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Recommended Mitigation Measures for an Influenza Pandemic in Remote and Isolated First Nations Communities of Ontario, Canada: A Community-Based Participatory Research Approach

Abstract

Influenza pandemics disproportionately impact remote and/or isolated Indigenous communities worldwide. The differential risk experienced by such communities warrants the recommendation of specific mitigation measures. Interviewer-administered questionnaires were conducted with adult key health care informants from three remote and isolated Canadian First Nations communities of sub-Arctic Ontario. Forty-eight mitigation measures (including the setting, pandemic period, trigger, and duration) were questioned. Participants' responses were summarized and collected data were deductively and inductively coded. The participants recommended 41 of the questioned mitigation measures, and often differed from previous literature and national recommendations. Results revealed that barriers, such as overcrowded housing, limited supplies, and health care infrastructure, impacted the feasibility of implementing mitigation measures. These findings suggest that pandemic plans should recommend control strategies for remote and isolated Canadian First Nations communities that may not be supported in other communities. These findings highlight the importance of engaging locally impacted populations using participatory approaches in policy decision-making processes. Other countries with remote and/or isolated Indigenous communities are encouraged to include recommendations for mitigation measures that specifically address the unique needs of such communities in an effort to improve their health outcomes during the next influenza pandemic.

Keywords

community mitigation measures, pandemic planning, influenza pandemic, remote and isolated First Nations, qualitative analyses, community-based participatory research

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Recommended Mitigation Measures for an Influenza Pandemic in Remote and Isolated First Nations Communities of Ontario, Canada: A Community-Based Participatory Research Approach

Since another global influenza pandemic is inevitable (Osterholm, 2005), the World Health Organization (WHO) recommends that nations have effective pandemic plans in place to minimize the associated social and economic consequences (World Health Organization, 2009). In Canada, the Canadian Pandemic Influenza Plan for the Health Sector (CPIP) provides guidance for a consistent and comprehensive pandemic response and recommends various mitigation measures, both pharmaceutical and non-pharmaceutical, to reduce the impact of an influenza pandemic (Public Health Agency of Canada, 2006). As the CPIP is national in scope and regional diversities regarding healthcare delivery exist, it recommends that jurisdictional plans address specific operational details associated with implementing an influenza pandemic response (Public Health Agency of Canada, 2006).

Having specific details regarding the implementation of effective mitigation measures is particularly important for marginalized populations, such as Aboriginal (First Nations, Inuit, and Métis) populations in Canada living in geographically remote and isolated areas. Although the 2009 H1N1 pandemic (A(H1N1)pdm09) was mild compared to previous pandemics (Gatherer, 2009; Reed et al., 2009; Shen, Ma, & Wang, 2009), Indigenous populations residing in remote and/or isolated areas suffered disproportionately, particularly in Canada, the United States, and Australia (Barker, 2010; Flint et al., 2010; Kermode-Scott, 2009; Kumar et al., 2009; La Ruche et al., 2009; Spence & White, 2010; Trauer, Laurie, McDonnell, Kelso, & Markey, 2011; Zarychanski et al., 2010). The differential health outcomes experienced in such communities during a pandemic may be attributed to a variety of complex challenges that arise from social, economic, environmental, and cultural inequalities (Groom et al., 2009; Richardson, Driedger, Pizzi, Wu, & Moghadas, 2012; Tsuji, 1998). Previous research suggests that differences in the presence of pre-existing co-morbidities, population profiles, access to healthcare services, transmission dynamics, and malnutrition in remote and/or isolated Indigenous communities may result in more severe influenza-related outcomes (La Ruche et al., 2009; Morrison, Buckeridge, Xiao, & Moghadas, 2014; Mostaço-Guidolin, Towers, Buckeridge, & Moghadas, 2013; Spence & White, 2010). Thus, the differential risk experienced by remote and/or isolated Indigenous communities warrants the recommendation of mitigation measures that are context-specific and community-informed to better prepare them for the next public health emergency (Lee, Rogers, & Braunack-Mayer, 2008; Richardson et al., 2012; Uscher-Pines, Duggan, Garoon, Karron, & Faden, 2007).

Scientific evidence regarding effective community measures to mitigate the ensuing effects of an influenza pandemic is limited (Aledort, Lurie, Wasserman, & Bozzette, 2007; Oshitani, 2006). Although important evidence and lessons learnt pertaining to the use of various mitigation measures emerged after the A(H1N1)pdm09 experience, gaps in knowledge remain (Cowling et al., 2010; Aburto et al., 2010; Halder, Kelso, & Milne, 2010). For instance, there remains a lack of data regarding the knowledge, attitudes, and practices of mitigation measures for pandemic influenza across diverse populations, especially those that are marginalized (Aiello et al., 2010). Recommendations for implementing mitigation measures are inherently complex as it varies according to the pandemic period, setting, availability of resources, severity of the pandemic, and requires reflection on societal values (Aledort et al., 2007; Thompson, Faith, Gibson, & Upshur, 2006). Since marginalized populations best understand how their community perspectives and values impact their ability to comply and implement public

health recommendations, directly engaging locally impacted populations can provide valuable insights to guide recommendations for specific mitigation measures (Braunack-Mayer et al., 2010; Groom et al., 2009; Uscher-Pines et al., 2007). Prior to the next pandemic, governments and relevant institutions are recommended to identify populations that have been historically marginalized and engage these populations in the planning process to facilitate the inclusion of ways to address their specific needs during a pandemic outbreak (Uscher-Pines et al., 2007).

Given this, the purpose of the presented study is to elicit a list of recommended mitigation measures (including the setting, pandemic period, trigger, and duration) specific for remote and isolated First Nations communities in Canada, using a community-based participatory research approach. These specific recommendations will subsequently be compared and contrasted to current national recommendations and relevant literature. This study also aims to highlight the importance and value of using participatory methods to engage locally impacted populations in health policy decision-making processes.

