

Adherence to Emergency Public Health Measures for Bioevents: Review of US Studies

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ABSTRACT

The frequency of bioevents is increasing worldwide. In the United States, as elsewhere, control of contagion may require the cooperation of community members with emergency public health measures. The US general public is largely unfamiliar with these measures, and our understanding of factors that influence behaviors in this context is limited. The few previous reviews of research on this topic focused on non-US samples. For this review, we examined published research on the psychosocial influences of adherence in US sample populations. Of 153 articles identified, only 9 met the inclusion criteria. Adherence behaviors were categorized into 2 groups: self-protective behaviors (personal hygiene, social distancing, face mask use, seeking out health care advice, and vaccination) and protecting others (isolation, temperature screening, and quarantine). A lack of uniformity across studies regarding definitions and measures was noted. Only 5 of the 9 articles reported tests of association between adherence with emergency measures and psychosocial factors; perceived risk and perceived seriousness were found to be significantly associated with adherence or adherence intentions. Although it is well documented that psychosocial factors are important predictors of protective health behaviors in general, this has not been rigorously studied in the context of bioevents. (*Disaster Med Public Health Preparedness*. 2018;12:528-535)

Key Words: emergency public health measures, adherence, psychosocial

A large and growing body of evidence is documenting an increased incidence and severity of a wide range of natural disasters, including infectious disease outbreaks, epidemics, and pandemics (collectively referred to here as *bioevents*). Caused by emerging, reemerging, and novel pathogens, these result in significant global morbidity and mortality.^{1,2} In the last few decades alone, over 80 bioevents caused by these agents have been identified, including West Nile, Hantavirus, severe acute respiratory syndrome (SARS), pandemic H1N1 influenza (pH1N1), Middle East respiratory syndrome (MERS), chikungunya virus, Ebola, and Zika.^{3,4} Even measles and other childhood diseases long considered under control are reemerging as threats to public health.⁵ The increased occurrence of bioevents is attributed to a wide range of factors including climate change, population growth, low vaccination rates, overuse of antibiotics, encroachment into wildlife habitats, altered ecosystems and vector range, increased global travel, increasing frequency and severity of meteorological natural disasters, and increased migration of human populations due to social unrest.⁶ There is also an increasing risk of bioevents related to purposeful or accidental spread of biohazardous, bioengineered, or weaponized pathogens. There are more than 1400 high-level biosafety

labs worldwide with the necessary capacity and capability for handling potentially lethal infectious disease agents, an increase of more than 10% in just a 2-year period.⁷

Effective control of lethal bioevents is dependent on the swift mobilization of the public health and health care sectors as well as the cooperation of the general public. For instance, in the early stages of bioevents, before effective vaccines are available, community members may be advised to comply with certain *nonpharmacologic countermeasures*, as recommended by the World Health Organization and the Centers for Disease Control and Prevention (CDC).^{8,9} Predicting community members' response to these measures and understanding the drivers of the response is important for public health planning purposes as this information can shape both policy recommendations and risk communication strategies. The countermeasures include a wide range of behaviors, including increased hand washing and use of sanitizing hand gels, avoidance of close contact with others (shaking hands, hugging, kissing, and sharing food and drinks), increased respiratory etiquette (covering coughs), and social distancing (avoiding crowds and public places). In certain circumstances, the public may be asked to submit to temperature monitoring (eg, at airports), be

advised to wear face masks when out in public, or be asked to stay home from school or work if symptoms appear. Occasionally, home isolation or home quarantine is recommended. In the United States, most of these behaviors are largely unfamiliar to the general public.

Adherence with these preventive behaviors may be considered in terms of protective health theories. Relatively new scholarship is attempting to draw parallels between drivers of preventive health behaviors (eg, smoking cessation, weight loss) and the complex set of behaviors required for disaster preparedness. Constructs and variables (eg, risk perception, self-efficacy, outcomes expectancy) that are well defined in various protective health theories are increasingly being applied to help predict disaster preparedness behaviors. Studies thus far, however, have mainly focused on geologic or climatologic disasters and comparable studies focused on bioevents are extremely sparse.

