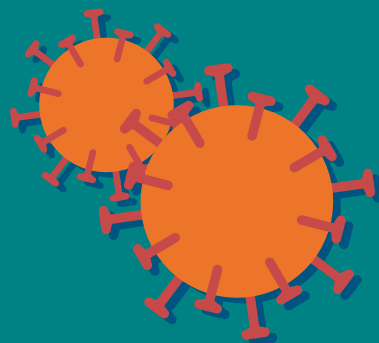
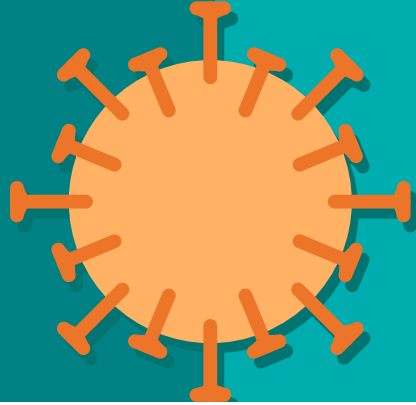
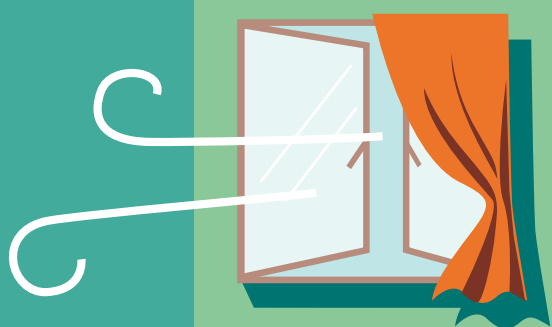




WHO guideline on public health and social measures for mitigating the risk and impact of epidemic and pandemic influenza



World Health
Organization

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Abbreviations

ABHR	alcohol-based handrub
CI	confidence interval
COVID-19	coronavirus disease 2019
GDG	Guideline Development Group
GDP	gross domestic product
GRADE	Grading of Recommendations Assessment, Development and Evaluation
GUUVL	germicidal ultraviolet light
HEPA	high efficiency particulate air (filtration)
IHR	International Health Regulations (2005)
ILI	influenza-like illness
LMIC	low- and middle-income countries
OR	odds ratio
PCR	polymerase chain reaction
PHSM	public health and social measure(s)
PISA	pandemic influenza severity assessment
R₀	basic reproduction number
RCT	randomized controlled trial
RCCE	risk communication and community engagement
RAT	rapid antigen test
RNA	ribonucleic acid
RR	risk ratio
R_t	effective reproduction number
SARS-CoV-2	severe acute respiratory coronavirus 2
WHO	World Health Organization

Glossary

Air purification

Removal of contaminants from the air, including allergens, odours and pathogens, to improve the quality of indoor air, and which may be used to prevent the transmission of certain respiratory infections (1). Ways in which this is achieved include air-purifying devices that pull air through either a filter to trap contaminants, ionizers that make particles dense and fall to the ground/surface and ultraviolet light devices that inactivate pathogens that transmit through the air. Promising technologies for the removal of pathogens in particular are high efficiency particulate air (HEPA) filtration with the ability to remove > 99% of aerosols (2) and germicidal ultraviolet light (GUVL). Air purification reuses the same air while ventilation pushes out indoor air and replaces it with outdoor air.

Active case-finding and contact identification measures

Measures and actions implemented to identify, track and manage cases and exposed individuals in the community (for example, contact tracing, testing and quarantine) to reduce transmission of an infectious pathogen.

Alcohol-based handrub

An alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to inactivate microorganisms and/or temporarily suppress their growth. Such preparations may contain one or more types of alcohol, other active ingredients with excipients and humectants (3, 4).

Close contact

A person who has been in close proximity, including touching, speaking with, providing care or being less than 1 metre away from another person.

Contact tracing

The identification and follow-up of persons who may have come into contact with an infected and contagious person and who may therefore be at risk of becoming infected (5).

Entry and exit screening at points of entry

The preliminary assessment of a traveller who is entering or exiting a country by an authorized health worker or by a person under the direct supervision of the competent authority, to determine the person's health status and potential public health risk to others, and which may include the scrutinizing of health documents and a physical examination when justified by the circumstances of the individual case. In this guideline, entry and exit screening at points of entry specifically refers to syndromic screening for influenza using one or more methods, such as temperature check, observation and health declaration forms.