Methods

Community-Based Participatory Research Approach

The present study employed a community-based participatory research (CBPR) approach, as participatory research approaches have been successful in influencing policy and practice (Horowitz, Robinson, & Seifer, 2009; O'Brien & Whitaker, 2011; Themba-Nixon, Minkler, & Freudenberg, 2008). The hallmark principles of CBPR, such as equitable partnerships, valuing different ways of knowing, and addressing issues of local importance, can foster the engagement of Indigenous populations in influencing health policy (Fletcher, 2003; LaVeaux & Christopher, 2009). As such, this project arose from a longstanding partnership between the co-author's (LJST) research team and the involved communities, and addressed a locally relevant issue (Horowitz et al., 2009; O'Brien & Whitaker, 2011). The study stemmed from previous research that involved modifying the community-level pandemic plans of the study communities by engaging various community stakeholders (e.g., Band Councils [locally-elected First Nations government], health care staff, clergy, education boards, etc.) (Charania & Tsuji, 2012). Since CBPR endeavours also emphasize shared control of decision-making, a community-based advisory group was formed of three community representatives (one from each study community) to aid in various aspects of this study including designing the study, piloting the questions, informing the data analysis process, and disseminating the results (Charania & Tsuji, 2011; Kirby, Lévesque, Wabano, & Robertson-Wilson, 2007). Achieving action-oriented outcomes that benefit the involved communities is an important aspect of CBPR (Israel, Eng, Schulz, & Parker, 2005; Israel et al., 2008) so the communities requested that the results of this study be used to further update the community infection control measures section in each of the community's influenza pandemic plan (Charania & Tsuji, 2012). Ethics approval to conduct this study was granted by the Office of Research Ethics at the University of Waterloo, and was supported by the Band Councils of the involved communities.

Study Area and Population

Three communities (names omitted for anonymity purposes) were included in the present study and are located in northern Ontario, Canada. All are characterized as being remote (i.e., the nearest service

center with year-round road access is located over 350 kilometers away) and isolated (i.e., the communities are only accessible by airplanes year-round) First Nations communities (Public Health Agency of Canada, 2006). Nine adult-key health-care informants were purposively selected (three from each community) based on the inclusion criteria of having experience as a practicing health care professional (e.g., health director, nurse-in-charge, clinical coordinator, etc.) in a remote and isolated First Nations community and being directly involved in their respective community's health sector response to A(H1N1)pdm09; thus, they had the required experience and authority to comment. Furthermore, as multiple government organizations are responsible for Aboriginal health in Canada (e.g., federal, provincial, and First Nations) (Public Health Agency of Canada, 2006), participants were chosen within each of the three communities to ensure that each applicable government body was represented. All of the participants invited subsequently agreed and consented to participate in the study.

Data Collection

An extensive review was conducted of relevant literature and existing (international, national, provincial, regional, and community level) pandemic plans to create a comprehensive list of currently discussed mitigation measures. Forty-eight mitigation measures (accounting for variations of 41 mitigation measures) were included in the interview questionnaire. The questionnaires were administered by the lead author (NAC) from July 2010 to October 2011 at a place and time chosen by the participants after obtaining informed verbal consent, which is culturally appropriate for the region (Kirby et al., 2007; Skinner, Hanning, & Tsuji, 2006). To gain additional insights regarding the data analysis and dissemination process, the community-based advisory group was consulted in person by the lead author (NAC) in June 2013.

The interview questionnaire employed a combination of closed- and open-ended questions; thereby allowing for comparability amongst participants' answers in addition to providing the opportunity for participants to expand on their opinions (Bryman, 2001). For each mitigation measure, the key informants were asked if they would recommend the measure in their community during a future influenza pandemic. If a mitigation measure was recommended, the participant was subsequently asked to elaborate on the setting, pandemic period, trigger (to begin implementation), and duration (of implementation) of the mitigation measure. Definitions of the mitigation measures and aforementioned terms were provided to the participant. The interviews ranged in duration from 2 to 4 hours long, were conducted in English (as requested by the participant) and audio recorded (with the participant's permission).

Data Analyses

The collected data were manually transcribed verbatim into electronic format to allow for deductive coding and inductive coding (to reveal any additional insights) using QSR NVivo® computer software (version 9.0). The data were deductively analyzed using a template organizing approach in which the interview questionnaire was used as a coding template (Bryman, 2001; Crabtree & Miller, 1999).

The closed-ended questions regarding setting and pandemic period were coded according to pre-established options, based on previous literature. The participants chose any option that applied for the setting (i.e., hospital, ambulatory/community-based healthcare facility, community, and home)

(Aledort et al., 2007) and pandemic period (i.e., interpandemic, pandemic alert, and pandemic) (Public Health Agency of Canada, 2006). The CPIP outlines the WHO pandemic alert system, which consisted of six pandemic phases categorized into three pandemic periods. The interpandemic period (phases 1 and 2) was characterized by outbreaks in animals caused by a novel influenza subtype that has not yet been detected in humans. The pandemic alert period (phases 3, 4, and 5) was characterized by a novel influenza subtype causing outbreaks in humans. And the pandemic period (phase 6) was characterized by increased and sustained human-to-human transmission of the novel influenza subtype in the general population.

The open-ended questions regarding the trigger and duration of the mitigation measure were categorized and coded to allow for comparability amongst participants' responses. The categories for the implementation trigger were outbreak in the zone, outbreak in the community, all the time, and other. Herein, zone will refer to the geographic zones in Ontario within which health services are provided by the First Nations and Inuit Health Branch of Health Canada (Health Canada, 2011). Implementation duration categories were post-outbreak in the zone, post-outbreak in the community, two weeks post-vaccination of community members (the time required to induce protective antibody titres) (Cox, Brokstad, & Ogra, 2004), post-pandemic, all the time, and other.

Participants' responses were summarized and the answer most commonly chosen is reported. When there was disagreement amongst participants' responses, the community-based advisory group was consulted to decide whether the measure would or would not be recommended.

