effect of age on behaviour.

Cross sectional studies carried out in the Netherlands, Australia, Saudi Arabia and Hong Kong found that being older was associated with precautionary behaviour such as using a face mask and frequent hand washing during an anticipated pandemic outbreak (Taylor, Raphael et al. 2009) or an outbreak of avian flu (de Zwart, Veldhuijzen et al. 2010; Lau, Tsui et al. 2010) or during the H1N1 2009 pandemic (Taylor, Raphael et al. 2009; Balkhy, Abolfotouh et al. 2010; Lau, Griffiths et al. 2010; Liao, Cowling et al. 2010). A longitudinal study carried out in the UK found that younger people were less likely to report that they carry tissues with them as a result of the outbreak of H1N1 influenza (Rubin, Potts et al. 2010).

Older age has also been found in studies carried out in the Netherlands, Australia and India to be associated with carrying out avoidant behaviours such as avoiding large gatherings, restricting travel and isolating oneself (Kamate, Agrawal et al. 2009; Taylor, Raphael et al.

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2009; de Zwart, Veldhuijzen et al. 2010). Cross sectional studies carried out in the USA and Australia found that being older was associated with greater intention to comply with quarantine restrictions during the 2009 H1N1 influenza pandemic (Eastwood, Durrheim et al. 2010) and in the event of an outbreak of avian influenza (Bass, Ruzek et al. 2010).

Gender

The results from the original review showed that when a difference was found women were more likely than men to carry out the behaviours. However, some studies found no evidence of an influence of gender on behaviour.

Findings were mixed from the updated review. In line with previous findings cross sectional studies carried out in Hong Kong and Australia during the H1N1 pandemic found that women were more likely to carry out hand washing behaviour and wear face masks than men (Lau, Griffiths et al. 2010; Liao, Cowling et al. 2010; Van, McLaws et al. 2010). A longitudinal study carried out in the UK found that women were more likely to report carrying tissues with them and having bought antibacterial gel than men (Rubin, Potts et al. 2010). Neither this study nor that carried out by Liao and colleagues found any gender differences for avoidant behaviours.

A cross sectional study carried out in the US found that women were more likely than men to report that they would comply with quarantine restrictions in the event of an avian flu outbreak (Bass, Ruzek et al. 2010). Similarly a cross sectional study carried out in Australia during the H1N1 2009 outbreak found that women were more likely to report an intention to comply with quarantine (Eastwood, Durrheim et al. 2010).

However, in contrast to these and earlier studies, men were more likely than women in Saudi Arabia and India to use face masks and comply with hand hygiene recommendations (Kamate, Agrawal et al. 2009; Balkhy, Abolfotouh et al. 2010), and to avoid crowds and public transport (Kamate, Agrawal et al. 2009). Men in Hong Kong were more likely than women to use antiviral drugs (Griffiths, Wong et al. 2010).

Studies carried out in the Netherlands, Australia and Hong Kong found no gender differences in self-reported behaviour to reduce the chances of contracting avian influenza (de Zwart,

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Veldhuijzen et al. 2010; Lau, Tsui et al. 2010) or in willingness to wear a face mask and isolate oneself in the event of an outbreak of pandemic influenza (Taylor, Raphael et al. 2009).

Ethnicity

The original review found insufficient evidence to draw any firm conclusions about the influence of ethnicity on behaviour. However, the updated review provided evidence that being from an ethnic minority is usually associated with greater compliance with preventive behaviours. A longitudinal study in the UK found that people from ethnic minorities were more likely to report carrying tissues with them, buying antibacterial gel and avoiding public transport as a result of the H1N1 2009 pandemic (Rubin, Potts et al. 2010). A study carried out in the Netherlands found that non-Dutch respondents were more likely to report having carried out various protective and avoidant behaviours against avian influenza (de Zwart, Veldhuijzen et al. 2010). A study carried out in Hong Kong during the H1N1 2009 pandemic found that students from Singapore were more likely to be compliant with behavioural recommendations such as frequent hand-washing, face mask use and taking antiviral medication than students from the USA (Griffiths, Wong et al. 2010). A cross sectional study carried out in Australia during the H1N1 2009 pandemic found that Asian people were likely to have carried out more protective and avoidant behaviours than other ethnic groups (Van, McLaws et al. 2010). This study also found that Asian respondents were more anxious and perceived a greater susceptibility to influenza which might explain this finding.

