# Supplementary Appendix

## Contents

## Appendix 1: Search Terms

### Ovid PsycINFO & Ovid MEDLINE

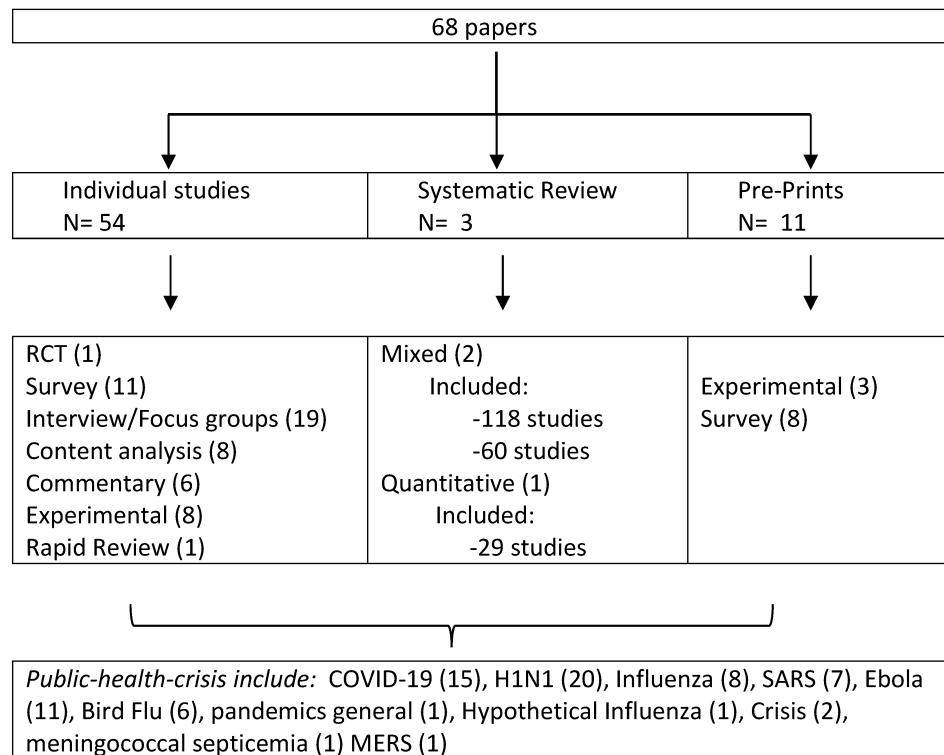| # | Search Terms | Results | Notes (e.g. where search terms were adapted from) |
|---|---|---|---|
| **Health and risk communication terms** | | | |
| 1 | public service announcements/ | 370 | |
| 2 | communication/ or messages/ or persuasive communication/ or scientific communication/ or social communication/ | 65306 | Imploded and selected a few narrower terms as the others were irrelevant |
| 3 | ((public health or health or risk or emergenc* or crisis* or catastroph* or disaster* or outbreak*) adj3 (communication* or campaign* or information* or plan* or message* or uncertain* or alert* or awareness or recommendation* or guideline* or guidance or measure*)).tw. | 54841 | |
| 4 | 1 or 2 or 3 | 116708 | |
| **Pandemic and epidemic terms** | | | |
| 5 | exp Pandemics/ | 473 | |
| 6 | exp Epidemics/ | 3399 | |
| 7 | exp Influenza/ | 1396 | Includes Swine Flu, no MeSH terms for SARs, MERs, and Ebola so these searched as keywords only |
| 8 | exp Emergency Preparedness/ | 1192 | |
| 9 | ("SARS" or coronavirus or severe acute respiratory syndrome).tw. | 587 | |
| 10 | (ebola or ebolavirus or ebola virus).tw. | 411 | |
| 11 | ("MERS-CoV" or "MERS or Middle East Respiratory Syndrome coronavirus").tw. | 11 | |
| 12 | (influenza or swine flu or H1N1 or pH1N1* or pdmH1N1* or nH1N1*).tw. | 2490 | |
| 13 | (pandemic* or epidemic*).tw. | 14247 | |
| 14 | 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 | 17926 | |
| 15 | 4 and 14 | 1525 | |

### Health Evidence (Reviews)

[(Public health messag*) OR ("Risk communication") AND Pandemic OR Epidemic] (224 results)

### Grey Literature Searches

OSF Preprints + PsyArXiv Preprints

| Search category | Search terms |
|---|---|
| Intervention | (Public health messag* OR communication OR plan OR alert OR health campaign OR health recommendation* OR public information OR medical information OR public awareness OR community engagement OR risk reduction OR health promotion) |
| Phenomena of interest | (Pandemic OR catastrophe OR cris?s OR outbreak OR emergency OR Coronavirus OR Covid* OR SARS* OR ebola* OR MERS OR epidemic) |
| Combination | (Public health messag* OR communication OR plan OR alert OR health campaign OR health recommendation* OR public information OR medical information OR public awareness OR community engagement OR risk reduction OR health promotion) AND (Pandemic OR catastrophe OR cris?s OR outbreak OR emergency OR Coronavirus OR Covid* OR SARS* OR ebola* OR MERS OR epidemic) |
| Limitations | Arts & Humanities; Life Sciences; Medicine and Health Sciences; Physical Sciences and Mathematics; Social and Behavioral Sciences |
| Results | 518 |

## Appendix 2: Breakdown of studies

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┌─────────────────────────────────────────────────────────────┐
│                         68 papers                            │
└─────────────────────────────────────────────────────────────┘
        │                        │                      │
        ▼                        ▼                      ▼
┌──────────────────┐  ┌────────────────────┐  ┌──────────────────┐
│ Individual studies│  │ Systematic Review  │  │ Pre-Prints        │
│ N= 54            │  │ N= 3               │  │ N= 11            │
└──────────────────┘  └────────────────────┘  └──────────────────┘
        │                        │                      │
        ▼                        ▼                      ▼
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| Individual studies | Systematic Review | Pre-Prints |
|---|---|---|
| RCT (1)<br>Survey (11)<br>Interview/Focus groups (19)<br>Content analysis (8)<br>Commentary (6)<br>Experimental (8)<br>Rapid Review (1) | Mixed (2)<br>   Included:<br>      -118 studies<br>      -60 studies<br>Quantitative (1)<br>   Included:<br>      -29 studies | Experimental (3)<br>Survey (8) |

*Public-health-crisis include:* COVID-19 (15), H1N1 (20), Influenza (8), SARS (7), Ebola (11), Bird Flu (6), pandemics general (1), Hypothetical Influenza (1), Crisis (2), meningococcal septicemia (1) MERS (1)

## Appendix 3: screening, data extraction and synthesis details

| Task | Authors |
|---|---|
| *Screening of titles and abstracts (1st and 2nd)* | NH, EJ, SS, JW, APK, DW, LS, NS, EG, DS, NC, DG, MYT, SLW, CK |
| *Conflicts resolved* | DG, MYT, SLW, CK |
| *Development of guidance document* | DG, MYT, SLW, CK, TE, AC, SH, LBD |
| *Pilot data extraction* | AG, SLW |
| *Data extraction* | NH, EJ, SS, JW, APK, DW, LS, NS, EG, DS, NC, DG, MYT, SLW, CK |
| *Quality check* | JW, SS, DG, MYT, NC, DS |
| *Analysis* | DG, MYT, SLW, CK |
| *Iterations and discussions* | DG, MYT, SLW, CK, TE, NH, EJ, AC, SH, RT, CJA, MAA, JH, LBD |
| *Agreed on final categories* | DG, MYT, SLW, CK, TE, NH, EJ, AC, SH, RT, CJA, MAA, JH, LBD |

## Appendix 4: Data and study characteristics tables 1-4

**Table 1: Characteristics of Qualitative Studies**

| | Country | Study Type | Health Threat | Intervention type | Target behaviour | Main findings |
|---|---|---|---|---|---|---|
| **Avery (2009)** | USA | Content Analysis of avian flu press releases | Avian flu | Press releases issued by federal and global health agencies | Not reported | The threat was not localized; outlets for publics to contact for more information were not always present, and there was inconsistency in how avian flu was referenced. There was a steady increase in the volume of releases since 2004, and public health information officers generally seemed to recognize the importance of partnerships and timeliness in pandemic preparedness. Public health communicators must establish a strong sense of efficacy in an informed public to insure that audiences will adhere to protocol rather than succumb to hysteria in the face of a wide-scale crisis such as pandemic flu. They must also provide information accessible to all publics, including those who do not have Internet access. |
| **Basnyat & Lee (2014)** | Singapore | Qualitative | H1N1 pandemic | Singapore Ministry of Health press release in newspapers | N/A | The media did convey useful information for managing the pandemic from the Ministry of Health press release (i.e. social responsibility, benefits of lockdown) and these were often in the tone/ semantics of colonial-era ideologies that are present within the culture in Singapore and reflect that of the government. Beneficial for the government to provide more than basic information, such as about coping with anxiety, and consider how other types of media (e.g. social media, blogs) can be used too. |
| **Berry (2007)** | Canada | Content analysis of the construction of news reports on health topics | SARS/other infectious diseases/general health | Media reports - newspaper, radio, television, and internet news on health-related topics | Not reported | The results of the content analysis showed that in 2003, there was far more information available in the news media on SARS and West Nile Virus than on other health topics with greater population prevalence, such as obesity or heart disease. The number of articles about SARS in 1 year was greater than for any other individual topic across all 5 years, with the exception of smoking (which in 2003 had only 36 articles, compared to SARS, which had 164) and "other" topics. Expert sources were cited far more often than nonexperts. |
| **Bonwitt (2018)** | Sierra Leone & Guinea | Longitudinal qualitative/ | Ebola | posters | Various preventative behaviours | All study participants, irrespective of age or gender, were aware of wild mammals acting as a source of transmission for Ebola virus disease (EVD); respondents gave a variety of answers when asked |