Results

The participants stated that they would recommend 41 of the questioned mitigation measures to be implemented in their communities during the next influenza pandemic. The collected data are summarized as a list of mitigation measures recommended for use (including the most commonly answered setting, pandemic period, trigger, and duration of implementation) (see Table 1) and not recommended for use (including participants' rationale for not supporting the measure) (see Table 2). As the level of agreement regarding the recommendation of measures sometimes varied, the most pertinent results (as suggested by the community-based advisory group) are highlighted below and supplemented by participants' quotes (Knafl & Howard, 1984).

The majority of participants deemed one measure, animal-human interchange as not applicable in their communities because domestic animal farming does not occur. However, a participant was concerned that avian influenza could be transmitted to humans while hunting and harvesting potentially infected wild geese. One participant suggested traditional medicine as an additional mitigation measure that would be beneficial and culturally-appropriate. The participant recommended that traditional medicine practices should be implemented in the community and community members' homes all of the time, but particularly during the alert period.

Table 1. List of Recommended Measures to Mitigate an Influenza Pandemic in Remote and Isolated First Nations Communities Suggested by Participants (n=9)

	Mitigation Measure	Setting	Period	Trigger	Duration
Travel Measures	Entry screening of travelers (8 ^a ,1 ^b)	Community (8 ^a ,0 ^b)	Alert (7 ^a ,1 ^b)	Other (5 ^a ,3 ^b)	Post-zone outbreak (4 ^a ,4 ^b); Post vaccine (4 ^a ,4 ^b)
	Exit screening of travelers (5 ^a ,4 ^b)	Community (5 ^a ,0 ^b)	Alert (5 ^a ,0 ^b)	Zone outbreak (2 ^a ,3 ^b); Other (2 ^a ,3 ^b)	Post vaccine (4 ^a ,1 ^b)
	Travel restrictions on all arriving passengers (6 ^a ,3 ^b)	Community (5 ^a ,0 ^b ,1 ^e)	Alert (5 ^a ,0 ^b ,1 ^e)	Other (5 ^a ,1 ^b)	Post vaccine (3 ^a ,2 ^b ,1 ^e)
	Travel advisories on all arriving passengers (8 ^a ,1 ^b)	Community (8 ^a ,0 ^b)	Alert (7 ^a ,1 ^b)	Other (5 ^a ,3 ^b)	Post-community outbreak (3 ^a ,5 ^b)
	Travel advisories on all departing passengers (9 ^a ,0 ^b)	Community (8 ^a ,0 ^b ,1 ^e)	Alert (6 ^a ,1 ^b ,2 ^e)	Zone outbreak (4 ^a ,4 ^b ,1 ^e)	Other (3 ^a ,5 ^b ,1 ^e)
	Closing down all borders (7 ^a ,2 ^b)	Community (7 ^a ,0 ^b)	Alert (6 ^a ,1 ^b)	Zone outbreak (4 ^a ,3 ^b)	Post vaccine (4 ^a ,2 ^b ,1 ^e)
	Quarantine of a geographic area (<i>cordon sanitaire</i>) (7 ^a ,2 ^b)	Community (7 ^a ,0 ^b)	Alert (5 ^a ,2 ^b)	Other (4 ^a ,3 ^b)	Post-zone outbreak (3 ^a ,3 ^b ,1 ^e)
Community Social Distancing Measures	Avoid visiting (9 ^a ,0 ^b)	Community (9 ^a ,0 ^b); Home (9 ^a ,0 ^b)	Alert (7 ^a ,2 ^b)	Zone outbreak (7 ^a ,2 ^b)	Post-community outbreak (4 ^a ,5 ^b); Post vaccine (4 ^a ,5 ^b)
	Avoid crowding (8 ^a ,1 ^b)	Hospital (8 ^a ,0 ^b); Ambulatory (8 ^a ,0 ^b); Community (8 ^a ,0 ^b); Home (8 ^a ,0 ^b)	Alert (8 ^a ,0 ^b)	Zone outbreak (7 ^a ,1 ^b)	Post vaccine (5 ^a ,3 ^b)
	Social distancing measures (9 ^a ,0 ^b)	Community (9 ^a ,0 ^b)	Alert (7 ^a ,2 ^b)	Zone outbreak (5 ^a ,4 ^b)	Post-community outbreak (4 ^a ,5 ^b); Post vaccine (4 ^a ,5 ^b)
	Voluntary sheltering (9 ^a ,0 ^b)	Home (7 ^a ,2 ^b)	Alert (6 ^a ,3 ^b)	Zone outbreak (4 ^a ,5 ^b)	Post vaccine (5 ^a ,4 ^b)
	School closures (9 ^a ,0 ^b)	Community (9 ^a ,0 ^b)	Alert (5 ^a ,4 ^b)	Community outbreak (8 ^a ,1 ^b)	Post vaccine (8 ^a ,1 ^b)

(continued)