Environmental measures	Measures taken to limit the transmission of a respiratory pathogen with epidemic or pandemic potential through decontamination or other modification of the environment.
Hand hygiene	Any action of hand cleansing such as handwashing, antiseptic handwashing, antiseptic handrubbing or surgical hand antisepsis (3, 4).
Handwashing	Washing hands with plain or antimicrobial soap and water.
Human rights	The meaning and scope of human rights as provided for in international human rights treaties and as interpreted and applied by the human rights bodies tasked with this work, which can include international, regional and national courts, and human rights committees.
Humidifier	A device for increasing the moisture level in the air within a room or other enclosed space.
Indoor hospitality and recreation measures	Measures taken by the indoor catering, leisure, fitness and personal care service industries to reduce the transmission of a respiratory pathogen.
Isolation of symptomatic and/or infected individuals	Separation or restriction of movement of ill persons with an infectious disease to prevent transmission to others (6). This can involve the isolation of ill persons with an infectious disease in a health-care facility (7) or isolation or confinement at home (often not needing hospitalization) (6, 7). Voluntary isolation (also known as self-isolation) is the voluntary separation or restriction of movement of ill persons in a designated space, usually in their own homes, but possibly be elsewhere (6).
Lateral flow test	A rapid diagnostic test suitable for point-of-care testing that identifies infections by detecting a viral target substance (antigens or antibodies) in a liquid sample (for example, urine, blood or saliva). When such target substances are present in the sample, they bind to the reactive molecules and show a visual positive result based on the principle of affinity chromatography. Rapid antigen tests (RATs) are a type of lateral flow test.
Mask wearing	The wearing of a mask (such as a medical mask) to block large respiratory particles, splashes, sprays or splatter that may contain infectious agents from coming into contact with the face of the wearer (8). Masks may also help to reduce the exposure of others to the wearer's saliva and respiratory secretions (8). In the current document, mask wearing is considered only in the community context.
Mass testing	Testing for a specific pathogen in an entire population or subpopulation regardless of symptoms to identify cases during a specific timeframe or at regular intervals.

Medical mask (also known as surgical or procedure mask)	A personal protective equipment device, flat or pleated, that covers the nose and mouth, and it is affixed to the head of the user with straps around the ears, head or both. Its performance is tested according to a set of standardized methods that aim to balance high filtration, adequate breathability and, optionally, fluid penetration resistance (9).
Mitigation	The action of reducing the transmission of an infectious pathogen in order to decrease its mortality and morbidity burden and its impact on the health system.
Modifying indoor humidity	Altering the amount of water vapour in the air in indoor environments. For example, humidifiers are devices used to increase the moisture level in the air in a room or other enclosed space.
Non-pharmaceutical interventions	See Public health and social measures below.
Personal protection measures	Measures taken by individuals to reduce their personal risk of acquiring or spreading an infectious disease; this includes the use of personal protective equipment.
Physical distancing	Maintaining a specific physical distance between people in public areas, for example by limiting the capacity of indoor or outdoor venues where gatherings occur.
Point of entry	A passage for the international entry or exit of travellers, baggage, cargo, containers, conveyances, goods and postal parcels, as well as agencies and areas providing services to them on entry or exit (10).
Public health and social measures	Non-pharmaceutical interventions implemented by individuals, communities, institutions and governments at community, national, regional and global levels to protect the health and well-being of populations affected by health emergencies. PHSM aim to reduce the risk and scale of transmission of infectious diseases by reducing transmission-relevant exposures and/or making them safer (11).
Quarantine of exposed individuals	Restriction of activities and/or separation from others of individuals who are not ill but have had close contact with a proven or suspected case of an infectious disease, in such a manner as to prevent the possible spread of infection (10). Such sequestration of individuals lasts for a defined period after their last exposure.
Rapid antigen test	A type of lateral flow test used for point-of-care testing that directly detects the presence of an antigen. It can be used to detect influenza infections in the community (separately from any clinical testing in ambulatory settings or hospitals). Such point-of-care tests may be administered to the entire population (see Mass testing above), to subpopulations (including those attending schools) or to facilitate self-testing at home.

Respiratory hygiene and cough etiquette	A personal protection measure to reduce the transmission of a respiratory pathogen by covering the nose and mouth with a bent elbow or disposable tissue while coughing or sneezing, followed by the immediate and hygienic disposal of used tissues and the performing of hand hygiene (12).
Restrictions on gatherings	The restriction of social gatherings such as religious pilgrimages, major sporting and cultural events, festivals, weddings or funerals.
R_0	Basic reproduction number; a measure of transmissibility. This number is generally estimated at the beginning of an epidemic or pandemic, and represents the average number of people infected by one infectious case in a completely susceptible population.
R_t	Effective reproduction number; a measure of transmissibility. This number represents the current average number of people infected by one infectious case in a population at any given time. After the initial spread of an infection in a community, the value of R_t may fluctuate over time due to public health and social measures, decreases in susceptible individuals or increases in population immunity.
School closure	Closure of a school or schools to all children and staff. Reactive school closure occurs after substantial transmission of the respiratory pathogen has been observed in the school or community, while proactive school closure occurs before substantial transmission among children and staff has been observed.
School measures	Adaptive strategies implemented to reduce the transmission of a respiratory virus in schools, or on the way to and from schools, by decreasing the frequency and intensity of interpersonal interactions.
Social measures	Measures that apply to all members or certain segments of the community regardless of their infection/exposure status, and typically aimed at reducing the frequency and intensity of interpersonal interactions.
Stay-at-home provisions	Public recommendations or decrees to prevent people from leaving their homes for anything other than essential activities (such as grocery shopping or limited exercise).
Surface and object cleaning and disinfection	Routine cleaning of frequently used surfaces and objects to reduce transmission of infectious pathogens. Disinfection may then be carried out using ultraviolet light or products such as chlorine, bleach or alcohol. Cleaning should always precede disinfection to remove dirt and impurities from surfaces and objects.