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| | | ethnographic study | | | | what species of animal could transmit Ebola - this confusion may have rested in the content of public health messages, which were inconsistent in the species shown to be potentially hazardous; People simply refused to believe that wild meat could pose any health risk; Those that believed or partially believed in the link between EVD and wild meat adopted various strategies to mitigate the perceived risk of infection. Most admitted to only refraining from eating those animals that they understood as posing a risk for EVD; The widespread suspicion over the risks posed by wild animals prompted discussions during village meetings to discuss the veracity of public health messages.<br>Rather than outright rejection of these messages, people elaborated situated hypotheses to make sense of the conflicting and incomplete information they had received. This process of contextualisation helped to bridge the disjuncture between fear and the highly routine nature of eating meat. |
| **Cole & Watkins (2015)** | Liberia, Sierra Leone or Guinea | interviews | Ebola | WHO, CDC, professional media (international, local) informal information e.g. rumours | Information-seeking | Their recall can be grouped into three broad source categories (official, international and local media, and informal) Throughout later information-seeking behaviour, interviewees maintained a distinction between the three categories. This affected how they trusted and processed information from each, although generally they tended to use all three simultaneously. Multiple source information gathering, especially following up from informal information (personal experiences) because they felt that was more rumour and wanted confirmation from official sources but felt official sources were slow with the information. Consistency provided reassurance and helped to be trusted. perception of risk, triggered by hearing that someone they knew personally, or felt an affinity to, had contracted the virus. know who employees see as their community and 'people like me'. Behavioural changes seemed to kick in at the border between the near and real at-risk rather than at the border between far at-risk and near at-risk. Those in the far at-risk group generally showed more concern for people they knew in higher risk categories than for themselves. |
| **Crosier (2015)** | UK. Italy, Hungary | Qualitative interviews | H1N | Government poster | Public compliance and engagement | The study found a lack of planning and a low value attached to the skills required to produce effective communications. There was a dearth of good quality audience research to inform the development of communications. Little thought had been given to |

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| | | | | | | the tone, targeting or channelling of messages. Instead, communications were characterized by a 'one size fits all' and a 'top down', expert-led response. There was also little effort to evaluate the impact of communications, but where this was done, very low levels of public compliance and engagement with key behavioural messages were found. |
| **Davis (2015)** | Australia & Scotland | Qualitative interviews and focus groups | H1N1 pandemic 2009 | Broadcast and electronic media | Hygiene (e.g. covering mouth when coughing or sneezing, washing hands, cleaning surfaces), social isolation, vaccination | Participants wanted information but to be able to interpret advice based on own situation. Information on hygiene and social isolation endorsed but seen as short-term solution as being social is a central part of life. Participants had an individualistic approach to risk, decide whether to adopt PH behaviours based on risk to themselves, gender norms play a part in understanding and engagement with hygiene and social isolation. |
| **Freiman (2011)** | USA | face to face interviews | H1N1 pandemic 2009 | TV, newspaper, internet, family/friends, workplace, radio, other | Reporting on a range of preventative behaviours | Variable - did not always have the desired effect, or an effect at all. relied on the internet - however a lot of the target population did not have access to this - and thus were missed. Even those with internet access were unlikely to visit the CDC's website to learn about H1N1 |
| **Gray (2012)** | New Zealand | Focus groups | H1N1 pandemic 2009 | Ministry of Health campaigns | General protective behaviours | Four major themes: personal and community risk, building community strategies, responsibility and information sources. People wanted messages about specific actions that they could take to protect themselves and their families and to mitigate any consequences. They wanted transparent and factual communication where both good and bad news is conveyed by people who they could trust. |
| **Holmes (2009)** | Canada | Semi-structured interviews | crisis | Hypothetical | Risk perceptions | The notion of uncertainty – and the difficulties associated with communicating in uncertain situations – arose frequently. Recommendations: is to set and get agreement on a goal or goals (there may be different goals set for different audiences or specific situations). View all other aspects of communications planning and implementation through this ethical lens. Media representatives should be engaged immediately in discussions about a potential emerging infectious disease outbreak, including the role media should play and how the public health community can help them fulfil that role. Building trust with the public. |

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| Jones (2010) | Australia | Focus groups | Bird Flu | Campaigns prepared by advertising agency | Hand washing and Hygiene and self-protection measures (e.g. | In the early stages of a pandemic (i.e., prior to the identification of cases within a given country), communications should focus on increasing awareness of the disease and communicating important, but simple, protective behaviours to reduce the risk of transmission. Social marketing campaigns will also need to have an associated strategy for their social marketing campaigns' targeting intermediaries—such as general practitioners and other medical personnel, schools, business owners, and commercial and public organisations which could be utilized to disseminate information and resources. |
|---|---|---|---|---|---|---|
| Lapka, (2008) | USA | Focus groups and interviews | Influenza | | Various | Cognitive Response Testing (CRT) is easily applied to various subject matters and effectively highlights problematic terminology and phrases, allowing for beneficial and efficient message revisions. CRT is a straightforward, appropriate and useful method in health promotion message development and pre-testing. |
| Li (2016) | China | focus group | H7N9 | News from various sources | Risk perception | Most people learnt about virus from tv, info was felt to be released in timely and transparent manner, most useful was info about preventative behaviours, and evolving outbreak trends. Gov info perceived as trustworthy, but young people trusted social media more and wanted gov to publish news in such way. Health recommendations seen as easy to follow and clear. Anxiety affected by disease severity, distance from pandemic, high level of news coverage, trust in gov ability to fight the issue. Health communication needs to be specific and practical |
| Liao, (2010) | Hong Kong | telephone interviews | H1N1 pandemic 2009 | | hand hygiene and social distancing | There was a relationship between trust in formal information and understanding (positive), trust in information info and susceptibility (negative) |
| Lohiniva (2020) | Finland | Qualitative | COVID-19 | e-mail and social media | Risk perceptions | Risk perception domain: catastrophic - potential strong wording describing the epidemic, catastrophe, worldwide threat. Concept - Emotional response. Recommendation - Avoid downplaying strong feelings. Concept - Localised epidemic; stigmatising attitude towards foreign nationals. Recommendation - Humanise infected people by telling stories. Location of transmission: public transportation linked with airports and foreign passengers. Concept - Crowded places; stigmatising attitudes towards foreign nationals. Recommendation - Emphasise handwashing and cough etiquette as effective ways to prevent COVID-19. Concept - Unreliable |

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| | | | | | | information Recommendation - Repeat information and provide an explanation (reason). |
| **Lyu (2012)** | Taiwan | Qualitative Interviews | SARS | News reports/ public announcements | Perception of spokesperson | The essential/favourable characteristics for spokespersons should include: having professional capability, having better media interactions, involvement in policy making, having trustworthiness, and having favourable (or positive) personality and traits. |
| **Mitchell (2014)** | USA | Focus groups | Influenza A H1N1 | University mobile message alerts | Various preventative behaviours | Reported concern and commitment to recommendations decreased rapidly. Initial university messaging and response was critical in shaping participants' later perceptions. |
| **Person, (2004)** | USA | Focus groups and rapid situational assessment | SARS | Community outreach strategies | N/A Community resilience | SARS-related stigmatization was occurring more frequently within the Asian community than from outsiders directed toward the Asian community. The team also found that those persons with SARS-like symptoms who used traditional herbal physicians and pharmacies were less likely to be referred to, or seek out, public health officials, suggesting that further research into strategies to reach this population is needed. Conducting community visits also showed that CDC was responding to the needs of the community at risk for SARS-related fear, stigmatization, and discrimination and was modelling positive behaviours to the public. |
| **Qian (2020)** | China | Content analysis | COVID-19 | Newspapers | N/A | The Chinese mass media news lagged when reporting the major developments of the viral spread. Prevention and control procedures, medical treatment, and research are major themes of the press but mainly focus on the whole society, while instructions on personal and individual prevention, clinic and medicine choices, and detection need to be further enhanced. |
| **Qiu (2018)** | China | qualitative comparative case study | SARS, H7N9 | Media | Risk perceptions and awareness | 8 key principles of risk communication Trust is the basis by maintaining an open and honest attitude and engage key stakeholders. Delaying in reporting cases caused distrust, need accurate, timely, honest reporting, transparency helped subdue rumours, maintain social stability and helped maintain trust, and ensured more cooperation to reduce the spread of the disease. Being honest and open, planning well, being empathetic and caring, Accepting and involving the public as a partner regular feedback from the public and interaction between government and community. |

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| **Rim (2014)** | USA | content analysis + correlating with survey results | H1N1 | News media | Various | The more info from health authorities, the more news coverage. The same correlation for severity of content. Increased information subsidies with salience of the severity attribute was linked with increased H1N1 salience in media coverage. But no relationship between the severity attribute use in media coverage, and the public perception of risk. Framing that effectively empowers the public to engage in desired behaviour should be further studied for the success of a public health campaign. |
|---|---|---|---|---|---|---|
| **Rimi (2016)** | Banglade sh | ethnography | avian influenza | Posters | Prevention (handling poultry) | Incorporating non-health benefits might improve acting on recommendations. More people heard about the bird flu after the intervention, and had more awareness around the disease, as well as performed preventative behaviours. Not all behaviours changed in the desired direction though (e.g., selling sick poultry, separating it). Reported behaviours were not consistent with the observations done by the researchers though. People rationalised ignoring recommended behaviours - low perception of risk - the flu not present among their birds, also finance issues and not worrying about getting ill. Also inconvenience was mentioned, as well as social pressure not to follow the recommendations, and scepticism about the necessity of the intervention - some conspiracy theories. |
| **Sell (2017)** | USA | Content analysis of news coverage | Ebola | News coverage | risk perception | more scientific knowledge to be used in media coverage. Certain risk messages about Ebola were used more frequently than others by US news media, which may have affected risk perception during the outbreak. Some messages increase, some decrease risk perception. |
| **Seltzer (2015)** | USA | Content analysis | Ebola | Instagram/ Flickr pictures relating to Ebola | Risk awareness | Images of health care workers and professionals [308 (25%)], West Africa [75 (6%)], the Ebola virus [59 (5%)], and artistic renderings of Ebola [64 (5%)]. Also identified were images with accompanying embedded text related to Ebola and associated: facts [68 (6%)], fears [40 (3%)], politics [46 (4%)], and jokes [284 (23%). Image sharing platforms are being used for information exchange about public health crises, like Ebola. Use differs by platform and discerning these differences can help inform future uses for health care professionals and researchers seeking to assess public fears and misinformation or provide targeted education/awareness interventions. |