	Mitigation Measure	Setting	Period	Trigger	Duration
Community Social Distancing Measures (continued)	Childcare center closures (6 ^a ,0 ^b ,3 ^d)	Community (6 ^a ,0 ^b)	Alert (4 ^a ,2 ^b)	Community outbreak (5 ^a ,1 ^b)	Post vaccine (6 ^a ,0 ^b)
	Workplace closures (4 ^a ,4 ^b ,1 ^c)	Community(4 ^a ,0 ^b)	Pandemic (3 ^a ,1 ^b)	Community outbreak (4 ^a ,0 ^b)	Post-community outbreak (3 ^a ,1 ^b)
	Mandatory isolation of ill individuals (7 ^a ,2 ^b)	Home (6 ^a ,1 ^b)	Alert (5 ^a ,2 ^b)	Community outbreak (3 ^a ,4 ^b)	Post-zone outbreak (2 ^a ,5 ^b); Other (2 ^a ,5 ^b)
	Voluntary isolation of ill individuals (6 ^a ,3 ^b)	Home (6 ^a ,0 ^b)	Alert (4 ^a ,2 ^b)	Zone outbreak (3 ^a ,3 ^b)	Post-zone outbreak (2 ^a ,4 ^b); Post-community outbreak (2 ^a ,4 ^b)
	Mandatory quarantine of case contacts (5 ^a ,4 ^b)	Home (5 ^a ,0 ^b)	Alert (4 ^a ,1 ^b)	Community outbreak (3 ^a ,2 ^b)	Other (3 ^a ,2 ^b)
	Voluntary quarantine of case contacts (6 ^a ,3 ^b)	Home (6 ^a ,0 ^b)	Alert (5 ^a ,1 ^b)	Community outbreak (5 ^a ,1 ^b)	Other (5 ^a ,1 ^b)
	Restricting attendance at public gatherings (6 ^a ,2 ^b ,1 ^e)	Community(6 ^a ,0 ^b)	Alert (3 ^a ,3 ^b); Pandemic (3 ^a ,3 ^b)	Zone outbreak (3 ^a ,3 ^b); Community outbreak (3 ^a ,3 ^b)	Post-community outbreak (3 ^a ,3 ^b)
	Cancelling public gatherings (9 ^a ,0 ^b)	Community(9 ^a ,0 ^b)	Alert (5 ^a ,4 ^b)	Zone outbreak (5 ^a ,4 ^b)	Post vaccine (4 ^a ,5 ^b)
Surveillance Measures	Monitoring trends of influenza-like illness (9 ^a ,0 ^b)	Ambulatory (9 ^a ,0 ^b)	Alert (7 ^a ,2 ^b)	All the time (3 ^a ,6 ^b); Other (3 ^a ,6 ^b)	All the time (3 ^a ,5 ^b ,1 ^e); Post pandemic (3 ^a ,5 ^b ,1 ^e)
	Human surveillance and case reporting (9 ^a ,0 ^b)	Hospital (8 ^a ,1 ^b)	Alert (8 ^a ,1 ^b)	All the time (4 ^a ,5 ^b); Other (4 ^a ,5 ^b)	Post-community outbreak (3 ^a ,6 ^b); All the time (3 ^a ,6 ^b)
	Contact tracing (6 ^a ,3 ^b)	Ambulatory (5 ^a ,1 ^b)	Pandemic (4 ^a ,2 ^b)	Community outbreak (6 ^a ,0 ^b)	Other (4 ^a ,2 ^b)
	Home support program (7 ^a ,1 ^b ,1 ^c)	Ambulatory (7 ^a ,0 ^b)	Alert (5 ^a ,2 ^b)	Community outbreak (6 ^a ,1 ^b)	Post-community outbreak (3 ^a ,4 ^b)
	Urge entire population in an affected area to check for fever at least once daily (5 ^a ,3 ^b ,1 ^c)	Home (5 ^a ,0 ^b)	Alert (3 ^a ,2 ^b); Pandemic (3 ^a ,2 ^b)	Community outbreak (3 ^a ,2 ^b)	Post pandemic (2 ^a ,3 ^b)

(continued)

	Mitigation Measure	Setting	Period	Trigger	Duration
Surveillance (cont.)	Rapid influenza diagnostic tests (8 ^a ,1 ^b)	Hospital (8 ^a ,0 ^b)	Alert (7 ^a ,1 ^b)	All the time (5 ^a ,3 ^b)	All the time (4 ^a ,4 ^b)
	Screening for influenza-like illness at public places (8 ^a ,1 ^b)	Hospital (8 ^a ,0 ^b); Ambulatory (8 ^a ,0 ^b); Community (8 ^a ,0 ^b)	Alert (7 ^a ,1 ^b)	Zone outbreak (4 ^a ,4 ^b)	Post vaccine (4 ^a ,4 ^b)
Infection Control Measures	Modifying cultural practices at church and funerals (9 ^a ,0 ^b)	Community(9 ^a ,0 ^b)	Alert (8 ^a ,1 ^b)	Zone outbreak (4 ^a ,5 ^b); Community outbreak (4 ^a ,5 ^b)	Post-zone outbreak (4 ^a ,5 ^b); Post-community outbreak (4 ^a ,5 ^b)
	Hand hygiene (9 ^a ,0 ^b)	Hospital (9 ^a ,0 ^b); Ambulatory (9 ^a ,0 ^b); Community(9 ^a ,0 ^b); Home (9 ^a ,0 ^b)	Interpandemic (9 ^a ,0 ^b); Alert (9 ^a ,0 ^b); Pandemic (9 ^a ,0 ^b)	All the time (9 ^a ,0 ^b)	All the time (9 ^a ,0 ^b)
	Respiratory etiquette (9 ^a ,0 ^b)	Hospital (9 ^a ,0 ^b); Ambulatory (9 ^a ,0 ^b); Community(9 ^a ,0 ^b); Home (9 ^a ,0 ^b)	Interpandemic (9 ^a ,0 ^b); Alert (9 ^a ,0 ^b); Pandemic (9 ^a ,0 ^b)	All the time (9 ^a ,0 ^b)	All the time (9 ^a ,0 ^b)
	Surface disinfection (beyond usual practice) (9 ^a ,0 ^b)	Hospital (9 ^a ,0 ^b); Ambulatory (9 ^a ,0 ^b); Community(9 ^a ,0 ^b); Home (9 ^a ,0 ^b)	Alert (8 ^a ,1 ^b)	Zone outbreak (4 ^a ,5 ^b); Community outbreak(4 ^a ,5 ^b)	Post-zone outbreak (4 ^a ,5 ^b)
	Ventilation (i.e., open windows) (8 ^a ,1 ^b)	Home (8 ^a ,0 ^b)	Alert (7 ^a ,1 ^b)	Zone outbreak (5 ^a ,3 ^b)	Post vaccine (3 ^a ,5 ^b)
	Air disinfection (7 ^a ,2 ^b)	Hospital (6 ^a ,1 ^b)	Alert (7 ^a ,0 ^b)	All the time (4 ^a ,3 ^b)	All the time (4 ^a ,3 ^b)
	Visitor restrictions (in health facilities) (7 ^a ,1 ^b ,1 ^d)	Hospital (7 ^a ,0 ^b)	Alert (6 ^a ,1 ^b)	Zone outbreak (6 ^a ,1 ^b)	Post vaccine (5 ^a ,2 ^b)
	Isolation precautions (in health facilities) (8 ^a ,1 ^b)	Hospital (8 ^a ,0 ^b)	Alert (8 ^a ,0 ^b)	Zone outbreak (4 ^a ,4 ^b)	Post vaccine (5 ^a ,3 ^b)
	Minimize aerosol-generating procedures (in health facilities) (8 ^a ,0 ^b ,1 ^d)	Hospital (7 ^a ,1 ^b)	Alert (7 ^a ,1 ^b)	Zone outbreak (4 ^a ,4 ^b)	Post-community outbreak (4 ^a ,4 ^b)