Previous reviews of research exploring behavioral theories with respect to emergency public health measures rarely included studies of US populations (with most focused on Asian populations). Most of the studies assessed in earlier reviews also tended to focus solely on pandemic vaccine uptake.¹⁰⁻¹³ The psychosocial factors found influential in prior reviews included perceived susceptibility (risk perception), perceived severity, perceived benefits, and perceived barriers. However, interpretation of the studies previously reviewed was noted to be difficult due to lack of generalizability, small sample sizes, and low response rates. Further, these earlier studies were generally not theory based and highly heterogeneous in terms of their conceptualization. Thus, these earlier reviews served to highlight the gaps in our knowledge regarding the psychosocial factors that influence community adherence to emergency public health measures. The lack of information on the psychosocial influences of adherence in the United States is concerning, as without this information, the development and implementation of effective public health prevention strategies, including risk communication, may be challenging.

In an effort to address this knowledge gap, we conducted a review of adherence studies conducted on US populations to determine the role, if any, of psychosocial factors on adherence. The goal of this review was to identify potentially modifiable risk factors for nonadherence, thereby informing the development of effective risk reduction strategies.

METHODS

Search Strategy and Inclusion Criteria

This review was informed by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) quality guidelines.¹⁴ The first step in the review involved a literature search for articles published in the PubMed (National Library of Medicine), Embase (Elsevier), and Web of Science

(Thomson Reuters) databases using key words that were linked (“AND,” “OR”), including “infection control,” “influenza,” “prevention and control,” “H1N1,” “human/transmission,” “pandemics/prevention & control,” “health knowledge, attitudes, practice,” “SARS,” “quarantine psychology,” “compliance,” and “health behavior.” The next step was to identify and exclude duplicate articles. Inclusion eligibility criteria were then applied, which included the following: (1) US human sample, (2) published between 2000 and 2015, (3) peer-reviewed with free full text, (4) quantitative design and analyses, (5) reported in English, (6) reported on adherence to *at least 2* emergency public health measures, and (7) assessed *at least 1* psychosocial construct (with or without providing tests of association). Articles identified from prior reviews and by using the “Similar Article” function in PubMed were also added to the search.

Study Selection

A total of 153 abstracts were assessed for inclusion eligibility. Based on this, 141 articles were excluded and 3 additional articles were identified through forward searching, resulting in 15 articles remaining for full-text review. Of these, 6 were excluded for the following reasons: psychosocial constructs not assessed, study limited to only one behavior (eg, vaccination), sample focused on first-response employees rather than the general public, and review studies (which were ineligible because they were primarily focused on non-US populations or pH1N1 vaccination behaviors). A final total of 9 articles meeting the review criteria were then assessed in terms of emergency public health behaviors and psychosocial factors potentially influencing adherence.

RESULTS

The characteristics of the review articles are summarized in Table 1. Four studies used random-digit-dial sampling to obtain representative samples of US community members. Three used convenience sampling, one used cluster sampling of households, and one used quota sampling via a vendor panel. Response rates ranged from a low of 2.8% to a high of 80%. All used a cross-sectional design, except one; Yanni et al¹⁵ assessed the behaviors of travelers to Asia using a pre/post design. The studies collected data by use of various modalities, including telephone survey, Internet-based survey, and in-person survey. Two studies assessed “intentions” to adhere, 4 measured actual adherence behaviors, 2 measured both, and 1 study measured attitudes toward adherence. Six studies explored adherence in the context of pandemic influenza (although this was variously referred to as swine flu, novel type A influenza, and pandemic influenza), one study focused on H5N1 (avian influenza), one on SARS, and one on a hypothetical “serious” outbreak.