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| Sumo (2019) | Liberia | Interpersonal communication' and dialogue | meningococcal septicemia | Community engagement (religious leaders, elders etc), radio talk shows, house to house visits, radio ads (jingles) | hand-washing, avoiding gatherings, risk perceptions | Increased trust and adherence. Contact tracing successful and epidemic contained, trust increased and adherence to messages increased (e.g. reporting sick people to health facility). |
| --- | --- | --- | --- | --- | --- | --- |
| Teasdale (2011) | UK | Focus groups | H1N1 pandemic | Government + author-developed messages | Government advice was stay at home if you have flu-like symptoms and continue to go to work if you do not (behaviour not tested in this study though) | Participants were sceptical about the feasibility and appropriateness of self-diagnosis of pandemic flu. Participants actively evaluated recommended actions according to their own beliefs and reasoning about flu and their perceptions of the costs of carrying out the recommended actions. For most people the experience of the H1N1 pandemic was relatively mild compared to previous influenza pandemics of the 20th century. Consequently, the recommendation to stay at home was perceived as inappropriate. Written government communications aiming to improve and maintain population health may also need to address the recipients' perspective. Attempts should be made to elicit and address common doubts and concerns, to reduce perceived barriers to recommended behaviours, emphasize benefits, to find ways to support people to adopt them and consider the likely contextual factors that may affect perceptions of the advice. |
| Tully (2019) | West Africa | Content analysis | Ebola | Hyperlinks - embedded content in social media, e.g.Twitter used for information dissemination. | Risk perceptions | Increased credibility and awareness of messages. Organizations produce proportionally fewer tweets than news outlets - maintaining an active Twitter presence allows response organisations to promote their work and position themselves centrally to the unfolding crisis and conversation. Results suggested that 'owned' and 'earned' media served as informational resources and promotional pieces for the organizations. Repeatedly linking to sites controlled by the organization and/or produced by news media and other reliable sources served as a low-cost way for organizations to keep pace with the rapid flow of information on social media. |

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**Table 2 – Characteristics of Quantitative Design Studies**

| | Country | Study Type | Health Threat | Intervention type | Target behaviour | Main findings |
|---|---|---|---|---|---|---|
| **Aburto (2009)** | Mexico | cross sectional representative household survey | H1N1 pandemic 2009 | | N/A - reporting on a range of preventative behaviours | Risk mediated behaviours in some cases e.g. if they perceived the threat of the virus to be high, they were in turn more likely to avoid crowds. People who did comply, were more likely to if they had knowledge about the virus. |
| **Bekalu (2017)** | USA | Experimental | Pandemic influenza | Video clips | washing hands frequently, staying home when sick and avoiding unnecessary travel | A non-narrative message format may be more effective than its narrative counterpart to communicate basic prevention information during public health emergencies. Compared with the narrative and/or fictional version, the more didactic and factual format was found to be more effective in changing knowledge and perceived response efficacy related to prevention of pandemic influenza. |
| **Chang (2012)** | Taiwan | Experiment (2 by 3 factorial design) | H1N1 pandemic | Newspapers | Risk perceptions | The amount of exposure to news stories increases its impact on the public. When a health issue is ambiguous, greater exposures to news coverage with high alarm frames, as opposed to low alarm frames, evoke more fear and increase participants' perceptions of the severity of the issue, as well as their vulnerability to it. Exposures to news do not increase prevention or treatment efficacy. Repetition exacerbates the effects of media exposure on perceived severity and vulnerability but not fear. The amount of exposure increases its impact. |
| **Daellenbach (2018)** | Australia, New Zealand | Quantitative online survey | Crisis | | Risk perceptions | Adaptable and personalised to be more effective. Segmentation based on Theory of Planned Behaviour variables. The study highlighting that vulnerability may be identified based on such factors as critical awareness, perceived barriers, and ultimately preparation undertaken, including community-related factors. |

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| Davis, (2013) | USA | Experimental design with 3 conditions | Influenza A; Influenza B; HINT | Posters | Hand washing | Prompts alone were not effective at increasing hand washing.<br><br>In the education building female bathroom soap usage significantly increased during the first poster prompt (following baseline), then fell below baseline during the second prompt (i.e., warning of influenza transmission). In the business building bathroom women's soap usage did not change significantly from baseline to first poster condition but decreased slightly on the second condition. Women in the education building used significantly more soap overall than women in the business building; there were no significant differences between men by building type. |
| Hickey (2014) | Quatar | Cross-sectional survey | H1N1 pandemic 2009 | Non-pharmaceutical interventions (e.g. using a thermometer, wearing a face-covering, hand washing, and household disinfection practices) | using a thermometer, wearing a face-covering, hand washing, and household disinfection practices | Attitudes towards recommended NPIs were generally negative or uncertain, limited experience applying these interventions (e.g., using a thermometer, wearing a face-covering) and inadequate hand washing and household disinfection practices |
| Hoda (2016) | Saudi Arabia | Survey | MERS | Promoting public awareness of MERS in the Saudi population | Risk awareness | The internet was the most commonly used source of information (39.5%) and the most endorsed channel for a MERS awareness campaign. Physicians were the preferred source of information (45.6%), followed by other health care providers (31.3%). In univariate multinomial logistic regression models, males and individuals aged ≤27 years were more likely to seek information from the internet than from physicians. Residents of southern and western Riyadh preferred physicians as a credible source of information over the Ministry of Health. |
| Idoiaga (2016) | Spain | Experimental | Flu epidemic | Mass media | Risk perceptions | The human interest framing increased the perception of risk, especially when the proximity of the epidemic was high; this effect was explained by people's emotional response. |

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| | | | | | | Furthermore, youth projected the risk towards 'the other' in order to protect their invulnerability identity. |
| **Jhummon-Mahadnac (2012)** | Australia | Cross-sectional survey | H1N1 pande mic 2009 | Public Education Campaigns | Working from home, postponing social gatherings, wearing facemasks, oseltamivir treatment if sick | 68% (175) reported behaviour change because of the pandemic. Gaps in knowledge included failure to identify certain high risk groups. Recall of government campaigns was significantly associated with a higher knowledge score. 60% (151) thought that authorities and media had exaggerated the threat; only 40% (101) would comply with recommended measures in a future pandemic. |
| **Johnson & Slovic (2015)** | USA | Experimental - 2 studies | Ebola | Mock story | Risk perceptions | Informing Americans about the small likelihood of post-21-days Ebola symptoms would not increase perceived risk and distrust and might diminish negative reactions to the media reporting a case who developed symptoms of Ebola after 21 days. Thus, public health officials wanting appropriate public responses to potential or actual epidemics may benefit from early communication of unpleasant infectious-disease facts before events reveal them, and signal officials' lack of preparedness for public reactions. |
| **Kavanagh (2011)** | Australia | cross sectional survey | H1N1 pande mic 2009 | official sources (health dept, schools) and unofficial sources (media, family and friends, health care providers) | quarantine | Compliance was higher when they understood the messages. make messages easy to understand for everyone. Official sources are trusted/legitimised more than unofficial sources |
| **Miczo (2013)** | USA | Cross-sectional survey | H1N1 pande mic | Campaigns on campus (flyers, posters, emails). Mass media (various, including television & radio) other sources (e.g. medical) | Various - Self-isolation, hand hygiene, respiratory etiquette, sanitizing frequently | No significant results found for the impact of the health messages on health behaviour performance. The most frequently mentioned messages students remembered were: to wash hands (56.9%), avoidance (23.5%) (e.g. staying away from others when feeling ill) and getting a flu shot/ vaccination (22.1%). Positive health self-concept was positively related to the argument message dimension and |

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| | | | | | touched surfaces, not attending public events if sick, vaccination, early intervention for high-risk students and staff members, and cancelling travel plans | flu-prevention behaviours; negative health self-concept was negatively related to the argument message dimension and hand washing. Campus most frequently cited source and useful from campus health viewpoint. There was limited success in attempting to assess memorable messages using a dimensional approach. |
| **Prati (2011)** | Italy | Cross-sectional survey | H1N1 | Educational campaign | Various – all preventative behaviours | Recommended behaviours such as cleaning objects, social distancing and washing hands were related to all the psychosocial factors except for trust in the institutional response to the outbreak and trust in medical science. Trust in medical science was significantly associated with cleaning objects. To use tissues when sneezing was predicted by all the psychosocial factors, except for trust in medical science and control. These results showed that media trust, trust in the Ministry of Health (regardless of what was done to reduce this risk), worry and perceived severity of illness predicted all the recommended behaviours. Exposure to the Topo Gigio campaign did have a limited influence on complying with health related recommendations but only with regard the use of tissues when sneezing. |
| **Rim (2014)** *(also reported in table 1)* | USA | content analysis + correlating with survey results | H1N1 | News media | Various | The more info from health authorities, the more news coverage. The same correlation for severity of content. Increased information subsidies with salience of the severity attribute was linked with increased H1N1 salience in media coverage. But no relationship between the severity attribute use in media coverage, and the public perception of risk. |