In contrast to these studies, a cross sectional Australian study found that being a non-English speaker was related to a reduced willingness to isolate oneself in the event of a pandemic influenza (Taylor, Raphael et al. 2009).

Educational level

The original review showed that whilst some results were inconclusive, being more educated tended to be associated with a greater likelihood of taking protective and avoidant behaviour during a pandemic.

A similar pattern of results was found from the updated review. Studies carried out in Australia, Saudi Arabia and Hong Kong found that those who were better educated were more likely to anticipate carrying out protective behaviours such as respiratory hygiene and mask wearing in

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the event of a pandemic (Taylor, Raphael et al. 2009) or during the H1N1 2009 pandemic (Taylor, Raphael et al. 2009; Balkhy, Abolfotouh et al. 2010; Lau, Griffiths et al. 2010) and to intend to comply with quarantine restrictions during the H1N1 pandemic (Eastwood, Durrheim et al. 2010).

In contrast a cross sectional study carried out in the Netherlands found that those with lower educational attainment were more likely to report a variety of behaviours in response to avian influenza such as not going to areas affected with avian influenza, avoiding gatherings and paying more attention to personal hygiene (de Zwart, Veldhuijzen et al. 2010).

Marital status

The influence of marital status on behaviour was not assessed in many studies and the original review found inconclusive results. However, two studies in the updated review found that being married was associated, in Hong Kong during the H1N1 2009 pandemic, with hand washing more frequently than usual and wearing a face mask in public (Lau, Griffiths et al. 2010) and, in Australia, with willingness to isolate oneself in the event of an outbreak of pandemic influenza (Taylor, Raphael et al. 2009).

Psychological factors associated with carrying out the behaviours

Perceived susceptibility

The original review found substantial evidence of positive associations between perceptions of being at higher risk and carrying out preventive behaviours.

Further evidence from the updated review supported the importance of perceptions of susceptibility to disease on behaviour. A cross sectional Australian study found that individuals who felt more concerned about developing pandemic influenza were more willing to wear a face mask (Taylor, Raphael et al. 2009). Cross sectional studies carried out in the Netherlands and Hong Kong also found that those who felt susceptible or vulnerable to developing avian flu, or who thought an outbreak was likely, were more likely to carry out protective behaviour (de Zwart, Veldhuijzen et al. 2010; Lau, Tsui et al. 2010).

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A longitudinal UK study found that those individuals who reported that they were generally in poor health were more likely to report carrying tissues and having bought antibacterial gel (Rubin, Potts et al. 2010).

Two Australian studies found that individuals who felt more concerned about developing H1N1 influenza or pandemic influenza were more willing to isolate themselves (Taylor, Raphael et al. 2009) or comply with quarantine restrictions (Eastwood, Durrheim et al. 2010). Cross sectional studies carried out in the Netherlands, the USA and Hong Kong have found that those who felt a personal susceptibility to avian flu or who believed that their family was at risk were more likely to intend to be compliant with quarantine restrictions (Bass, Ruzek et al. 2010) or to carry out avoidant behaviour such as cancelling holidays to areas where there was avian influenza and avoiding large gatherings (de Zwart, Veldhuijzen et al. 2010; Lau, Tsui et al. 2010).

In contrast a cross sectional study carried out in Saudi Arabia during the H1N1 pandemic found no association between levels of concern and compliance with precautionary recommendations including face mask use and more frequent hand washing (Balkhy, Abolfotouh et al. 2010).

Worry and distress

Worry and distress were not specifically examined in the original review. However, the updated review found evidence of the effect of these on behaviour. A recent longitudinal population study (Rubin, Potts et al. 2010) assessed the effect of Government and media communication on beliefs, emotions and self-reported behaviours during the 2009 swine flu outbreak using an analysis of telephone surveys of 1000 people across the UK, weekly since the outbreak began. Results showed that those who were more concerned about swine flu were more likely to report having carried tissues with them and bought antibacterial gel. Those who were more worried about H1N1 influenza were also more likely to have avoided public transport. A cross sectional study carried out in Hong Kong found similar results with those more worried about H1N1 influenza being more likely to carry out a variety of social distancing behaviours (Liao, Cowling et al. 2010).