(continued)

	Mitigation Measure	Setting	Period	Trigger	Duration
Infection Control Measures (cont.)	Wearing surgical masks and N95 respirators – provider and patient use (9 ^a ,0 ^b)	Hospital (9 ^a ,0 ^b); Ambulatory (9 ^a ,0 ^b); Community(9 ^a ,0 ^b)	Alert (5 ^a ,4 ^b); Pandemic (5 ^a ,4 ^b)	Community outbreak (3 ^a ,6 ^b); Other (3 ^a ,6 ^b)	Post-community outbreak (5 ^a ,4 ^b)
	Wearing personal protective equipment – provider and patient use (9 ^a ,0 ^b)	Ambulatory (9 ^a ,0 ^b)	Alert (7 ^a ,2 ^b)	Community outbreak (5 ^a ,4 ^b)	Post-community outbreak (4 ^a ,5 ^b)
	Public education (9 ^a ,0 ^b)	Community(9 ^a ,0 ^b); Home (9 ^a ,0 ^b)	Interpandemic (9 ^a ,0 ^b); Alert (9 ^a ,0 ^b); Pandemic (9 ^a ,0 ^b)	All the time (9 ^a ,0 ^b)	All the time (9 ^a ,0 ^b)
Pharmaceutical Measures	Vaccines (9 ^a ,0 ^b)	Ambulatory (8 ^a ,1 ^b)	Alert (8 ^a ,1 ^b)	Other (8 ^a ,1 ^b)	Other (9 ^a ,0 ^b)
	Antivirals (9 ^a ,0 ^b)	Hospital (8 ^a ,1 ^b)	Alert (8 ^a ,1 ^b)	Community outbreak (8 ^a ,1 ^b)	Post-community outbreak (6 ^a ,3 ^b)

^a Participant recommended measure ^b Participant did not recommend measure ^c Participant suggested a modification to the measure ^d Participant deemed measure not applicable ^e Missing data

Table 2. List of Measures Not Recommended to Mitigate an Influenza Pandemic in Remote and Isolated First Nations Communities Suggested by Participants (n=9)

Mitigation Measure	Rationale for Not Recommending
Disinfection of clothing, shoes, or other objects of persons exiting affected areas (4 ^a ,5 ^b)	Measure would not be feasible to implement in a remote and isolated community due to required monies, supplies, and human resources.
Sanitary measures at frontiers or on conveyances (2 ^a ,7 ^b)	Measure would not be feasible, practical, or cost-effective to implement.
Travel restrictions on all departing passengers (2 ^a ,7 ^b)	Community members would not adhere to the measure and measure would be difficult to enforce.
Self-health monitoring and reporting if ill but no restrictions on movement (0 ^a ,9 ^b)	Self-health monitoring and reporting would be beneficial, but difficult for community members to conduct. Measure would also contradict the purpose of other mitigation measures directed at limiting virus transmission.
Wearing surgical masks and N95 respirators – public use (4 ^a ,5 ^b)	Limited resource availability, proficiency regarding proper use and adherence to the measure would render the measure ineffective for the general public.
Wearing personal protective equipment – public use (1 ^a ,8 ^b)	Limited resource availability, proficiency regarding proper use and adherence to the measure would render the measure ineffective for the general public.

^a Participant recommended measure ^b Participant did not recommend measure

Travel Measures

The majority of travel mitigation measures were recommended for a future influenza pandemic. All of the recommended measures were to be implemented in the community, primarily at the airport, during the alert period. Most participants agreed that these measures should be implemented when positive cases are detected in Canada or at the latest when positive cases are detected in the zone. These measures were recommended to be implemented until the outbreak has ceased in the zone or two weeks post-vaccination of community members.

Participants almost unanimously agreed that entry screening of travelers would be a beneficial measure if executed properly because the airport is typically the only entry point into their remote and isolated communities during the ice-free season. Screening measures could include health questionnaires and declarations, temperature screening, thermal scanning, medical examinations, and stop lists (Bell, Nicoll, Fukuda, Horby, & Monto, 2006a; Bell, Nicoll, Fukuda, Horby, & Monto, 2006b; Gostin, 2006). Although participants felt that exit screening of travelers is an important measure and would help contain an outbreak, participants were more mixed about recommending the measure as it was expected that the receiving community would conduct screening.

Participants generally agreed with implementing voluntary travel advisories instead of mandatory travel restrictions, although the recommendation would depend on the severity of the community outbreak. Participants reported that voluntary measures encourage people to be more self-conscious and responsible for their health, while mandatory measures were not perceived to be as practical or feasible.

Also, participants reported that voluntary travel advisories would effectively deter the majority of people from traveling:

With voluntary advisories, you would weed out a lot of people ... there would probably only be a select few that would probably still want to travel anyways and if you could implement the precautions and if they would follow them, then I think that would be enough. (Participant #7)

The majority of participants recommended travel measures that would block the main entry point into their communities. Participants reported that closing down all borders and quarantine of a geographic area (*cordon sanitaire*) would help protect their at-risk population if a community outbreak has not yet occurred. However, the decision to implement these measures would depend on the severity of the pandemic because participants considered these measures to be difficult to implement, enforce, and maintain.