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| | | | | | | Framing that effectively empowers the public to engage in desired behaviour should be further studied for the success of a public health campaign. |
|---|---|---|---|---|---|---|
| **Roess (2017)** | DR Congo | Pre- post interventional study | Ebola | Four films | Risk perceptions and awareness | a culturally and linguistically appropriate video-centred intervention was effective in improving knowledge, attitudes and behaviours related to EVD in Congo. The results also demonstrate retention of the knowledge one year after exposure to the intervention. |
| **Updegraff (2011)** | USA | Experimental design with 3 conditions | H1N1 | Posters/ signs placed besides hand sanitizer units around university campus | Use of hand sanitizer dispensers | All signs resulted in significantly greater usage than no sign, but they were not equally effective. Dispensers with the gain-framed signs had the greatest usage of all, with 66.4% more use than dispensers with no signs (p <.001). Loss-framed signs were associated a 58.4% increase in use over no sign (p <.001). The social norms signs (44.3% increase) and the perceived susceptibility signs (40.6% increase) were associated with somewhat lower increases in usage compared to the gain-framed and loss-framed signs, but both led to significantly more usage than no sign at all (both p's < .01). Gain-framed signs received 12.5% more usage than dispensers in the other sign conditions combined, a significant difference (p = .029). Usage of sanitizer dropped consistently over time, closely mirroring temporal trends in public interest in H1N1. This study showed that the relatively simple strategy of placing theoretically grounded cue-to-action reminder signs at the point-of-use significantly promoted usage. The worst-performing sign emphasized people's susceptibility to contamination. |
| **Van der Weerd (2011)** | Netherlands | repeated measure cross-sectional telephone survey | H1N1 | | information-seeking | During the course of the pandemic the majority of respondents wanted to receive information from health services/health care providers and media. Wanted information on how to prevent infection, what to do in the event of illness, symptom, risks , consequences and number of infected cases. Trust in governmental information depressed |

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| | | | | | | by the time of period 3. At first, mistrust was because information was incomplete, kept secret or withheld. Later, because they thought the situation was exaggerated, information unclear and information was contradicted itself. Fear/worry was sig associated with intention to adopt protective measures during all time periods. |
| **Winters (2018)** | Sierra Leone | Cross-sectional | Ebola | A variety of sources: mostly electronic media, followed by community sources, print and new media. About half received government communications and most were exposed to more than 2 types of info. | Not reported | increased protective behaviours. Strong dose-response between info exposure and protective behaviours, however exposure to all sources (except electronic and print media) was associated with misconceptions |
| **Yardley (2011)** | UK | parallel-group pragmatic exploratory trial design | H1N1 pandemic | Website | hand washing | Increased hand washing, targeted/changed attitudes |
| **Zikmund-Fischer (2017)** | Netherlands | experiment | hypothetical influenza | mock news article | cover mouth, wash hands | Participants are more influenced by average than extreme case information, presenting both is counterproductive. |

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**Table 3 – Characteristics of Reviews and Narrative Reports**

| Author (date) | Country | Study Type | Health Threat | Intervention type | Target behaviour | Main findings |
|---|---|---|---|---|---|---|
| **Barrelet (2013)** | | Systematic Review | H1N1, H5N1 | | Risk perception, vaccine perception, rumours | Risk perceptions vary across time, social groups, cultures, and countries. Social resistance to vaccination is an enduring phenomenon that should not be downplayed by public health officials. Competing narratives (official statements and presentations, rumours, conspiracy theories, alternative worldviews and explanations, urban legends, hoaxes, etc.) about public health crises always coexist in the public sphere. Trust building is a key aspect of risk perceptions. |
| **Crouse Quinn (2008)** | USA | Commentary /proposal of a model for crisis and emergency and risk communication in a pandemic | Pandemics (general) | | Not reported | Overall proposed model: pre-disaster phase (ongoing risk education, partnership formation, community engagement, opportunity for deliberation on difficult policies and procedures); during an emergency (more one way, emergency risk communication, more need for immediate action, community partners' engagement in response); increased capacity and resilience of communities at times of disasters and pandemics |
| **Goldberg (2015)** | USA | Report | Ebola and others | Checklist | Risk awareness and perceptions | 5 stages: agree on a common goal, coordinate the leadership, develop a coordination strategy, launch a communication operation, maximize communication effectiveness |
| **Lin (2014)** | | Systematic review | H1N1 | Non-specific variety of interventions, including 'Websites', 'Commercial television', 'Health department' | Preventive behaviours such as hygiene and social distancing practices in 70% of the studies (N = 64), risk perceptions (70%, N = 64), levels of knowledge and awareness about the pandemic (53%, N | To reduce communication inequalities during a large scale emergency, such as a pandemic, public health officials should focus their communication efforts on the young, the less educated and the indigent because there is evidence that these are the people at risk of not knowing about the threat, perceiving the threat to be of low risk and ultimately being less likely to follow recommended behaviours. An honest reporting of what the threat looks like, through a presentation of known and unknown factors, seems to have a better impact on people's knowledge, attitudes and beliefs, |

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| | | | | | = 49), and emotional responses such as fear and worry (47%, N = 43). Factors influencing the H1N1 vaccination acceptance rate (26%, N = 24) were also frequently investigated. | including trust in the way the government is handling the emergency. Consequently, there is some evidence that better knowledge and trust are likely to be associated with the adoption of recommended behaviours (i.e. immunization practices). Social networks and ties to the community are also drivers of better knowledge and compliance with preventive measures; these results suggest that non-traditional channels of communication (i.e. partnership with community leaders or organizations) should be used to reach out to the most vulnerable and those in need of a better understanding of the risks and actions needed to be able to protect themselves. Public health communication messages are still delivered at a literacy level that does not meet the needs of the less educated. |
| **Menon (2005)** | Singapore | Commentary – narrative review | SARS | | Risk perceptions | 1. Providing more information is more effective than less information, 2. it always better to over-react than to under-react. 3. fear and ignorance of any disease is worse than the disease itself. It reduces all to impotence and defeat. Information is an all-powerful tool to fight fear. It empowers people and allows them to become socially responsible. |
| **Menon (2006)** | Singapore | Narrative review/ commentary | SARS | Mixed - TV, technology | Not reported | Technology (The Infrared Fever Screening System), a SARS-dedicated TV channel, transparency, leadership (highest levels of government came into the picture very early in the crisis and took the lead), communication tools (moderating public fear through dialogue with grassroots leaders and community, briefings for foreign business groups, diplomats, religious groups, trade associations, cartoons, hotlines, songs on TV), earning the trust and confidence of Singaporeans, rebuttal of negative reports in the foreign media claiming that foreign visitors had been infected with SARS whilst transiting Singapore, outbreak communications across cultures. |
| **Rogers (2009)** | Australia | Deliberative forum | Influenza | hypothetical | Risk awareness | The forum wanted full and frank information about the potential risk and international developments including numbers of cases and fatalities. Forum members understood that predictions about the pandemic influenza were uncertain, |

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| | | | | | | this did not lead to loss of confidence in the experts or the information they imparted. Third, the forum recommended releasing geographically localizing information about initial cases. The forum recommended increasing use of television and websites, including those targeting youth and rural and remote groups as the pandemic developed. The forum recommended immediate activities to educate and build awareness and swift action if and when Australia has its first cases of PI. |
| **Santibañez (2015)** | USA | Commentary | Ebola | | N/A | 10-step approach can be adapted for infectious disease response communications (in this case Ebola) allowing community and faith-based organisations to help spread effective health messages |
| **Schiavo (2014)** | | Systematic review | Influenza, SARS | Media | Handwashing, immunizations, infection control precautions | most studies found behaviour changed |
| **Toppenberg (2018)** | Various | Rapid Review of Grey Literature | Ebola | | Awareness only | Literature strongly underlines the central importance of local communities. A one-size-fits-all approach does not work. For maximum effectiveness, local communities need to be involved with and own emergency risk communication processes, preferably well before an emergency occurs. Social media can open new avenues for communication but is not a general panacea and should not be viewed as a replacement for traditional modes of communication. In general, the gray literature indicates movement toward greater recognition of emergency risk communication as a vitally important element of public health. |
| **Vaughan (2009)** | Not reported | Commentary – narrative review | Pandemic Influenza | | Message acceptance | Barriers to accepting messages include, environmental factors, social and cultural characteristics, language preferences (translation, culturally sensitive) difficulty of and attitudes towards public health interventions |

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**Table 4 – Characteristics of Preprint Studies**

| | Country | Study Type | Health Threat | Intervention type | Target behaviour | Main findings |
|---|---|---|---|---|---|---|
| **Abu-Akel, Spitz & West (2020)** | Switzerland | Pilot experimental survey study | COVID-19 | Social distancing | Social distancing | The government official was more effective at garnering support for social distancing than the celebrity, particular in older respondents. Support and compliance relating to social distancing was higher in older people, despite them having lower percieved risk of threat. Females were overall more in support of social distancing. Higher support and compliance was related to greater concern about the situation, concern for others health, greater belief in social distancing measures and feeling more constrained by them. Inverse relationship between city size and practise of social distancing. |
| **Bilancini, (2020)** | Italy | Four-condition, between-subjects experiment. | COVID-19 | Official coronavirus-related messages | Behaviours relating to the COVID-19 emergency | No statistically significant difference between the 4 conditions. Authors conclude that stronger 'nudging' interventions may be needed to influence behaviour. |
| **Blagov (2020)** | USA | Online survey | COVID-19 | Public health messages worded to target different personality traits (self-centered, responsible, compassionate, avoidant & sociable). Looks like she were developed by the researchers. | Staying at home, physically distancing and practising handwashing | Agreeableness and conscientiousness predicted endorsement of social distancing and hygiene. Meanness and disinhibition (and overall psychopathy) as well as Machiavellianism (less so) predicted lower intent for social distancing. Together with boldness, the psychopathy traits predicted endorsement of risky, venturesome behavior under the pretend scenario that one is a disease carrier. Meanness and disinhibition predicted endorsement of knowing and possibly deliberate behaviour that puts others at risk of infection. |