A cross sectional study carried out in Hong Kong during the H1N1 pandemic found that those who reported greater mental distress due to the outbreak were more likely to report washing

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their hands more frequently than usual and wearing a face mask in public (Lau, Griffiths et al. 2010).

Perceived severity of disease

On the whole the original review found that greater perceived severity of the diseases (such as its infectivity or the chances of dying from it) was associated with a higher chance of carrying out behaviours.

The updated review found further evidence that underlines the importance of a perception that the disease is severe on behaviour. Perceptions of H1N1 as a severe disease were found in a study in Hong Kong to be associated with hand washing behaviour, and a belief that it is fatal was associated with intentions to wear a face mask in public (Lau, Griffiths et al. 2010). A study of beliefs about avian influenza amongst Hong Kong Chinese respondents found that those who thought that avian influenza was more severe than SARS were more likely to anticipate that they would wear a face mask and wash their hands more frequently (Lau, Tsui et al. 2010).

Cross sectional studies in Australia and India have found that those who believed that H1N1 influenza was severe and would have adverse health effects were more likely to have carried out a variety of avoidance behaviours such as cancelling social events, reducing time spent on public transport and taking time off work (Kamate, Agrawal et al. 2009; Van, McLaws et al. 2010). Cross sectional studies in Australia found that a belief that H1N1 influenza or avian influenza are severe was associated with intention to comply with quarantine restrictions (Bass, Ruzek et al. 2010; Eastwood, Durrheim et al. 2010; Lau, Tsui et al. 2010).

Studies carried out in Hong Kong have found that believing that there is no vaccine against avian or H1N1 influenza or antiviral drugs available to treat the disease is associated with a greater chance of carrying out a variety of preventive and avoidant behaviours (de Zwart, Veldhuijzen et al. 2010; Lau, Griffiths et al. 2010; Lau, Tsui et al. 2010), such as wearing face masks, more frequent hand washing and avoiding crowds.

Perceived efficacy of behaviour

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The original review found that a greater perceived efficacy of behaviours to protect them against the disease was associated with uptake of various protective behaviours.

The updated review found further evidence consistent with the original findings. A longitudinal study carried out in the UK found that those who thought that use of tissues and antibacterial gel were efficacious in helping to prevent H1N1 influenza were more likely to report carrying tissues with them and having bought antibacterial gel in response to the H1N1 pandemic outbreak (Rubin, Potts et al. 2010). A cross sectional study in Hong Kong found that a belief in the efficacy of hand washing and face mask use to control H1N1 influenza was associated with hand washing more frequently and wearing a face mask in public (Lau, Griffiths et al. 2010). Similarly, a study in India found that those individuals who had a positive attitude towards preventive behaviours such as washing hands with soap more often and disinfecting the home were more likely to report doing these during the outbreak of H1N1 pandemic influenza (Kamate, Agrawal et al. 2009).

A longitudinal UK study found that those who thought that avoiding public transport was efficacious in controlling H1N1 influenza were more likely to report that they had done this in response to the H1N1 influenza pandemic (Rubin, Potts et al. 2010). A positive attitude towards avoidant behaviours such as cancelling social events, reducing the use of public transport and taking time off work was found by a cross sectional study in India to be associated with having done these things during the H1N1 influenza pandemic (Kamate, Agrawal et al. 2009).

A cross sectional study carried out in Hong Kong during the H1N1 pandemic found that those students who believed that preventive measures (hand washing, face mask use, antiviral use) were necessary were more willing to take Tamiflu in the event of developing the disease (Griffiths, Wong et al. 2010).

Perceived costs of behaviours

The evidence from the original review suggested that individuals perceiving the protective behaviours to be personally costly were less likely to carry them out. Perceived costs as assessed in the studies included both practical barriers such as the behaviour being time consuming and also emotional barriers such as fear of side effects of medication or

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vaccination. None of the studies in the updated review assessed the influence of perceptions of costs of the recommended behaviours on intentions or behaviour.