Community Social Distancing Measures

Participants recommended that all of the proposed community social distancing measures be implemented in their communities. Measures that decrease the frequency and duration of social contact, such as avoid visiting, avoid crowding, and general social distancing measures (e.g., spacing people, staggering work schedules, allowing employees to work from home, etc.) were highly recommended by participants during the alert period. Although participants noted the difficulties associated with avoiding crowding in overcrowded homes in the communities:

Overcrowding in the home, it's hard to try to stay your distance from someone that is sick because you're close to each other walking by and stuff. (Participant #3)

Participants reported that voluntary sheltering of healthy persons to avoid exposure would be a beneficial mitigation measure during the alert period, although it would be the community members' prerogative to implement. Most participants recommended this measure to be implemented in the community members' homes; however, some mentioned that members could camp in the bush as long as they had sufficient resources. Participants recommended that these measures should be implemented when an outbreak occurs in the zone until the community outbreak has ceased or two weeks post-vaccination of community members.

In the community, participants unanimously recommended that schools and childcare centers close during the alert period to aid in controlling influenza transmission in the younger age groups, especially given the prior experience of infections among First Nations populations.

It stops the spread of the flu because there are so many children and they are close together and it's a lot more difficult telling a child to close their mouth, wash their hands. (Participant #8)

It helps a lot to control the spreading... I think the community here took it [A(H1N1)pdm09] very seriously... there's fear because of the history, so the fear is so high here, it's not like anything else down South ... they've been decimated by infection [in the past]... (Participant #1)

Conversely, participants' responses were divided regarding the closure of workplaces during the pandemic period. Some participants reported that closing workplaces would be impractical as the limited amount of workplaces is essential for the daily functioning of the community; however, others were willing to recommend this measure if the severity of the pandemic warranted it. All of these measures were recommended to be implemented when a community outbreak occurred and workplaces should re-open as soon as the community outbreak ceases, but schools and childcare centers should stay closed until two weeks post-vaccination of community members.

Although all of the participants recommended these measures during the alert period to reduce virus transmission, participants were also divided regarding whether recommendations for isolation of patients and quarantine of contacts should be mandatory or voluntary. In general, participants recommended voluntary isolation when there is an outbreak in the zone, escalating to mandatory isolation when a community outbreak occurs. Participants agreed that mandatory or voluntary quarantine should only be implemented when there is a community outbreak. Some participants stated that community members should isolate until the outbreak has ceased in the community and the zone; however, others recommended only isolating until the symptomatic period is over. Participants recommended that community members should quarantine for the incubation period post-exposure, and then isolate for the symptomatic period if the person falls ill.

Surveillance Measures

Participants recommended the implementation of all of the surveillance measures, except for one. Participants did not recommend the mitigation measure of self-health monitoring and reporting if ill without restrictions on movement. Participants unanimously agreed that monitoring and reporting about one's health would be a beneficial surveillance measure, but not limiting the movement of ill individuals would provide opportunities for virus transmission within the community.

Of the recommended measures, participants reported that monitoring trends of influenza-like illness and human surveillance and case reporting during the alert period would produce helpful statistics to indicate how effective the response was and how they could better target future response efforts. Participants generally suggested that these measures should be implemented on an ongoing basis; however, in the context of a pandemic, these measures would be implemented when treating a symptomatic person and continue until the outbreak has ceased in the community or post-pandemic.

The majority of participants also recommended that contact tracing be implemented in the ambulatory setting during the pandemic period in order to identify contacts of an index case that may be at risk of becoming infected and, in turn, help contain a community outbreak. Participants reported that contact tracing should ideally occur until all of the contacts have been reached, but would realistically occur until available resources and manpower became overwhelmed. Support for conducting contact tracing was qualified by concerns regarding human resources, as a significant number of household and casual contacts would have to be contacted due to the overcrowding in homes and extensive social networking.

Overcrowding is a problem, so even if you call them but you have a family [and] they have 15 people around them, or 20, if they've made contact ... and those contact[s] have to be contact[ed], so at the end you have to call the whole community for contact tracing ... because everybody's related with someone. (Participant #6)

If enough resources and manpower were available, participants recommended the implementation of a home support program, which involves the provision of infection control supplies and education to families in need, during a community outbreak. Moreover, participants considered recommending that community members check for fever on a daily basis in their homes during a community outbreak, as this measure is a valuable diagnostic tool that would raise awareness about self-health. However, participants noted that many families do not own thermometers because they are not available for purchase in community stores.

Infection Control Measures

Participants recommended most of the proposed infection control measures. Participants recommended modifying the cultural practices of kissing and handshaking at church and funeral services during the alert period. Hand hygiene and respiratory etiquette were unanimously recommended to be implemented all of the time in all of the settings to decrease virus transmission. Participants also recommended other general infection control measures during the alert period, including disinfecting surfaces (beyond usual practice) and ventilation (i.e., opening windows); although, some drawbacks were noted.

Moneywise ... because of the cost of the things we have in here, I don't think every ... [person] can buy that [cleaning supplies] to clean the house ... [and] most of the houses in here have a mold problem ... (Participant #6)

All depends on how well their windows are in the community, but some have broken windows, some are boarded up ... (Participant #2)

In the hospital setting, participants recommended that visitor restrictions, isolation precautions, and minimizing aerosol-generating procedures be implemented when an outbreak in the zone occurs; these measures would be in effect until after the community outbreak ceases or two weeks after community members have been vaccinated. Participants unanimously recommended that health care providers and patients wear surgical masks to reduce virus transmission during a community outbreak, although it was suggested that providers wear N95 respirators if the situation warrants it. Furthermore, participants recommended that providers wear personal protective equipment (PPE) during a community outbreak. Symptomatic patients were not recommended to wear PPE as the person will ultimately contaminate any items that he or she wears, thereby rendering the measure ineffective. Moreover, participants did not recommend that the general public wear masks and PPE due to concerns of supply, proficiency regarding proper use, and adherence to the measures.