A wide range of behaviors were studied; these were sorted into 2 major categories: (1) self-protective behaviors: increased personal hygiene such as hand washing and use of

TABLE 1

Characteristics of Reviewed Studies^a

Author and Year	Sample (N)	Method	Responses	Bioevent	Psychosocial Measures
Blendon, ¹⁹ 2004	Representative national sample of US adults, N = 1025	Random-digit-dial telephone survey, 2003	N/A	SARS	• Concern
Blendon, ²⁰ 2006	Representative national sample of US adults, N = 500	Random-digit-dial telephone survey, 2004	N/A	Serious infectious disease outbreak	• Concern • Trust in various sources of information
Horney, ²³ 2010	Adults from 2 counties in North Carolina, N = 207	Random household cluster sampling, 2009	80%	H1N1	• Concern
Ibuka, ²¹ 2010	US adults, N = 1290	Quota sampling via vendor panel, Internet survey, 2009	2.8%	H1N1	• Perceived risk
Jones, ²² 2009	Stanford alumni, social science students at a community college, and social media, N = 6249	Convenience sample, Internet survey, 2009	N/A	H1N1 ("Swine Flu")	• Perceived risk • Self-reported anxiety
Kim, ¹⁶ 2015	Representative sample of Arizona adults, N = 727	Random-digit-dial telephone survey, 2009	77%	H1N1	• Perceived risk
Loustalot, ¹⁷ 2011	Parents of children in San Antonio, TX, N = 668	Convenience sampling, Internet survey, 2009	39%	H1N1	• Perceived seriousness
SteelFisher, ¹⁸ 2010	US representative national polls (N varies)	National public opinion polls, 2009-2010	N/A	H1N1	• Concern • Trust in authority
Yanni, ¹⁵ 2010	Adult travelers at 4 international airports located in the US, N = 1301	Convenience sample, in-person survey, 2008	69%	H5N1	• Perceived risk

^aAbbreviation: SARS, severe acute respiratory syndrome.

hand gels, wearing face masks, avoiding close contact with ill people, seeking information and professional advice, taking antiviral pharmaceuticals, social distancing (avoiding crowds and public places), and vaccination and (2) protecting others: staying at home when ill, agreeing to public temperature screening when entering public places such as airports, and adhering to home quarantine or isolation. Note that some adherence behaviors are both self-protective and protective of others, for example, avoidance of hand shaking and vaccination.

Explicit theoretical models were not tested in any of these studies, and across all studies only the following 4 psychosocial variables (typically measured using a single item) were assessed: perception of risk (perceived likelihood of infection), perceived seriousness, concern regarding infection, and perceived trust (in government officials and other sources of information). While all studies in this review reported on the proportion of the sample that endorsed certain psychosocial variables, several did not provide data on statistical tests of association between these variables and adherence behaviors. Table 2 summarizes the study findings, which are discussed below.

Self-Protective Behaviors and Association With Psychosocial Factors

Self-protective behavior was the focus of several of the studies in this review. In one study, by Kim et al, which surveyed members of the general public living in Arizona during the

peak of the 2009 pH1N1 outbreak (pre-vaccine), increased hand washing was commonly reported (92%), as was avoidance of close contact with anyone with flu-like symptoms (83%). Other behaviors were less prevalent; for instance, few respondents avoided shaking hands (24%) or limiting close contact (hugging and kissing) with relatives (14%).¹⁶ The researchers examined the correlation between personal hygiene behaviors and psychosocial factors and found that personally knowing someone who was infected with pH1N1 was positively (albeit weakly) correlated with perceived likelihood of infection transmission ($r=0.19$, $P<0.01$), as well as with concern about contagion ($r=0.08$, $P<0.05$). Concern, in turn, was correlated with increased hand washing ($r=0.13$, $P<0.01$).¹⁶