Perceived self efficacy

The evidence from the original review was mixed with some studies finding an association and some finding no association between perceived self-efficacy (i.e. how capable the individual felt they were of carrying out the recommended behaviour) and behaviour.

The updated review identified a cross sectional study carried out in Hong Kong during the H1N1 pandemic which found an association between greater self efficacy to perform hand hygiene behaviours and reported behaviour (Liao, Cowling et al. 2010). In addition, a cross sectional study carried out in the Netherlands found an association between a greater perceived self efficacy to carrying out both preventive (e.g. buying a face mask) and avoidant (e.g. avoiding large gatherings, cancelling holidays to places where there was avian influenza) behaviours and reporting having done these things in response to avian influenza (de Zwart, Veldhuijzen et al. 2010).

Social norms

The original review found some evidence of the influence of social norms (i.e. beliefs about what others do and expect you to do) on carrying out protective behaviour. None of the studies identified by the updated review examined the effect of social norms on intentions or behaviour.

Cues to action

The original review found some evidence that experience of symptoms (i.e. an internal cue to action) was associated with adopting precautionary behaviours. None of the studies identified in the updated review examined the influence of cues to action on reported intentions or behaviour.

State Anxiety

The original review found that individuals with higher levels of general anxiety (measured by the State-Trait Anxiety Inventory; Spielberger et al 1973) were more likely to undertake

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protective behaviours. None of the studies identified in the updated review examined the influence of levels of general anxiety on reported intentions or behaviour.

Perceptions about communications from authority

The original review found evidence that believing that the authorities were being open in their communication with the public was associated with a greater likelihood of compliance with behaviour. Furthermore individuals were more likely to undertake precautionary behaviours if they had greater trust in the authorities' ability to control the disease spread. Compliance with behavioural recommendations was adversely affected if individuals felt the information was inconsistent as this led to them questioning its credibility.

The updated review identified a cross sectional study carried out in Hong Kong which found that levels of perceived self efficacy to carry out behaviours mediated the positive association between trust in formal sources of information (such as the government and the media) and hand hygiene and social distancing behaviour (Liao, Cowling et al. 2010). In addition they found that levels of worry about developing H1N1 influenza mediated the positive association between trust in informal sources of information (friends and family) and hand hygiene and social distancing behaviour (Liao, Cowling et al. 2010).

Knowledge

The original review found some evidence that greater knowledge about the diseases was associated with greater adoption of precautionary behaviours. Misconceptions and lack of knowledge were also important. However, the evidence was mixed as other research found no association between knowledge and behaviour.

The updated review found further evidence of the influence of knowledge levels on behaviour. Cross sectional studies carried out in Saudi Arabia, India and Hong Kong found that greater knowledge about H1N1 influenza was associated with hand-washing and face mask wearing (Kamate, Agrawal et al. 2009; Balkhy, Abolfotouh et al. 2010; Liao, Cowling et al. 2010) and a variety of avoidance behaviours such as cancelling social occasions and avoiding public transport (Kamate, Agrawal et al. 2009; Liao, Cowling et al. 2010). A cross sectional study about avian influenza carried out in the USA found that those who were more knowledgeable were more likely to comply with quarantine restrictions (Bass, Ruzek et al. 2010).

In contrast studies carried out in the Netherlands and Hong Kong about precautionary behaviour in relation to avian influenza found that those who were *less* knowledgeable were more likely to adopt the behaviours (de Zwart, Veldhuijzen et al. 2010; Lau, Tsui et al. 2010). This is in keeping with the findings of Lau et al (2006) included in the original review.

4. Discussion

The results of the updated review are broadly consistent with the original review. The only result which varies from the original is the finding that men are more likely to carry out some behaviours than women from studies conducted in Saudi Arabia and India (no studies in the original review were carried out in either country). Theories of behaviour such as the Health Belief Model, Theory of Planned Behaviour, Protective Motivation Theory and the Common Sense Model of Illness provide explanatory models of how people react to a threat to their health and can help to explain the pattern of results. Appendix 1 gives more detail of these theories. See Bish & Michie (2010) for a full discussion and setting of the results within a theoretical framework.