Lastly, all of the participants reported that pertinent health teachings about influenza and the importance of infection control measures should be occurring in Cree and English on an ongoing basis to raise awareness. Participants reported that community members received lots of misinformation during A(H1N1)pdm09 from various media sources. Thus, participants suggested using multiple community-based measures, such as announcements on the local radio station and door-to-door visits with Cree translators, to rectify the received misinformation. Also, participants suggested that educational materials should be visual, simple, and targeted to their community members in order to be most effective.

Be more specific and simple, too much information is not better than not enough, and I think we have too much information on that case [A(H1N1)pdm09] coming from ... too [many sources] at the same time, confusing the people, confusing the health care provider, confusing almost everyone. (Participant #6)

Pharmaceutical Measures

The participants unanimously recommended implementing pandemic-sensitive vaccines and antivirals during a community outbreak. The mass vaccination campaigns should commence as soon as the vaccines are delivered to the community and ideally continue until herd immunity is achieved. The community-based healthcare facility would be responsible for distributing the vaccines to community members in a variety of settings, including the hospital, school, and homes of people who are not mobile. The antivirals would be dispensed by the hospital to symptomatic people meeting the required criteria.

Discussion

Given the unique challenges experienced in remote and isolated Canadian First Nations communities during an influenza pandemic that in turn impact their pandemic response capacity and may result in more severe health outcomes, the participants recommended that the majority of questioned mitigation measures be implemented in their communities. Not surprisingly, similar to national recommendations, the participants unanimously recommended the use of vaccines and antivirals, since pharmaceutical measures are the best measures to mitigate the impact of a pandemic outbreak (Oshitani, 2006; Public Health Agency of Canada, 2006). Although much uncertainty still remains regarding optimal vaccine allocation (Tuite, Fisman, Kwong, & Greer, 2010), previous modelling studies have reported that rapidly immunizing the population, even with a poorly matched vaccine, could significantly reduce the outbreak and number of ill people (Ferguson et al., 2006; Germann, Kadau, Longini Jr., & Macken, 2006; Wu & Cowling, 2011). Furthermore, the implementation of antiviral drugs for treatment and/or prophylaxis purposes during a pandemic could reduce influenza-related attack, hospitalization, and death rates (Gani et al., 2005; Longini Jr., Halloran, Nizam, & Yang, 2004; Wu & Cowling, 2011). Previous modelling research has suggested that aggressive antiviral therapy significantly reduced the impact of A(H1N1)pdm09 in an isolated Canadian First Nations community (Xiao et al., 2013).

As limitations of supply and cost restrict the use of vaccines and antivirals, especially in remote and isolated settings (Finnie, Hall, & Leach, 2012; Low, 2008; Oshitani, 2006), the participants noted the importance of recommending a wide variety of non-pharmaceutical mitigation measures to supplement the use of pharmaceutical measures. Non-pharmaceutical mitigation measures may aid in delaying, reducing, and containing a pandemic outbreak (Bell et al., 2006a; Low, 2008; Markel et al., 2007). Pandemic response strategies that appropriately combine pharmaceutical and non-pharmaceutical interventions have been shown to be more effective than individual strategies in terms of delaying the outbreak, reducing the number of ill cases, and delaying and reducing the peak attack rate (Lee, Lye, & Wilder-Smith, 2009).

At the national level, of relevance to the presented paper, Annex B of the CPIP discusses planning considerations for on-reserve First Nations communities, while Annex M outlines public health recommendations including public education, case and contact management, travel and border related measures, and community-based interventions (Public Health Agency of Canada, 2006). Three

community-based interventions are recommended to control a community outbreak, including self-isolating if symptomatic, closing schools and daycare centres, and restricting “high-risk” indoor public gatherings (other than schools) (see Table 3) (Public Health Agency of Canada, 2006). All of the aforementioned recommendations were also supported by the participants. The participants recommended that isolation and quarantine measures begin as voluntary and escalate to mandatory as needed. Previous research states that isolation and quarantine are generally effective and acceptable measures (Crabtree & Henry, 2011); however, mandatory isolation and quarantine are considered ineffective and impractical since viral shedding occurs prior to the onset of symptoms and healthcare facilities would rapidly become overwhelmed (Aledort et al., 2007; Bell et al., 2006b). Furthermore, although participants recommended the closure of schools and daycare centres, along with cancelling and/or restricting public gatherings, due to increased influenza transmission in these settings, there are limited data to support the effectiveness of these measures (Roth & Henry, 2011).

Interestingly, the participants recommended 8 of the 10 community-based interventions that are not nationally recommended (see Table 3) (Public Health Agency of Canada, 2006). Contrary to national recommendations, the majority of participants placed much value in recommending various travel measures to protect their communities. Previous research has reported that screening travelers, travel restrictions, and closing down airports are generally ineffective and result in substantial economic and societal costs (Bell et al., 2006b; Inglesby et al., 2006). However, the CPIP does note that travel measures may be more feasible to implement in geographically remote and isolated communities due to small population sizes and limited ports of entry (Public Health Agency of Canada, 2006). As disease transmission is typically amplified due to the characteristics of the study communities (Finnie, et al., 2012; Groom et al., 2009; Kermode-Scott, 2009; Massey et al., 2009; Massey et al., 2011), travel measures directed at preventing the importation of the pandemic virus, especially during a severe pandemic, may be particularly important.

The CPIP notes that recommendations will vary according to local conditions, especially with regards to the timing of their implementation (Public Health Agency of Canada, 2006). The participants also highlighted the importance of specifying the timing of implemented mitigation measures, especially since these specifications may vary for geographically remote and isolated communities. Three mitigation measures—hand hygiene, respiratory etiquette, and public education—were recommended by participants to be implemented all of the time. Similar to the CPIP recommendations, the participants recommended that the trigger to implement mitigation measures would be dependent on the location of confirmed cases (Public Health Agency of Canada, 2006). Participants generally recommended that measures should be employed until the outbreak ceases in their community and/or the zone, or until herd immunity is achieved two weeks post-vaccination of their community members.