Personal hygiene was also the focus of a 2011 study by Loustalot et al,¹⁷ which was conducted shortly after cases of pH1N1 were identified among students attending a large high school in San Antonio, Texas. Parents of the high school students were surveyed to ascertain household transmission rates and to assess the adoption of nonpharmaceutical interventions to limit spread. Very high rates of hygienic behaviors such as hand washing (91%), use of hand sanitizers (84%), and avoidance of sharing of food, drink, or utensils (79%) were noted. They found that high perceived seriousness of pH1N1 infection was significantly associated with increased handwashing ($P<0.01$); avoidance of ill persons ($P=0.01$); avoidance of sharing food, drinks, or utensils ($P=0.02$); avoidance of crowds ($P<0.01$); staying at home if ill

TABLE 2

Adherence Attitudes, Intentions, and Behaviors ^a		
Author and Year (Agent)	Attitudes, Intentions, and Behaviors	% Adherence
Blendon et al, ¹⁹ 2004 (SARS)	• Used a disinfectant	16%
	• Avoided recent visitors to Asia	11%
	• Avoided Asian restaurants or stores	9%
	• Avoided public events	7%
Blendon et al, ²⁰ 2006 (Serious outbreak)	• Favor wearing face mask in public	53%
	• Favor temperature screening	44%
	• Favor quarantine	76%
	• To receive pH1N1 vaccine (2009-2010)	64%
Horney et al, ²³ 2010 (A H1N1)	• To stay at home if infected with pH1N1	31%
	• To receive pH1N1 vaccine	58%
Ibuka et al, ²¹ 2010 (H1N1)	• To take prophylactic antivirals	57%
	• Changed or canceled social plans	5%
Jones et al, ²² 2009 (A H1N1)	• To increase hand washing	78%
	• To avoid travel to affected region	63%
	• To avoid people suspected of infection	50%
	• To use alcohol-based disinfectant	26%
	• To avoid large gatherings	23%
	• To stay at home if ill	10%
	• To wear a protective mask	3%
	• Increased hand washing	92%
	• Avoided people with flu-like symptoms	83%
	• Avoided touching eyes, nose, and mouth	54%
Kim et al, ¹⁶ 2015 (H1N1)	• Avoided large gatherings	46%
	• Stopped shaking hands	24%
	• To stay home from work or school	90%
	• To wear face mask to protect others	23%
	• Increased hand washing	91%
	• Used hand sanitizer	84%
	• Avoided sharing food, drinks, or utensils	79%
	• Avoided ill persons	75%
	• Avoided crowds	62%
	• Wore face mask to protect self	4%
Loustalot et al, ¹⁷ 2011 (pH1N1)	• Increased hand washing/hand sanitizer use	62%
	• Avoided contact with symptomatic people	38%
	• Reduced contact with people	20%
	• Limited use of public transportation	12%
	• Avoided close contact (hugging, kissing)	9%
	• Wore a face mask	6%
	• Received seasonal influenza vaccine	41%
SteelFisher et al, ¹⁸ 2010 (H1N1)	• Sought advice from Internet	53%
	• Received seasonal influenza vaccine	41%
	• Sought advice from Internet	53%
Yanni et al, ¹⁵ 2010 (H5N1)	• Received seasonal influenza vaccine	41%
	• Sought advice from Internet	53%

^aAbbreviation: SARS, severe acute respiratory syndrome.

($P < 0.01$); and wearing a face mask to protect others ($P = 0.02$).¹⁷ Increased hand washing (62%) was also reported in the SteelFisher et al study of national poll data, and similar to the Kim et al study, few respondents stopped shaking hands (12%) or avoided close contact (9%).¹⁸

Wearing face masks in public, even during a serious bioevent, is not typically recommended in the United States, and the CDC did not recommend this during the 2009-2010 H1N1 outbreak.²⁴ However, the CDC did recommend the use of face masks (as tolerated) for household members infected with pH1N1 and for people caring for an infected family member. Six studies in this review examined intentions or behaviors regarding wearing face masks during a bioevent,

with rates varying from a low of 4% for actually wearing a face mask¹⁷ to a high of 26% for purchasing (but not wearing) a face mask.¹⁶ While only 4% of the parents in the Loustalot et al study reported wearing a face mask to protect themselves, 23% said they would consider wearing one to protect others.