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| **Bradshaw, (2020)** | Australia | Randomized experimental online study | COVID-19 | Online vignettes about the contact tracing app | Downloading and using a contact tracing app | Autonomy-supportive and controlling message framing did not differentially affect intended uptake. However, there was a main effect of information safety. Those in high information safety conditions reported higher intentions to use the application and to recommend it to others than those in low information safety conditions, regardless of message framing. Australians appeared more willing to assent to authority regarding contact tracing insofar as their data safety can be assured. |
| **Dai (2020)** | China | Cross-sectional online survey | COVID-19 | Information on government emergency management measures relating to COVID-19 | Protective behaviours, including preventive (i.e. wearing masks, disinfectants), avoidant (i.e. stringent quarantine, avoiding public places), and management of disease behaviours (i.e. seeking professional protection or treatment information, paying for preventive and therapeutic drugs) | Governmental information transparency, positive propaganda, rumour refutation, and supplies positively predict the protective behaviours. Individual factors such as perceived control, positive emotions, and risk perception mediate role in predicting protective behaviours. |
| **Everett, (2020)** | USA | online experimental survey study | COVID-19 | Social media (Facebook post) either from a citizen or leader. | Behavioural intentions for: Hand washing, avoiding gatherings, isolation, cancelling holidays | Stronger intentions if messages were shared by 'leader' than citizen, modest effects of using deontological and virtue-based messaging (compared to utilitarian) |
| **Goldberg, (2020)** | USA | Online Survey | COVID-19 | N/A - measured behaviours as a result of seeing | mask buying and mask wearing | Once the CDC recommendation had been disseminated for at least one full day, there were large increases in reported mask wearing and mask buying. |

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| | | | | national guidance from the CDC | | |
| **Heffner (2020)** | USA | Within subject design, online survey | COVID-19 | 2 messages about staying at home, one focused on 'fear', the other on 'altruism' | Intentions to self-isolate, emotional response | Both messages were associated with increased willingness to self-isolate. The prosocial message was more effective at boosting willingness to self-isolate if it produced a strong, positive, and arousing emotional response. Fear messages created a stronger emotional response. |
| **Jordan (2020)** | USA | Three-part online experimental study | COVID-19 | PH messages/ fliers about COVID-19 emphasising personal, public or personal & public protective messages. | Hand washing, social distancing, staying at home, wearing a mask. | In the early stages of the pandemic, prosocial (i.e. public) messaging was more effective. However, as the pandemic progressed, all three types of framing (i.e. prosocial/ public, self-interested/ personal and both) were equally as effective. Self-interested framing was never more effective than prosocial framing and did not improve efficacy of prosocial framing. |
| **Merkley, (2020)** | Canada | 2-part online experimental survey study | COVID-19 | News stories relating to the pandemic - signalling information from experts or non-experts. | Information on hygiene (i.e. cleaning surfaces), social gatherings, testing and scientific discoveries. | Study 1: We find that our respondents were on average 3 points more likely to select news stories with headlines featuring experts (p~0.007). News stories with headlines featuring experts scored 2 points higher in credibility (p<0.002). In support of H1, we find that the effect of receiving headlines featuring experts is heterogeneous across levels of anti-intellectualism. The marginal effects on story selection are shown in the left panel of Figure 2. Respondents with the lowest levels of anti-intellectualism are six points more likely to select stories featuring experts (p<0.001), but this effect disappears once the mid-point of the scale is reached. Study 2: Our respondents were 19 points more likely to select COVID-19 news (p<0.001). They also viewed such news as 6 points more credible (p<0.001) and 19 points more important (p<0.001). Once again, |

| | | | | | | |
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| | | | | | | anti-intellectualism strongly conditions news preferences. Respondents with the highest levels of trust in experts were 25 points more likely to select COVID-19 news (p<0.001), and viewed it as 8 points more credible (p<0.001) and 24 points more important (p<0.001). In all three cases this effect weakens as anti-intellectualism rises, though it does not entirely vanish for the most part. |
| **Wirz, (2020)** | USA | Online Survey | COVID-19 | N/A - survey asking whether people were practising guidelines (e.g. social distancing) and questions about barriers and communication. | Social distancing | Perceived effectiveness of social distancing for decreasing the risk of infection and perceived social norms related to social distancing were strongly correlated with reported social distancing, suggesting that individuals engaged in social distancing if they thought it worked and if they thought their peers were doing it. If they learned that their social distancing behaviour would help others (e.g., family, older members of the community) and that there are serious health consequences for people like them, they would engage in more social distancing. Respondents in this group reported often getting news from national news networks and social media, followed by newspapers/news magazines. Respondents reported having the highest levels of trust in information from the CDC, public health experts, and the WHO. These groups were followed by university scientists and friends and family. The White House, state and local governments, and the news media were among the least trusted sources for information. |

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## Appendix 5- Data quality table using Mixed Methods appraisal tool and AMSTAR

| Studies | Method | Score | Stars | S1 | S2 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | Criteria from the mixed methods appraisal tool | | | | | | | | | | | | | | |
| 1. Aburto (2009) | cross sectional representative household survey | 4 | **** | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 0 | 1 | | | | | |
| 2. Avery (2009) | Content analysis | 5 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| 3. Berry (2007) | Content analysis | 4 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | |
| 4. Bekalu (2017) | Pre/post intervention study | 4 | **** | 1 | 1 | | | | | | 1 | 1 | 1 | 0 | 1 | | | | | | | | | | | | | | | |
| 5. Basnyat & Lee (2014) | Qualitative | 4 | **** | 1 | 1 | 1 | 0 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| 6. Bonwitt (2018) | Experimental | 4 | **** | 1 | 1 | 1 | 0 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| 7. Chang (2012) | Experiment (2 by 3 factorial design) | 5 | ***** | 1 | 1 | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| 8. Cole & Watkins (2015) | interviews | 2 | ** | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | |
| 9. Crouse Quinn (2008) | Commentary | | n/a | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10. Crosier (2015) | Qualitative Interviews | 4 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | |
| 11. Daellenbach (2018) | Quantitative online survey | 3 | *** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 0 | 1 | 0 | 1 | | | | | |
| 12. Davis, (2013) | Experimental design with 3 conditions | 5 | ***** | 1 | 1 | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| 13. Davis (2015) | Qualitative interviews and focus groups | 3 | *** | 1 | 1 | 1 | 1 | 0 | 1 | 0 | | | | | | | | | | | | | | | | | | | | |
| 14. Freiman (2011) | face to face interviews | 5 | ***** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | |
| 15. Goldberg (2015) | Report | | n/a | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| # | Author | Study type | Score | Stars | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 | V9 | V10 | V11 | V12 | | | | | | V18 | V19 | V20 | V21 | V22 |
|---|--------|-----------|-------|-------|----|----|----|----|----|----|----|----|----|-----|-----|-----|--|--|--|--|--|-----|-----|-----|-----|-----|
| 16. | Gray (2012) | Focus groups | 5 | ***** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| 17. | Hickey (2014) | Cross-sectional survey | 5 | ***** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| 18. | Hoda (2016) | Survey | 2 | ** | 1 | 1 | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 1 |
| 19. | Holmes (2009) | Semi-structured interviews | 5 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| 20. | Idoiaga (2016) | experimental | 2 | ** | 1 | 1 | | | | | | 0 | 0 | 1 | 0 | 1 | | | | | | | | | | |
| 21. | Jhummon-Mahadnac (2012) | Cross-sectional survey | 5 | ***** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| 22. | Johnson (2015) | Experimental – 2 studies (both studies) | 3 | *** | 1 | 1 | | | | | | 1 | 1 | 1 | 0 | 0 | | | | | | | | | | |
| 23. | Jones (2010) | Focus groups | 2 | ** | 1 | 1 | 0 | 0 | 1 | 0 | 1 | | | | | | | | | | | | | | | |
| 24. | Kavanagh (2011) | cross sectional survey | 4 | **** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 0 | 1 |
| 25. | Lapka (2008) | Focus Group and Interviews | 5 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| 26. | Lohiniva (2020) | Qualitative | 4 | **** | 1 | 1 | 1 | 1 | 1 | 0 | 1 | | | | | | | | | | | | | | | |
| 27. | Li (2016) | Focus group | 5 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| 28. | Liao, (2010) | telephone interviews (surveys) | 4 | **** | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 0 | 1 |
| 29. | Lyu (2012) | Qualitative Interviews | 3 | *** | 1 | 1 | 1 | 0 | 1 | 1 | 0 | | | | | | | | | | | | | | | |
| 30. | Menon (2005) | Narrative review | | n/a | | | | | | | | | | | | | | | | | | | | | | |
| 31. | Menon (2006) | Narrative review/commentary | | n/a | | | | | | | | | | | | | | | | | | | | | | |
| 32. | Miczo (2013) | Cross-sectional survey | 2 | ** | 1 | 1 | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 1 |
| 33. | Mitchell (2014) | Focus groups and interviews | 5 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |

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| # | Author | Method | Score | Stars | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | ... | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34. | Person, (2004) | Focus groups and rapid situational assessment | 2 | ** | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | | | | | | | |
| 35. | Prati (2011) | Cross-sectional survey | 3 | *** | 1 | 1 | | | | | | | | | | | | 1 | 0 | 1 | 0 | 1 |
| 36. | Qian (2020) | Content analysis | 2 | ** | 1 | 1 | 0 | 0 | 1 | 1 | 0 | | | | | | | | | | | |
| 37. | Qiu (2018) | Focus groups and interviews | 5 | ***** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| 38. | Roess (2017) | Pre-post interventional study | 3 | *** | 1 | 1 | 0 | 0 | 1 | 1 | 1 | | | | | | | | | | | |
| 39. | Rogers (2009) | Deliberative forum | 3 | *** | 1 | 1 | 1 | 1 | 1 | 0 | 1 | | | | | | | | | | | |
| 40. | Rim (2014) | Content analysis +correlation with survey results | 1 | * | 1 | 1 | 0 | 0 | 1 | 0 | 0 | | | | | | | | | | | |
| 41. | Rimi (2016) | ethnography | 3 | *** | 1 | 1 | 1 | 0 | 1 | 1 | 0 | | | | | | | | | | | |
| 42. | Santibañez (2015) | Commentary | | n/a | | | | | | | | | | | | | | | | | | |
| 43. | Sell (2017) | Content analysis of news coverage | 5 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| 44. | Seltzer (2015) | Content analysis | 3 | *** | 1 | 1 | 1 | 0 | 1 | 0 | 0 | | | | | | | | | | | |
| 45. | Sumo (2019) | Interpersonal communication' and dialogue | | n/a | | | | | | | | | | | | | | | | | | |
| 46. | Teasdale (2011) | Focus groups | 4 | **** | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | | | | | | | | | | |
| 47. | Toppenberg (2018) | Rapid Review of Grey Literature | 5 | ***** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| 48. | Tully (2019) | Content analysis | 3 | *** | 1 | 1 | 1 | 1 | 0 | 1 | 0 | | | | | | | | | | | |
| 49. | Updegraff (2011) | Experimental design with 3 conditions | 4 | ***** | 1 | 1 | | | | | | 1 | 1 | 1 | 0 | 1 | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50. | Vaughan (2009) | Narrative review | | n/a | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 51. | Van der Weerd (2011) | Cross-sectional telephone survey | 5 | **** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | |
| 52. | Winters (2018) | Cross-sectional | 5 | ***** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | |
| 53. | Yardley (2011) | parallel-group pragmatic exploratory trial design (RCT) | 4 | **** | 1 | 1 | | | | | 1 | 1 | 1 | 0 | 1 | | | | | | | | | | | | | | | | |
| 54. | Zikmund-Fischer (2017) | experiment | 2 | ** | 1 | 1 | | | | | 0 | 0 | 0 | 1 | 1 | | | | | | | | | | | | | | | | |