Travel advice	Health information and advice on potential health risks provided by health authorities to help travellers understand how best to avoid or minimize these risks, take appropriate preventive measures and exercise necessary precautions before, during and after travel. In the context of this guideline, travel advice specifically refers to health advice or warnings or recommendations which aim to prevent or limit influenza virus transmission.
Travel-related measures	Public health measures concerning travellers, baggage, cargo, containers, conveyances and goods (for example, the provision of travel health advice, screening of travellers and travel restrictions).
Travel restrictions	The restriction of movement of persons, baggage, cargo, containers, conveyances and goods, for example through travel bans, border closures, flight suspensions, banning ground crossings, restricting ship itineraries, and refusal of entry through visa suspensions or denial.
Upon-arrival quarantine	The sequestration, for a defined period upon arrival, of individuals, regardless of exposure or infection status, travelling from a high-risk area, with the aim of reducing the likelihood of importing cases, thus delaying the onset of an epidemic in the community.
Ventilation	The process of supplying outdoor air (or outdoor air plus recirculated air that has been treated) and removing indoor air from a space, for the purpose of controlling air contaminant levels, by natural or mechanical means (13). Natural ventilation involves the exchange of air in a building through windows, doors, solar chimneys, wind towers or trickle ventilators, while mechanical ventilation uses mechanical fans to drive the outdoor air into an indoor space at a designed airflow rate. Treatment of the outdoor air may be needed before introducing it into the building if local outdoor air conditions require it (for example, due to high particulate matter concentration). The basic elements of building ventilation are the ventilation rate, airflow direction and air distribution and airflow pattern (14).
Workplace closure	Reactive closure of offices and businesses when the transmission of the respiratory pathogen has been observed in the workplace, or the proactive closure of all workplaces irrespective of the infection status of workers.
Workplace measures	Adaptive strategies implemented to reduce respiratory virus transmission in workplaces, or on the way to and from work, by decreasing the frequency and intensity of interpersonal interactions, and including policies to encourage working from home or hybrid working models of employment.

Executive Summary

Influenza virus infections cause acute respiratory illness that is usually self-limiting but can be severe in some cases. Each year, seasonal influenza epidemics cause considerable morbidity and mortality, while influenza pandemics, which occur sporadically when a new influenza virus emerges and spreads in populations which lack immunity against it, are public health emergencies.

Both seasonal and pandemic human influenza viruses are readily transmissible from human to human, mainly during close contact, and their spread is challenging to control. Protecting public health during a severe influenza epidemic or pandemic can be achieved through the implementation of public health and social measures (PHSM) such as mask wearing, physical distancing and hand hygiene. In the early stages of an influenza pandemic, effective vaccines and antivirals may be unavailable or in short supply, leaving PHSM as the only type of countermeasure that can be quickly implemented and scaled up in most countries. The primary objectives of such measures are to delay and reduce the peak number of cases, and related demands on the health-care system, and to reduce the overall number of cases and their health and socioeconomic impacts.

This WHO guideline provides recommendations for or against the use of specific PHSM during influenza epidemics and pandemics based on existing guidance on the prevention, control and management of influenza, and on an extensive review of the latest scientific literature on the effectiveness of individual PHSM in community settings. Although evidence on the effectiveness of some PHSM were drawn from lessons learned during the COVID-19 pandemic, the recommendations provided in this guideline relate specifically to their likely effectiveness in reducing or delaying the transmission of influenza viruses only. The document does not provide specific recommendations on the use of PHSM in settings such as hospitals, care homes and detention centres. In addition, strategies based on the use of pharmaceutical interventions such as vaccines and antivirals are also not covered in this document.

The guideline is intended for use by national and local health authorities, and stakeholders from other sectors involved in the decision-making or implementation of PHSM during an influenza epidemic or pandemic. It can also serve as a supporting resource for the development and updating of national influenza pandemic preparedness plans.