In the United States, another rarely recommended emergency public health measure is social distancing (eg, avoidance of public places, public transportation and public events). Studies that explored this measure found varying rates of adherence. For example, in the Kim et al study in Arizona, which took place during the height of pH1N1, 46% of respondents reported that they avoided public places.¹⁶ An

even higher proportion (62%) of respondents in the study by Loustalot et al¹⁷ similarly avoided crowds. In contrast, a study examining the dynamics of risk perceptions and precautionary behavior in travelers to Asian countries during the peak of H5N1 found that while 65% of participants thought they were at risk of infection because of their planned travel, only 5% altered their social plans and few avoided poultry markets, rural areas, or large crowds. Interestingly, reports of flu-like illness during or within 7 days of return from Asia was common among this sample; on the post-travel survey (N = 337, response rate = 56%), 43% of travelers reported at least one flu-like symptom, with 3% meeting the definition of influenza-like illness.¹⁵ In the 2010 pH1N1 study by Steel-Fisher et al, the authors found that 14% of their sample stayed away from malls, 13% limited air travel, 12% limited use of public transportation, 6% reduced attendance at places of worship, and 6% avoided family events, including funerals.¹⁸

Data on “seeking out information” (a behavior) and “trusted sources” (a psychosocial construct) of information was reported in several studies. In a 2004 report by Blendon et al,¹⁹ 8% of respondents reported that they had consulted a website for information on outbreaks. In the 2006 study by Blendon et al,²⁰ a large proportion (78%) indicated that their most trusted source of information regarding a serious bioevent was a health care professional, followed by family member or friend (52%), public health officials (40%), and newspapers/television (27%) (this study did not provide the Internet as an option). In the study by Yanni et al,¹⁵ which was conducted in 2008, a sizeable proportion of travelers sought out information on avian influenza on the Internet (53%), most typically a health website or the CDC website, or from their primary care practitioner (50%). Other sources of information included travel medical specialists (20%), friends and relatives (18%), and travel agents (7%). In the Ibuka et al²¹ 2010 study on H1N1, respondents reported that they first learned about the pH1N1 pandemic via television (66%), Internet (18%), or radio (8%). The authors also noted that Google search spikes for “pandemic” were noted in April 2009, at the start of the pandemic, although within 2 weeks this dropped to prepandemic levels. Finally, in a study by Jones et al,²² the authors found that participants with high scores on a “protection index” composite score that accounted for all of the precautionary behaviors that they studied were statistically more likely to report obtaining high levels of information from the Internet, television, and health officials, compared to those reporting lower levels on the protection index composite score.

During novel bioevents, new vaccines may become available to the public. Three studies in this review examined intentions to receive a vaccine during pandemic influenza. A study by Horney et al²³ on intentions to receive the H1N1 vaccine was conducted in the fall 2009 as part of North Carolina’s public health pandemic preparedness planning. They found that a fairly large proportion (64%) of respondents intended

to receive the pandemic vaccine when available and that this was significantly associated ($P < 0.05$) with high levels of concern regarding the disease and past receipt of seasonal influenza vaccine. In another study where vaccine was assessed, Ibuka et al²¹ noted that 58% of their sample intended to receive the vaccine and that 57% were willing to use antiviral medication. They also found that as the outbreak unfolded, media reports peaked and then declined (as measured by the authors), and perceived likelihood of infection increased while interest in taking preventive pharmaceuticals declined. In SteelFisher et al’s¹⁸ study of the public’s response to pH1N1, roughly half of the population intended to be vaccinated. In the Yanni et al¹⁵ study, which was focused on seasonal influenza vaccine and not pH1N1 vaccine, seasonal influenza vaccination was examined in the context of the H5N1 avian influenza virus outbreaks occurring in Asia, and self-reported uptake for the seasonal influenza vaccine was relatively high, at 41%. The reasons for lack of uptake in several of these studies were similar and centered around safety concerns, limited availability and cost, fear of side effects, doubts about the efficacy of vaccine, distrust of government officials, fear of needles, and a belief that the vaccine may cause the disease.