The studies included in the original and updated reviews examine associations between demographic factors, psychological factors and behaviour amongst the general public. There is a wealth of literature describing the range and frequency of behaviours in response to a pandemic, and this type of information can of course be useful in itself to establish whether responses are in line with official recommendations. There is also considerable research examining the behaviour of health care professionals during a pandemic. Some of this research is summarised in the two papers submitted simultaneously to the Scientific Pandemic Influenza Advisory Group: *'Factors associated with uptake of vaccination against pandemic influenza: A review of the scientific evidence'* and *'Health Care Workers willingness to work during a pandemic: A review of the scientific evidence'*.

The original review highlighted the importance of carrying out behavioural research during a pandemic where actual behaviour can be measured. Eight of the studies reviewed here were carried out in these circumstances. The findings from these studies are broadly consistent with those carried out before pandemics and the results from them can be used to develop targeted interventions to encourage appropriate protective behavioural responses during a future pandemic.

5. Conclusions

The findings from the original review and this update can be broadly explained by theories of health behaviour. However, given that the studies included in the updated review were not prospective, theoretically driven prospective studies are still required to further clarify the relationship between demographic factors, attitudes and behaviour. The findings of the original review suggested “that intervention studies should focus on particular demographic groups and on raising levels of perceived threat of the pandemic disease and belief in the effectiveness of measures designed to protect against it. Communication strategies should maximize levels of trust amongst the public by being open and transparent in order to maintain the credibility of the information provided.” (Bish & Michie 2010, p.820). Following the update of the review this conclusion would still stand.

References to studies included in updated review

- Balkhy, H. H., M. A. Abolfotouh, et al. (2010). "Awareness, attitudes, and practices related to the swine influenza pandemic among the Saudi public." Bmc Infectious Diseases **10**.
- Bass, S. B., S. B. Ruzek, et al. (2010). "If You Ask Them, Will They Come? Predictors of Quarantine Compliance During a Hypothetical Avian Influenza Pandemic: Results From a Statewide Survey." Disaster Medicine and Public Health Preparedness **4**(2): 135-144.
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- Taylor, M., B. Raphael, et al. (2009). "Public health measures during an anticipated influenza pandemic: Factors influencing willingness to comply." Risk Management and Health Care Policy **2**: 9-20.
- Van, D., M. L. McLaws, et al. (2010). "University life and pandemic influenza: Attitudes and intended behaviour of staff and students towards pandemic (H1N1) 2009." Bmc Public Health **10**.

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Table 1: Summary of additional studies identified by updated search November 2010

Study	Study design & method & months	Disease	Country	Participants	Psychological Theory	Behaviour	Results: Factors associated with behaviour or intention
Balkhy et al 2010	Cross sectional Interview September 2009	H1N1	Saudi Arabia	N= 1,548 Convenience sample	None stated	Behaviour: Face mask use, hand washing, respiratory etiquette	Older, male, better educated, more knowledgeable about H1N1 related to behaviour
Bass et al 2010	Cross sectional telephone interview September 2006	Avian influenza	USA	N=1,204 Representative sample from random digit dialling	None stated	Intention: quarantine compliance	Female, older, unemployed, religious, lower income, more knowledge, perception that avian influenza is severe, perception of greater susceptibility for self and family to avian flu
De Zwart et al 2010	Cross sectional 7 consecutive web based surveys 2006-2007	Avian influenza	Netherlands	N=3,840 general population	Protection Motivation Theory	Self reported behaviour: Avoiding contact with (wild) birds or poultry, not going to areas with AI, paying more attention to hygiene, cancelling or not booking a holiday to an area with AI, getting oneself vaccinated against influenza avoiding gatherings of	Time of survey (2 after AI incidents), older, lower education, non-Dutch, perceived greater susceptibility to AI, perceived higher vulnerability to AI, higher self-efficacy to carry out behaviours, lower knowledge, thinking