Table 3. List of Recommended and Not Recommended Mitigation Measures from Annex M of the Canadian Influenza Pandemic Plan for the Health Sector as Evaluated by Study Participants

Recommended Community-Based Interventions	Not Recommended Community-Based Interventions
<ul style="list-style-type: none"> • Close schools and daycares* <ul style="list-style-type: none"> ○ Trigger: declaration of one or more confirmed cases in the local community, depending on the epidemiological context. • Self-isolate if symptomatic* <ul style="list-style-type: none"> ○ Trigger: arrival of one or more confirmed cases in the province/territory. Reinforce recommendation when cases occur in the local jurisdiction. • Restrict indoor public gatherings in 'high-risk' settings (other than schools)* <ul style="list-style-type: none"> ○ Trigger: when transmission occurs within the community. 	<ul style="list-style-type: none"> • Thermal scanning in public places* • Restricting travel to and from affected areas* • Cordon sanitaire* • Broadly restricting indoor public gatherings (other than schools) * • Urge entire population in an affected area to check for fever at least once daily* • Hand-sanitizing stations in public settings* • Surface disinfection beyond usual practice in public settings* • Air disinfection* • Disinfection of clothing, shoes, or other objects of persons existing affected areas** • Use of masks by the general public (well individuals)**

Note. Source: Public Health Agency of Canada, 2006

*Participants in the study recommended the measure

**Participants in the study did not recommend the measure

Interestingly, although typical responses for the implementation trigger were outbreak in the zone or community, the participants recommended that most of the mitigation measures be implemented in the alert period (before the official declaration of a pandemic). In contrast, during the alert period, the CPIP recommends measures to aggressively contain an outbreak and prevent a pandemic, such as isolation and quarantine, contact tracing, exit screening, and antiviral therapy; while population-based measures are recommended during the pandemic period to reduce and delay the pandemic outbreak (Public Health Agency of Canada, 2006). This finding may infer the desire of participants residing in remote and isolated First Nations communities to be prepared to rapidly implement mitigation measures to prevent the introduction and subsequent spread of a pandemic virus in their communities.

Since community-level measures will likely be more effective at mitigating a pandemic than international- and national-level measures (Bell et al., 2006b), it is vital that remote and isolated First Nations communities have appropriate recommendations included in pandemic plans. In light of these findings, pandemic planners, especially those that are dedicated to community-based pandemic planning, should consider the following policy implications. Given the different challenges and health outcomes experienced in remote and isolated First Nations communities, it may be appropriate that future pandemic plans recommend pandemic control strategies in such communities that may not be supported in other Canadian communities. These findings highlight the importance of developing

mitigation measures that address the population's values, beliefs, perceptions, and cultural differences in order to be appropriate and effective (Massey et al., 2011). For instance, culture influenced some of the recommended mitigation measures since participants were open to modifying the cultural practices of kissing and handshaking at church and funeral services, and traditional medicine was suggested as an additional beneficial mitigation measure.

It is also important that future policies address community differences. Participants raised concerns that overcrowded impoverished housing and limited supplies impacted the ability of community members to comply with the recommended mitigation measures. Participants also noted that the implementation of some mitigation measures might overwhelm their limited health care infrastructure. As these communities have a high proportion of people with pre-existing co-morbidities who are at risk of more severe influenza-related outcomes, the capacity of their health care infrastructure may be further strained by patients visiting with influenza symptoms and by the effects of non-pharmaceutical mitigation measures. To help overcome these barriers, policies and action aimed at improving living conditions, providing money for stockpiling supplies, and improving health care infrastructure in these communities is imperative prior to the next influenza pandemic.

Furthermore, the implementation of certain measures, such as the distribution of scarce resources (e.g., antivirals), may raise many legal, political, and ethical issues, especially when there is limited scientific evidence to support the measure (Aledort et al., 2007; Thompson et al., 2006). For instance, although mandatory isolation and quarantine may infringe upon the ethical value of individual liberty and are not commonly recommended (Thompson et al., 2006), the majority of participants reported that they would recommend these measures to help minimize virus transmission if a community outbreak occurred. Engaging and partnering with community members using participatory approaches are vital to create pandemic plans that are community- and culturally- appropriate (Massey et al., 2011).

The optimal community-level approach to mitigate the effects of an influenza pandemic in remote and/or isolated Indigenous communities is still unknown. There remains a paucity of scientific evidence regarding the assumptions that currently guide pandemic planning and the effectiveness of mitigation measures; thus, most planners resort to historical accounts, mathematical modelling studies, and expert opinion (Aledort et al., 2007; Bell et al., 2006b; Markel et al., 2007). To aid planners in making more informed recommendations, future research regarding influenza transmission characteristics should be encouraged in remote and/or isolated Indigenous communities because vast heterogeneities exist. Future studies should also explore what mitigation measures are most cost-effective and what combination of mitigation measures would be most effective in these communities

Conclusion

Influenza pandemics continue to disproportionately impact Indigenous populations worldwide, especially those residing in geographically remote and/or isolated areas. The differential risk experienced by such communities warrants the need for recommendations for mitigation measures that are context-specific and community-informed. The present study elicited a list of recommended pharmaceutical and non-pharmaceutical measures to mitigate the effects of an influenza pandemic in three remote and isolated Canadian First Nations communities. The results indicated that participants recommended a wide variety of mitigation measures that often differed from national recommendations

and existing literature. Participants also revealed that a number of barriers impacted their ability to feasibly implement recommended measures.

These findings suggest that it may be appropriate to recommend pandemic control strategies in remote and isolated Canadian First Nations communities that may not be supported in other communities. These findings also highlight the importance of engaging locally impacted populations using participatory approaches in policy decision-making processes. Other countries with remote and/or isolated Indigenous communities are encouraged to include recommendations for mitigation measures that specifically address the unique needs of such communities in an effort to improve their health outcomes during the next influenza pandemic. Future research should be directed towards better understanding the current assumptions that guide pandemic planning and the effectiveness of mitigation measures in remote and/or isolated Indigenous communities, as vast heterogeneities exist.

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