Protecting Others

Three studies examined intentions toward staying at home if sick and potentially infectious, with varying results. Loustalot et al¹⁷ noted that a very high proportion (90%) of respondents intended to stay home if they became ill, whereas in the Horney et al²³ study, only 31% of the respondents who worked outside the home full or part-time were willing to stay at home. In the study by Jones et al,²² even fewer, less than 10%, would stay home from work or school if ill.

Only one study, by Blendon et al,²⁰ asked respondents about their attitudes regarding temperature screening at public places. They found that 44% of respondents were in favor of this strategy; however, this declined to 23% when asked if they would still favor this if lack of compliance resulted in arrest.

As an emergency public health measure, quarantine (ie, the separation and restriction of the movement of people *exposed* to a contagious disease),²⁵ was assessed in only one study in our review. Blendon et al²⁰ found that 76% of respondents were supportive of quarantining people suspected of exposure during a serious bioevent. However, support for quarantine decreased to 42% if refusal to comply with quarantine orders resulted in arrest. The authors also found that certain forms of monitoring of quarantine compliance, such as wearing electronic bracelets, stationing guards outside the quarantine area, or video monitoring, were generally not well received. However, respondents were generally in favor of daily health checks by a public health nurse (84%) or periodic telephone monitoring (74%) to ensure compliance with quarantine orders. Compared to the 3 other national samples assessed in

the 2006 study by Blendon et al²⁰ (Hong Kong, Singapore, and Taiwan), Americans were much less likely to support quarantine measures.

DISCUSSION

Research is lacking on the psychosocial factors that influence precautionary behaviors in the context of a bioevent. Our review identified only 9 eligible studies aimed at understanding the US public's intentions and behaviors regarding emergency public health measures. Because of the high degree of variability across the studies, definitive statements regarding this issue cannot be made. Nevertheless, we can discern some patterns. For instance, increased handwashing and use of hand gels appeared to be the most acceptable public health measure. We also noted that pH1N1 vaccine uptake intentions were quite high in these studies, all of which had collected data before the vaccine was readily available. On average, 50% of the study populations intended to receive the vaccine. State-level data in the United States, however, indicated that actual pH1N1 coverage was much lower, ranging from a low of 9% (Mississippi) to a high of 34% (South Dakota).²⁶ This discrepancy highlights the challenge of using intentions rather than actual behaviors when assessing preventive health behaviors. A behavior that seemed to have a moderate degree of endorsement was the avoidance of crowds. While this seemed relatively well accepted, limiting one's use of public transportation, as reported by one study,¹⁸ was very low and probably a reflection of the fact that for many people this is the only means of transportation.

Two behaviors that seemed to have low levels of support from the general public included wearing face masks and staying home when ill. While it seems to make complete sense that people would want to stay at home when they are feeling poorly, studies have shown that Americans are hesitant to do so, mainly for fear that it would jeopardize their employment.²⁷ Face masks were also not well received. This may be explained by the fact that these are generally not recommended by the CDC for use among the public because they are not seen as particularly efficacious. Also, because face masks are so rarely worn in the US, wearing these might be stigmatizing and therefore potentially unacceptable to many people. Temperature screening was not in practice in the US for SARS or pH1N1, and therefore there was no history of this practice at the time these studies were conducted. However, studies conducted in Australia, where temperature screening was enforced during the pH1N1, found that it was not a particularly efficient means of identifying potentially ill people and furthermore it was costly, because professional nurses were hired to monitor the screenings at each airport.²⁸ More recently, during the 2013-16 Ebola outbreak, the US did implement temperature screening; under the auspices of the CDC, passengers arriving from West African countries underwent temperature screening at 5 US airports, and this seems to have been well tolerated by passengers.²⁹

The studies in this review generally did not assess quarantine. However, based on Blendon's 2006 study, enthusiasm for this and any other behavior that is *mandated* rather than *recommended* is not likely to be well accepted by the US public.