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						people, buying antiviral drugs and buying a face mask	more about AI related to precautionary behaviours.
Eastwood et al 2010	Cross sectional Telephone interviews following up previous participants in 2009 study Aug-Sept 2009	H1N1 Influenza	Australia	N=830 (71% of earlier sample). Randomly selected using a quota system	None stated	Intended compliance with quarantine	Older, female, higher education, perception of H1N1 as serious, more concerned about H1N1 related to willingness to comply with quarantine. Levels of compliance lower than in earlier study
Griffiths et al 2010	Cross sectional Questionnaire June 2009	H1N1 Influenza	Hong Kong	N=359 students at a summer school	None stated	Behaviour: compliance with hand washing, temperature taking, face mask use, antiviral use	Singapore students more compliant than students from US on all measures. Males more likely to take Tamiflu Belief in need for preventive measures associated with willingness to take Tamiflu

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Kamate et al 2010	Cross sectional Questionnaire July-Aug 2009	H1N1 influenza	India	N=791	None stated	Behaviour: cancelled or postponed social event, reduced the number of rides on public transport, taken time off work, reduced the amount of time going into shops, kept children out of school or nursery, avoided crowded places; increased amount of cleaning or disinfecting things that might be touched and washed hands with soap and water more often than usual	Older, being male, perceiving H1N1 as severe, more knowledgeable about H1N1 and having a positive attitude to preventive behaviours associated with carrying them out.
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Lau et al 2010	Serial cross sectional studies. 6 telephone interviews (based on Lau et al 2006, 2007). November 2005-February 2008	Avian influenza	Hong Kong	N=3,527 Hong Kong Chinese adults	None stated	Anticipated responses: wearing face mask, more hand washing, declare if had flu at a check point, would reduce visiting other places, would not eat poultry, would avoid going out, crowds and hospitals, would comply with quarantine	Older, lack of knowledge of AI, perceived greater susceptibility of self or family to AI, perceived high likelihood of outbreak, perceived lack of drugs available to treat AI, belief that AI more severe than SARS associated with carrying out more preventive behaviours. Susceptibility declined over time.
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Lau et al 2010	Cross sectional Telephone interview May-June 2009	H1N1 influenza	Hong Kong	N=999	None stated	Hand washing behaviour, face mask use	Being female, older, married, perceiving H1N1 to be severe, belief in the efficacy of hand washing to control H1N1, belief that there is no vaccine against H1N1 and greater mental distress are associated with hand washing more frequently. Being female, more educated, perceiving a lack of a vaccine are associated with face mask use when ill with an ILI. Being female, older, married, perceiving H1N1 to be fatal, believing in the efficacy of face mask use and mental distress are associated with face mask use in public.
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Liao et al 2010	Cross sectional. Telephone interview June 2009	H1N1 influenza	Hong Kong	N=1,001 adults randomly selected	Model proposed by authors	Hand hygiene and social distancing behaviour	Being female, older, greater understanding of H1N1 and self efficacy related to hand hygiene (trust in formal sources of information related to self efficacy). Perceived worry related to social distancing (trust in informal sources of information related to worry)
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Determinants of protective behaviours

Rubin et al 2010	Longitudinal. 5 Telephone interviews. May 2009	H1N1 influenza	UK	N=5,419 randomly sampled adults	None stated	Behaviour: carried tissues, bought antibacterial gel, avoided public transport, visited GP, Hospital or called NHS direct about flu	Being female, younger, from ethnic minority, in poor health, worried about H1N1 and a belief that behaviour to be useful in preventing H1N1 infection was associated with tissue carrying. Being female, from an ethnic minority, from households with more than 2 people, in poor health, worried about H1N1 and a belief that behaviour to be useful in preventing H1N1 infection was associated with buying antibacterial gel. Being from an ethnic minority, in poor health, worried about H1N1 and believing that the behaviour is useful in preventing H1N1 infection is associated with avoiding public transport. Being from an ethnic minority and in poor
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Determinants of protective behaviours