Data Quality check of Systematic Reviews with AMSTAR

| Citation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Schiavo et al | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| Lin et al | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Barrelet et al | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Studies | | | | | Criteria from the mixed methods appraisal tool | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | S1 | S2 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 |
| 1. Abu-Akel (2020) | Pilot survey-based study (randomised) | 4 | **** | 1 | 1 | | | | | | 1 | 1 | 1 | 0† | 1 | | | | | | | | | | | | | | | |
| 2. Bilancini (2020) | Randomised controlled trial | 3 | *** | 1 | 1 | | | | | | 1 | 0 | 1 | 0 | 1 | | | | | | | | | | | | | | | |
| 3. Blagov (2020) | Cross-sectional survey | 2 | ** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 0 | 0 | 0 | 1 | | | | | |
| 4. Bradshaw (2020) | Randomised controlled trial | 4 | **** | 1 | | | | | | | 1 | 1 | 0 | 1 | 1 | | | | | | | | | | | | | | | |
| 5. Dai (2020) | Cross sectional design survey | 4 | **** | 1 | 1 | | | | | | | | | | | 1 | 1 | 0† | 1 | 1 | | | | | | | | | | |
| 6. Everett (2020) | Randomised cross-over study | 1 | * | 1 | 0 | | | | | | 0 | 0 | 0 | 0 | 1 | | | | | | | | | | | | | | | |
| 7. Goldberg (2020) | National survey | 4 | **** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 0 | 1 | | | | | |
| 8. Heffner (2020) | Cross-sectional analytic study | 4 | **** | 1 | 1 | | | | | | | | | | | 2 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| 9. Jordan (2020) | Randomised controlled trial | 2 | ** | 1 | 1 | | | | | | 0 | 0 | 1 | 0 | 1 | | | | | | | | | | | | | | | |
| 10. Merkley (2020) | Randomised controlled trial | 1 | * | 1 | 1 | | | | | | 0 | 0 | 0 | 0 | 1 | | | | | | | | | | | | | | | |
| 11. Wirz (2020) | Online Survey | 3 | *** | 1 | 1 | | | | | | | | | | | | | | | | 1 | 1 | 0† | 0† | 1 | | | | | |

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## Appendix 6: Influences on effective public-health messaging

Most of the studies were qualitative work and reported on determinants of intent to adhering to guidelines by reporting what influences people's responses to public health messaging. These are: preconceptions and understanding of the threat, perceived susceptibility and perceived risk severity (threat appraisal(Rogers, 1975)).

*Preconceptions and understanding of the threat*

Of the 68 studies included, 26 specified that public health messaging included information about the threat which can be effective in identifying symptoms and changing behaviours. Some of these, including the only randomised control trial, reported changes in handing washing (Yardley, Miller, Schlotz, & Little, 2011), changes in knowledge and higher compliance to quarantine (Kavanagh et al., 2011). However, this particular study found the messages were not effective in encouraging quarantine behaviour suggesting that increasing knowledge alone did not change behaviour (Kavanagh et al., 2011). More comprehensive reporting on what the threat is and looks like, including presentation of known and unknown factors has a positive impact on people's knowledge, attitudes and beliefs. Self-reports, in the qualitative studies and in surveys, suggest changes in hygiene and unspecified protective behaviours following messages of how a virus (e.g. H1N1, SARS, Ebola) is transmitted, and the ability to idenitfy symptoms, and how to prevent transmision (Chidgzey, Davis, Williams, & Reeve, 2015; Gray et al., 2012; Hickey, Gagnon, & Jitthai, 2014; Hoda, 2016; R. Li, Xie, Yang, & Frost, 2016; Rim, Ha, & Kiousis, 2014; Teasdale & Yardley, 2011; Yardley et al., 2011). In the systematic reivew, public health messaging campaigns using posters (e.g. "*Catch it, Bin it, Kill it"*) increased knowledge about tramsission, and successfully increased self-reported prevention behaviours (hygiene when using tissues and sneezing). However, compliance to these behaviours was also predicted by worrry (Lin, Savoia, Agboola, & Viswanath, 2014). The systmatic review argued that individuals with higher education were better informed about H1N1. The review concluded that messages and communication are still delivered at a high literacy level (Lin, Savoia, et al., 2014). Whilst most of these papers highlighted that people will have different preconceptions and concerns to address in the public health messages, three papers also highlighted that people may have limited experiences of engaging in the preventative behaviour e.g. using face masks or using a thermometer (Hickey et al., 2014). Such cases highlighted a need for training/skill development as part of a public health campaign.

People that were able to identify symptoms of H1N1 were more likely to avoid crowds and washed hands more (Aburto et al., 2010). Framing and choice of language were found to be influential in behaviour and how individuals understand the threat (Teasdale & Yardley, 2011). Positively framed messages (emphasising the benefits of prevention behaviours) were considered 'robust contingency measures' (Basnyat & Lee, 2015). Gain-framed signs were significantly more effective in influencing the use of hand sanitizer as cue-to-action reminder signs at the point-of use during the H1N1 pandemic (Updegraff, Emanuel, Gallagher, & Steinman, 2011). The worst-performing signs emphasised people's susceptibility to contamination (Updegraff et al., 2011).  Communication strategies were characterized in three case studies from the H1N1 pandemic from Italy, Hungary and England as "top-down" expert-led responses by public health communications specialists because there was no audience research. With no audience research, there was a perceived lack of planning and consideration to the tone, targeting or channelling of public health messages. Lack of consideration of these aspects led to low levels of public compliance and engagement with

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behaviour (Crosier, McVey, & French, 2015). A non-narrative message format (i.e., factual) may be more effective than a narrative counterpart to communicate basic prevention information during public health emergencies. Compared with the narrative and/or fictional version, the more didactic and factual format was found to be more effective in changing knowledge and perceived response efficacy related to prevention of pandemic influenza however, behaviour or intent were not measured in the study (Bekalu, Bigman, McCloud, Lin, & Viswanath, 2018). When messages provided the public with clear consistent information whilst admitting that information is evolving, reported the risks, and focused on the practical actions that people can do to reduce their risk and emphasized the efficacy of those actions, people were more likely to clean objects, wash hands and use tissues when sneezing (Prati, Pietrantoni, & Zani, 2011). A pre-print manuscript found that for one to perceive and understand the extent of a threat, messages that are framed in relation to identity (e.g. "don't be a spreader" vs "don't spread") were more likely to predict preventative behaviour following the Japanese Ministry of Health guidelines (Yonemitsu, 2020).

When individuals do not understand the message or the preventative behaviour being communicated, participants did not outright reject public health messages. Instead, people adjusted the key underlining message to what they thought made sense, and engaged in behaviour consistent with the adjusted message (Bonwitt et al., 2018). As there is general uncertainty around a pandemic flu it is hard for people to differentiate this from seasonal flu especially when symptoms are framed as "flu-like symptoms" (Teasdale & Yardley, 2011). In a qualitative study, people reported being more likely to follow guidelines when there were fewer perceived barriers to perform the recommended behaviours, when there are emphasised benefits and when contextual factors are considered such as feeling guilty and anxious about missing work and not wanting to let people down (Teasdale & Yardley, 2011). High levels of knowledge was associated with exposure to messages and was a mediator between different sources and complying with recommended protective behaviour. However, engaging with social media was associated with misconceptions of public health information (Winters et al., 2018).

*Threat appraisal: perceived susceptibility/vulnerability*

Increase in exposure to any type of information was associated with increased knowledge, and as level of outbreak increased (that increased the level of threat appraisal), protective behaviours increased, suggesting a strong dose-response (Johnson & Slovic, 2015; Winters et al., 2018). As perceptions of higher risk increase so did self-reported behaviours such as handing washing, wearing a facemask and using hand gels (Aburto et al., 2010). However, salience (i.e. prominence) in media coverage did not have a direct relationship with increasing perceived risk. One study found that there was no relationship between salience in media coverage of H1N1, or the severity of content and the public perception of risk (Rim et al., 2014).

Being worried about H1N1 was associated with media attention and number of H1N1 cases, and overall an important predictor of compliance with recommended preventative behaviours, such as using tissues, hand gel and washing hands (Lin, Savoia, et al., 2014). Worry led to effective compliance and increased adaptive behaviour in one included study (Gutteling, Terpstra, & Kerstholt, 2018). Evoking fear increased participants' perceptions of the severity of the issue and their vulnerability to the risk but did not increase prevention behaviours or treatment efficacy (Chang, 2012). Moreover, panic could be counterproductive (Zikmund-Fisher, Scherer, Knaus, Das, & Fagerlin, 2017); providing a "worse-case" scenario (that there is a high risk and there is a pandemic) and increasing knowledge of the health threat simultaneously, has been found to induce panic in

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those receiving the message (Jhummon-Mahadnac, Knott, & Marshall, 2012). Believability of messages was reduced by scepticism towards the media and governments; in these instances the threat was perceived as exaggerated and able to cause unnecessary panic which could influence low adoption of recommended action (Teasdale & Yardley, 2011). In a preprint manuscript, messages arousing an emotional response (such as fear) was more effective in boosting willingness to self-isolate alongside prosocial messages that are producing strong and positive emotional response (Heffner, 2020).