Given these limited findings, what, if anything, can be done to encourage behaviors that may help to limit the spread of contagion during a bioevent? It seems prudent to encourage the development and maintenance of basic personal hygiene habits: to wash hands frequently or use hand gels, to avoid people who are ill and to stay home when feeling ill, and to take the seasonal influenza vaccine and other recommended vaccines. These habits can help prevent illness from many common diseases, and, importantly, these same habits can also be helpful in stopping the spread of disease during bioevents. The health care and public health systems can help to further encourage and support these behaviors, thereby helping to promote a culture of health in general and specifically during times of crisis. Furthermore, national policy is needed to address the issue of competing priorities, such as staying home when ill vs loss of wages or loss of job due to absenteeism. This issue has been thoughtfully addressed by Blake et al,²⁷ and further discussion on how best to support paid sick leave for all workers is urgently needed.

The literature included in this study had several limitations. Nonrepresentative sampling, low response rates, and geographic and demographic variations could have contributed to biased samples and lack of generalizability of findings. A wide range of behaviors was studied, with definitions, measures, and results varying greatly. The lack of uniformity with respect to the measures was problematic; to our knowledge, no questions were asked the same way across any of the studies. The results of these articles were also difficult to compare and contrast due to a high degree of temporal variability in survey administration (some studies were conducted during the height of outbreaks; others were strictly hypothetical and predated the outbreaks). Adherence questions were sometimes asked in terms of intentions, others in terms of actual behaviors. Although intentions are a strong predictor of actual behaviors,³⁰ this may not be the case for these types of protective behaviors as they are so rarely warranted. In addition, the benefits of some of these behaviors are to protect others and not the individual (eg, staying home if ill or exhibiting symptoms), thus making it difficult to predict. Study methodology varied; while most studies used cross-sectional designs, sample recruitment varied. Some studies sampled local populations, whereas others used representative population samples. Furthermore, the cross-sectional design precludes the ability to determine causality. We also noted that behaviors were measured in these studies by using self-report and participants may have provided socially desirable responses.

Although the psychosocial (scale) measures used in these studies were novel, to our knowledge, the psychometric properties of

these new measures were not assessed. Clearly, well-defined and validated measures (both behavioral and psychosocial constructs) are needed and research should be directed toward developing standardized, psychometrically valid measures. Statistical analyses of association between psychosocial measures and behaviors were limited in these studies and none tested health behavior theories. This was unfortunate, because this would have been helpful in terms of predicting behaviors. Theoretically driven studies on this issue are needed to help elucidate the factors that predict these types of complex protective behaviors.

CONCLUSIONS

This review underscores the gaps in our knowledge regarding adherence and the factors that predict adherence to emergency public health measures. Information on the risk and risk factors for nonadherence is essential for developing and implementing effective public health strategies to reduce risk of spread. A full understanding of the drivers of these behaviors is needed so that we can effectively mitigate and prepare for these types of events, as they are increasing in both frequency and severity. Precautionary actions of community members that are taken during the early stages of bioevents can help to protect oneself and others, thereby helping to reduce reliance on limited health care and public health resources during bioevents. This in turn will help support community resiliency, which has been defined as “the sustained ability of a community to utilize available resources to respond to, withstand, and recover from adverse situations.”³¹

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Author Contributions

RRG and AFC conceptualized the study. AFC conducted the initial literature reviews that guided this manuscript. EMN and QZ conducted additional literature reviews and designed all tables. QZ finalized the MESH terms that were used and RRG created the inclusion and exclusion criteria. RRG and LMG drafted and edited the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

The authors report no conflicts of interest.

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