Taylor et al 2009	Cross sectional. Telephone interview. Jan-March 2007	Pandemic influenza	Australia	N=2,081 random sample of adults in NSW Health Population Survey	None stated	Willingness to have vaccine, wear face mask, isolate self	Concern for self and family is related to greater willingness to comply with all behaviours Being older, more educated, and having more concern is related to face mask use. Being younger, not married, non-English speakers is related to reduce willingness to isolate selves.
Van et al 2010	Cross sectional. Online questionnaire June-Sept 2009	H1N1 influenza	Australia	N=2,882 academic staff, other staff and students at a University in Sydney	None stated	Behaviour: cancelled social events, avoided public places, avoided public transport, cancelled travel plans (not recommended by government) buying hygiene products, receiving the seasonal influenza vaccine, using online resources for teaching and learning and stockpiling necessities (recommended)	Being female, Asian related to carrying out more behaviours (Asian people also felt more anxious and perceived greater susceptibility). Being a student and a belief that infection would have adverse health effects was related to uptake of avoidant behaviours.

Appendix 1: Theories of Health Behaviour

The Health Belief Model

The HBM has been applied in a number of contexts including use of preventive screening, obtaining immunizations, compliance with medical regimens, and response to illness symptoms (see Sheeran & Abraham, 1996, for a review; Harrison, Mullen, & Green, 1992, for a meta-analysis). The HBM includes assessments of perceived susceptibility to, and severity of, a disease; and perceived benefits and perceived costs of a preventive health action and also cues to action.

The Theory of Planned Behaviour (TPB)

The TPB, an expansion of the theory of reasoned action which was devised by Fishbein and Ajzen (1975) to explain social behaviour, has been widely applied to a variety of behaviours – both health and non-health related (see Conner & Sparks, 1996, for a review and meta-analyses by Godin & Kok, 1996 and Sheppard, Hartwick, & Warshaw, 1988). The TPB postulates that the proximal determinant of a behaviour is an intention to perform it. In turn, intentions are determined by three constructs: attitude towards the behaviour, subjective norm, and perceived behavioural control (PBC).

Attitude towards the behaviour refers to the person's overall evaluation of the behaviour, which may be positive or negative. Subjective norms involve perceptions of how other people think the individual should behave in relation to the particular behaviour in question and also how these other people themselves behave. PBC aims to take account of differences in abilities, skills, access to resources, confidence, etc. between individuals.

Protection Motivation Theory

PMT (Rogers, 1975, 1983) was originally developed to understand the basis of fear appeals in health promotion. Protection motivation (a behavioural intention to perform a maladaptive or adaptive behaviour) is postulated to be determined by two processes: threat and coping appraisals. Threat appraisal involves a consideration of the severity of the health threat and a perception of personal vulnerability to it. Coping appraisal involves a consideration of whether

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or not the health action is an effective means of alleviating the threat (i.e., response efficacy), and also a consideration by the individual of whether they will be able to carry out the health action (i.e., their perceived self-efficacy). PMT suggests that threat appraisal will generate an intention to act whereas coping appraisal will determine the type of action. This can be adaptive (i.e., in line with recommended behaviour) or maladaptive (i.e., against the recommendations). Rogers suggests that protection motivation is a linear function of the belief that the threat is severe, high personal vulnerability, a belief that one can perform the coping response and that the response is effective. It is a negative linear function of the reinforcements associated with the maladaptive response and of the response costs. A criticism of the above theories of behaviour is that they do not explain behaviours that are emotionally rather than cognitively and rationally driven as they do not adequately take into account emotional factors in decision making (Joffe, 1996).

The common sense model of illness

This was developed by Leventhal, Meyer, and Nerenz (1980) is a 'parallel processing model' whereby individuals simultaneously make cognitive and emotional representations of an illness. When faced with a new threat, individuals build a mental model of the threat in order to make sense of and manage the problem. The representation involves beliefs about the cause, consequences (in terms of the impact the disease would have), identity, time line, and controllability of the illness (Petrie & Weinman, 1997, 2006). A parallel emotional reaction interacts with this mental model and drives coping strategies and health behaviours relating to that threat. A meta-analysis including 45 studies examined the relationship between illness representations and coping and illness outcomes. This demonstrated how the relationships between these concepts were consistent with those predicted by the model and that the model predicted a variety of health behaviours (Hagger & Orbell, 2003).