Perceiving a threat would mean that population warning systems (method where local, regional or national authorities contact the public en masse)  can work but social pressure in addition to increasing perceived risk is also required (Gutteling et al., 2018). Worry about self or family members led to increased perceptions of disease severity and a stronger belief of being susceptible to the infection, leading to a greater compliance with recommended behaviours (Lin, Savoia, et al., 2014). Perceived susceptibility in the messaging (e.g. "this can happen to someone like me") was more likely to lead to engagement in physical distancing than the geographical closeness of the disease (e.g. cases in the local area) thereby appraising the threat as high (Cole & Watkins, 2015). If risk is perceived to be low (e.g. H1N1 pandemic likened to influenza pandemics) recommendations such as "stay at home" were perceived as extreme and inappropriate (Teasdale & Yardley, 2011). This then has implications for increasing distrust in the messages and sources. Behaviours such as usage of a sanitizer dropped over time mapping the temporal trends in public interest in H1N1 (Updegraff et al., 2011).

Individuals were more likely to be concerned about the risk to themselves rather than the risk they would pose to others (M. D. Davis, Stephenson, Lohm, Waller, & Flowers, 2015). A recent systematic review concluded that beliefs about personal susceptibility to H1N1, and perceiving it as potentially severe (infection rate), is linked with high levels of worry about self or family members at risk (Lin, Savoia, et al., 2014). Efficient public health messaging (where individuals were more likely to comply with behaviour (e.g. avoiding crowds; (Aburto et al., 2010) tapped into worry about self or family members by framing messages with positive social responsibility (Basnyat & Lee, 2015). Concern for family led to reporting more information-seeking and appraising the threat as a higher risk to self and their family (Cole & Watkins, 2015). Prosocial framing and focus on activating social norms were found in the grey literature to be effective in increased engagement in physical distancing (Jordan, 2020; Wirz 2020). Tailoring public health messages with compassion may increase acceptance of the messages (Blagov, 2020). Such prosocial framing in the public health messaging personalised the risk and increasing the perceived susceptibility and vulnerability.

### Increasing trust
An important finding that 60% of the included studies identified the need to increase the public's trust in the messages during pandemics and epidemics (Aburto et al., 2010; Cole & Watkins, 2015; Gray et al., 2012; Hickey et al., 2014; Holmes, Henrich, Hancock, & Lestou, 2009; Jhummon-Mahadnac et al., 2012; Johnson & Slovic, 2015; Kavanagh et al., 2011; Liao, Cowling, Lam, Ng, & Fielding, 2010; Lohiniva, Sane, Sibenberg, Puumalainen, & Salminen, 2020; Lyu et al., 2013; Person et al., 2004; Prati et al., 2011; Qiu et al., 2018; Sumo et al., 2019). Participants cited trust as the main reason they complied, and observational studies found trust to be essential in complying with preventative behaviours (R. Li et al., 2016; Menon & Goh, 2005), both when communicating public health advice from public health agencies (Li et al., 2016) or from the government (Menon & Goh, 2005). Arguably, the need to increase trust highlights that acceptability of the message is reliant on

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the right message given in the right way (framing cross-reference), by an appropriate messenger (cross-reference credible source) at the right time.

One of the systematic reviews, concluded that competing narratives should be addressed to support trust-building, and this can be achieved through involving the public with two-way communications in the design of the messages (Barrelet, Bourrier, Burton-Jeangros, & Schindler, 2013). Whilst the other systematic review, found that an honest reporting of what the threat looks like, through a presentation of known and unknown factors, seems to have a better impact on people's knowledge, attitudes and beliefs, including trust in the way the government is handling the emergency (Lin, Savoia, et al., 2014).

In a repeated measures survey during H1N1 pandemic, trust levels in the government decreased over time, higher levels of government trust led to higher intention to adhere to the guidelines and change in trust was due to conflicting messages at the same time points and as they change over time (van der Weerd, Timmermans, Beaujean, Oudhoff, & van Steenbergen, 2011). Anxiety was mitigated by messages that were prompt and delivered at the right time for the point of the pandemic/epidemic, transparent, recommended preventative behaviours, and provided evolving outbreak trends (i.e. giving information as it happens) (R. Li et al., 2016). People are more likely to engage in behaviour inconsistent with the message if messages lack clarity or there is inconsistent messaging both over time and between sources. This eventually results in individuals distrusting the message. Therefore, one paper argues besides information and excessive exposure of such information there is also a need for behavioural modelling (to see the behaviour by others) (O. L. Davis, Fante, & Jacobi, 2013). Information in messages needs to be relevant and trustworthy to influence behaviour change and can include: catastrophic potential, probability of dying, and reasons for exposure. Providing explanations for perceived differences from other countries, not being too optimistic and not hide information can increase overall trust towards authorities (Lohiniva et al., 2020). Attempting to increase knowledge in the context of low levels of public trust in the source can make a message ineffective, and mistrust can increase if the perception is that the information is exaggerated (Jhummon-Mahadnac et al., 2012; Teasdale & Yardley, 2011). When an epidemic (e.g. Ebola) seemed contained, and contact tracing was successful, trust increased and, in response, so did the adherence to messages (e.g. reporting to health facility) (Sumo et al., 2019).

*Multiple and credible sources*

Individuals seek information from multiple sources to meet different information needs (Cole & Watkins, 2015). Whilst official sources of information (such as governmental sources, or public health bodies) are seen as legitimate, individuals do not always find them useful (Toppenberg-Pejcic et al., 2019; Tully, Dalrymple, & Young, 2019) thereby seek other sources. When official sources take a long time to provide information, individuals rely on informal sources such as rumours, word of mouth, social media (Cole & Watkins, 2015; van der Weerd et al., 2011); the value of information is at its highest when the outbreak is emerging. If mass media do not report the outbreak in time (before unofficial/informal sources start reporting the outbreak) it fails to become the leading indicator that people use for their information (J. Li, Xu, Cuomo, Purushothaman, & Mackey, 2020). Delay can impact the public's trust in official sources (e.g. government) and has led to beliefs that the threat is exaggerated by government or news and media (J. Li et al., 2020; Teasdale & Yardley, 2011) especially when information is conflicting. Furthermore, a delay in addressing rumours

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circulating among the public increases the chances of apathy and communication fatigue (Mitchell et al., 2014).

The grey literature reported that individuals seek information from sources that they consider trustworthy these include public health experts, WHO and Centers for Disease Control and Prevention (CDC) and state and local governments;  news media were the least trusted sources (Wirz 2020). Another preprint found that there was greater compliance and acceptance of messages when the messages came from government officials and credible sources (Abu-Akel, 2020). The effect on behaviour change (self-reported mask wearing and mask buying) from messaging was greater amongst individuals who trusted the Centers for Disease Control and Prevention (CDC), government agencies and scientists (M. H. Goldberg, Gustafson, A., Maibach, E.W., Ballew, M.T., Bergquist, P., Kotcher, J.E., Marlon, J.R., Rosenthal, S.A., Leiserowitz, A.,, 2020) and these messages were better received (Merkley, 2020). Explicit information, data safety and transparency were important (Bradshaw 2020) especially when describing protective behaviours (Dai, 2020).  Whilst individuals generally preferred expert sources for the initial information-seeking, they eventually relied on other sources (and perceptions such as "anti-intellectualism" increased); eventually leading to discontinuing use of official sources for information during a pandemic (Merkley, 2020).

### Community engagement and social networks

Social networks and close ties to the community are drivers of better knowledge and compliance with preventive measures. A systematic review suggests that non-traditional channels of communication (i.e. partnership with community leaders or organizations) should be used to reach out to the most vulnerable (can include those who have a disability e.g. hearing/vision/intellectual) and those who are least literate as well as non-Native speakers. Public health communication messages are still delivered at a literacy level that does not meet the needs of the less educated. To reduce communication inequalities, those who are less likely to identify risk associated with the threat and so less likely to adhere to the behaviours should be targeted. These include the young, least educated and hard to reach communities (Lin, Savoia, et al., 2014).  The public pay more attention if the community is engaged in the intervention (Schiavo, May Leung, & Brown, 2014) as communication is a dynamic process and to address the concerns, values, interests and priorities the public need to be partners in communication (Barrelet et al., 2013).

The inclusion of various communities increases the chances of developing materials with which all individuals can identify (Crosier et al., 2015). This in turn increases the chances of perceiving the message is relevant to their self and important people in their lives thus heightening risk perception, and changing behaviours (Crouse Quinn, 2008; Gray et al., 2012; Person et al., 2004). Individuals want information that fits with their experiences (Freiman et al., 2011; Teasdale & Yardley, 2011). Adaptable and personalised information, that is context-driven, is more effective in changing determinants of behaviour (e.g. especially in vulnerable groups) (Daellenbach, Parkinson, & Krisjanous, 2018; Qiu et al., 2018).  Core messages should be consistent to ensure trust but also considerations need to be made to ensure the involvement of communities to address their needs (e.g. including community leaders, translations, access to resources). Message delivery should be appropriate for the targeted population; for example, social media can open new avenues but should not to other types of delivery (Toppenberg-Pejcic et al., 2019). There is a use for social media, as it can be effective in communicating messages (Lwin, Lu, Sheldenkar, & Schulz, 2018), fostering trust and providing opportunities for dialogue (Tully et al., 2019). Social media can be especially

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useful for reaching young people who trust social media channels (R. Li et al., 2016). Social-economic status (SES) is related to information access and understanding; those of lower SES were less likely to use a website, and more likely to find public health messages from TV and Radio to be confusing and contradictory than those of higher SES (Aburto et al., 2010).

The grey literature highlighted that developing prosocial messages and identity, increased willingness to self-isolate especially when producing a strong, positive emotional response (Heffner, 2020). Another preprint found that messages should not just target those who are at risk but those who do not perceive themselves at risk from COVID-19 (e.g. young people and hard to reach groups). Messages must also address barriers to physical distancing and outline benefits of carrying them out, emphasising altruism through messaging from credible sources using social media (Wirz 2020). Another preprint found that prosocial messages were the most effective type of framing, tapping into people's sense of morality especially at the beginning of a pandemic. This changed over time and self-interest messaging were just as effective (Jordan, 2020).

## Messages for sub-populations

Young (Student populations) and older adult populations

Three studies examined perceptions and experiences of H1N1 messages with student populations (Idoiaga, De Montes, & Valencia, 2016; Miczo, Danhour, Lester, & Bryant, 2013; Mitchell et al., 2014). An experimental study on framing found that younger students (mean age = 21.05) perceived themselves as less vulnerable than older students (over the age of 60) in falling ill with flu when reading a news report that described a flu epidemic (Idoiaga et al., 2016). The authors suggest this may be due to the 'social invulnerability identity' of younger people. This is consistent with social cognitive approaches to health risk perception, which suggests people may be "unrealistically optimistic" about a particular health threat (Weinstein, 1987).

Campus and mass media were reported, by students, as the most common places for getting information about the H1N1. Students tend to perceive information from the university as more credible than the media (Mitchell et al., 2014).

Focus groups exploring reactions to two different campaign ideas (for a potential avian influenza epidemic in Australia) found that there was some confusion amongst older adults whereby they presumed the 'WIPE' part of the WASH, WIPE, and WEAR' message was referring to handkerchiefs, rather than disposable tissues. Older adults (and separately mothers) predominantly preferred messages which emphasised protecting others (e.g. that they should wear a mask if they were sick in order to protect others) (Jones, Waters, Holland, Bevins, & Iverson, 2010). On the other hand, regional and frequent travellers' groups thought it was equally important to protect themselves from other people's germs, and also protect others from their germs (Jones et al., 2010).

Vulnerable groups

The importance of both protecting themselves and others was evident in findings from focus groups conducted with vulnerable groups in New Zealand during the influenza H1N1 2009 pandemic (Gray et al., 2012). People wanted messages about specific actions that they could take to protect themselves and their families during the pandemic.

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During the influenza H1N1 2009 pandemic, a cross-sectional survey was conducted with migrant workers (i.e., anyone who did not have Thai citizenship) to explore their perceptions of and ability to implement non-pharmaceutical interventions (NPIs; e.g., using face masks when sick) proposed by the WHO (Hickey et al., 2014). Certain groups of migrant workers were considered as a vulnerable group due to traditions in raising poultry and swine, poor personal hygiene and sanitation, low health literacy, limited access to healthcare, and high frequency of cross-border communication. Attitudes towards recommended NPIs were generally negative or ambivalent. Barriers included never having worn a face mask and not knowing the correct way to wear one. This highlights the need to educate vulnerable groups about performing NPIs during pandemics as migrants are at risk of propagating the spread of a pandemic virus. It is also important that public education campaigns can reach migrants living in remote and difficult to access areas, and to accommodate for the diverse cultural and linguistic needs.

The importance of ensuring that public health messages can reach different linguistic groups was also echoed by the Pacific Peoples' participants in the focus groups conducted by Gray et al. (Gray et al., 2012). Older people in the group are unlikely to understand English so messages should be communicated in the original languages. However, as noted by Person et al., (Person et al., 2004) this can be very difficult when an in-house translation service does not exist, and the rapidly evolving scientific evidence will challenge the turnaround time for developing, translating, and disseminating information. To help address this, the team prioritised key SARS documents for translation and back-translations conducted by professional translation services ensured accuracy. The translated information should be disseminated through culturally appropriate channels such as community visits, town hall meetings, and health and education and communication channels to complement mass media messages. This is similar to reflections of Singapore's experience in dealing with the SARS outbreak (Menon, 2006) where there was ongoing transparent dialogue with grassroots leaders and communities, and religious groups.

Social Economic Status (SES)

A cross-sectional survey with 1010 adult Italians during the influenza H1N1 2009 pandemic found that respondents who were women, and were facing economic hardship, were more likely to clean objects, wash their hands, and use tissues when sneezing (Prati et al., 2011).

A Mexican study, which explored the public's ability and willingness to adopt community mitigation efforts during the influenza H1N1 2009 pandemic, found that respondents from lower SES groups were more likely to report costs of masks being a barrier to their use (Aburto et al., 2010). Respondents from lower SES tertials were also more likely to report that mitigation recommendations were contradictory or confusing. The authors highlight that it is important for future campaigns to tailor the messaging to people of lower SES who are more likely to have lower literacy levels and reduced ability to interpret messages. Messages should be coordinated, consistent, and simplified for these groups.

### *Evaluation of messages at salient points in an epidemic/pandemic*

This presents the papers that had specific aims for the time of the study (either beginning, during, or post a pandemic/epidemic) and these are mapped to recommendations developed in this review. Evaluations collecting data at different time points over the course of a pandemic can tell us about any changes in patterns of public behaviour or perceptions as the situation evolves.

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Table 1: Papers organised according to timepoints of epidemic/pandemic

| | Study | Aim of messages | Mapped to Recommendations | |
|---|---|---|---|---|
| **Beginning of epidemic/pandemic** | Yardley et al 2011° <br><br> Chang et al, 2012° <br><br> Teasdale et al, 2011° <br><br> Mitchell et al, 2014° <br><br> Kavanagh et al, 2011° <br><br> Freiman et al, 2001° <br><br><br> Aburto et al, 2010° <br><br> Hickey et al, 2014† <br><br> Roess et al, 2017† <br><br> Bonwitt et al, 2018† <br><br> Winters et al, 2018† <br><br> Lohiniva et al, 2020 ¥ | Increase knowledge and awareness <br><br><br><br><br><br><br><br> Empower use of behaviours to prevent spread of virus within the first 6 months | • Early announcements <br> • Consistency of messages <br> • Acknowledge uncertainties <br> • Timing of recommendations / announcements / alerts | **Addressing uncertainty and increasing trust** |
| | | | • Integrate community /community leaders in risk comms and into planning <br> • Social responsibility <br> • Tailor to increase accessibility | **Community engagement** |
| | | | • Different sources of information – ensure consistency <br> • Clear instructions <br> • Language to explain severity | **Message framing and unified messaging** |
| **During epidemic/pandemic** | Jhummon-Mahadnac et al, 2010° <br><br> Gray et al, 2012° <br><br> Prati et al, 2011° <br><br> Updegraff et al, 2011° <br><br> Rim et al, 2014° <br><br> Johnson & Slovic, 2015† <br><br> Toppenberg et al, 2018† <br><br> Tully et al, 2019† <br><br> Davis et al, 2013‡ <br><br><br> Bekalu et al, 2017‡ <br><br> Rimi et al 2016⁺ <br><br> Avery et al, 2009⁺ | Assess efficacy of messages/ campaigns <br><br><br><br><br><br> Update and possibly introduce new behaviours based on new information <br><br><br> Continue with raising awareness and maintain behaviours <br><br><br> Manage misinformation | • Responding to concerns questions <br> • Skilled / credible spokespeople <br> • Admitting mistakes <br> • Acknowledge uncertainties <br> • Acknowledge unknowns and knowns <br> • Labelling recommendations as interim | **Addressing uncertainty and increasing trust** |
| | | | • Tailor information to users needs (accessibility) <br> • Use of local spokespeople and influencers <br> • Translate and use different sources with consistency in messaging | **Community engagement** |
| | | | • Increase understanding of health threat <br> • Promote sense of personal control <br> • Social responsibility | **Message framing and unified messaging** |
| **Post** | Davis et al, 2015° <br><br> Basnyat & lee, 2014° <br> Miczo et al, 2013° <br> Crosier et al 2015° <br> Barrelet et al 2013° <br> Person et al, 2004• <br> Qui et al, 2017⁺• <br> Lyu et al, 2012• | Assess efficacy of messages/ campaigns <br><br> Manage misinformation | • Responding to concerns questions <br> • Skilled / credible spokespeople <br> • Admitting mistakes <br> • Acknowledge uncertainties <br> • Acknowledge unknowns and knowns | **Addressing uncertainty and increasing trust** |

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| | Study | Aim of messages | Mapped to Recommendations | |
|---|---|---|---|---|
| | Li et al 2016[+]<br><br>Sell et al 2017[†]<br>Sumo et al 2019[†]<br>Cole & Watkins, 2015[†] | Evaluation for lessons learnt and Preparation training | • Public release of evaluations and reviews | |
| | | | • Translate and use different sources with consistency in messaging<br>• Equity considerations | **Community engagement** |
| | | | • identify inconsistencies<br>• Core messages consistent<br>• understanding of health threat | **Message framing and unified messaging** |

Note a: °Study at beginning, during or post H1N1; ¥ Study during COVID-19; †Study at the beginning, during or post Ebola; ‡Study at beginning, during or post influenza season; ⁺Study at beginning, during or post avian flu; • Study at beginning, during or post SARS

## Appendix 7: Rapid review findings mapped to the BPS COVID-19 Behavioural Science and Disease Prevention Psychological Guidance

| Recommendation in review | BPS Behavioural Science guidance |
|---|---|
| Address uncertainty | 2. Deliver messages from a credible source in relatable terms to the target audience |
| Engaging communities | 1. Minimise the 'I' and emphasise the 'we'<br><br>4. Identify what influences each preventative behaviour and ensure policies, messaging and interventions target all relevant drivers<br><br>6. Avoid unintended negative consequences |
| Unified messaging | 5. Clearly specify behaviours and their effectiveness<br><br>7. Create clear channels of access for health literacy<br><br>8. Use behavioural scientists and the psychological evidence base to support the COVID-19 response<br><br>9. Make a pledge to work together, through a multi-disciplinary approach. #CombatCovid19Together |
| Message framing | 3. Create worry but not fear |

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