The guideline was developed in accordance with the *WHO handbook for guideline development* (15) and meets international standards for evidence-based guidelines. In collaboration with members of the Guideline Development Group (GDG), the guideline methodologist and the systematic review lead, members of the WHO Steering Group identified the priority questions to be addressed. Systematic evidence reviews were then synthesized and the certainty of the evidence assessed in line with the Grading of Recommendations Assessment, Development and Evaluations (GRADE) approach (16, 17). In developing its recommendations, the GDG considered in detail: (i) the certainty of evidence; (ii) values and preferences; (iii) balance of benefits and harms; (iv) resource implications; (v) equity and human rights; (vi) acceptability; and (vii) feasibility. For each of the recommendations provided in this guideline, summary overviews of these seven key considerations are provided. When deliberating on the recommendations

to be made, the GDG used the established evidence-to-decision framework approach. Where a strong recommendation was made, the GDG was confident that the desirable effects of the intervention outweighed any undesirable effects. Where there was uncertainty concerning the balance between desirable and undesirable effects, the GDG issued a conditional recommendation. Unanimous agreement was reached on all of the recommendations contained in this guideline. All potential conflicts of interest for the individual experts constituting the GDG were declared, assessed and managed in line with WHO procedures.

A total of 21 recommendations in five areas (sections 4–8 below) were developed and are summarized in Table 1 of the current document. When making decisions on the selection and implementation of interventions, countries must comply with domestic and international laws and obligations, including human rights laws and the obligations set out in IHR (2005). In this regard, consideration should be given to the balance of benefits and harms, the feasibility and acceptability of proposed interventions in the local context, anticipated barriers to effective implementation, and the potential impacts of measure on vulnerable and marginalized groups. Consideration should also be given to how best to maintain access to health-care services for other health conditions, and to the medium and long-term repercussions of interventions on society and the wider economy.

In general, limiting the number and intensity of interactions between infected and uninfected people through both targeted and community-wide measures is an effective strategy for reducing respiratory virus transmission in the community. Such a strategy is likely to significantly reduce the total number of infections, hospitalizations and deaths, thereby also reducing the peak demand for hospital beds. However, both targeted and community-wide measures can be highly disruptive, and their potential beneficial impact on community transmission of an epidemic or pandemic influenza virus must be weighed against the socioeconomic and other costs of such measures. Early risk assessments of the potential impact of an epidemic or pandemic influenza virus will help public health authorities determine the stringency of interventions required to mitigate its impact. For all influenza epidemics and pandemics, recommending the isolation of symptomatic and/or infected individuals at home should help to reduce transmission, and policies that facilitate the voluntary isolation of such individuals (such as hybrid working models and paid sick leave) should be prioritized. For more severe pandemics, measures to increase physical distancing in schools, workplaces and public areas could further reduce transmission. In all cases, consideration should also be given to putting in place measures aimed at minimizing the socioeconomic impact of disruptive measures on affected individuals.

This document is intended to serve as a core component of WHO's influenza prevention and control programme in community settings. The successful implementation of the recommendations provided will depend upon the systematic integration of PHSM into health emergency prevention, preparedness and response plans at national and subnational levels, and on the appropriate application of its recommendations alongside other PHSM implementation guidance.

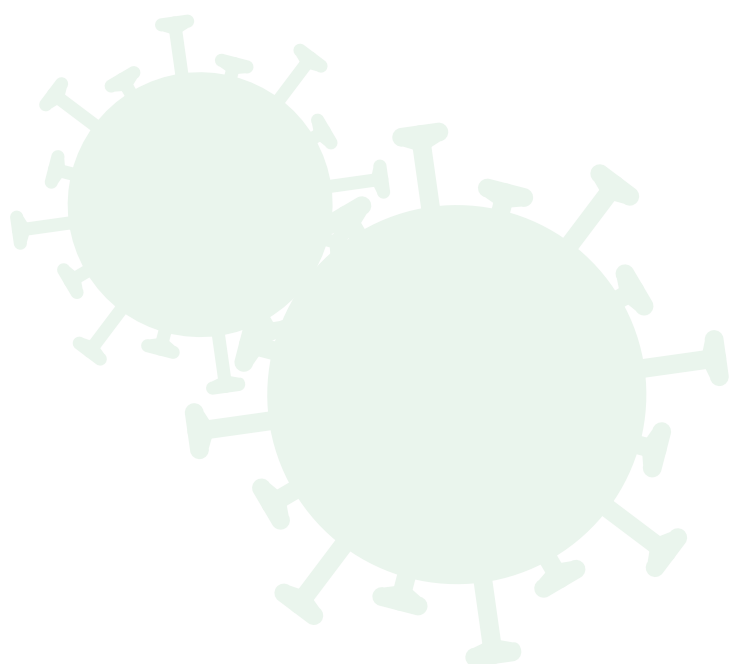
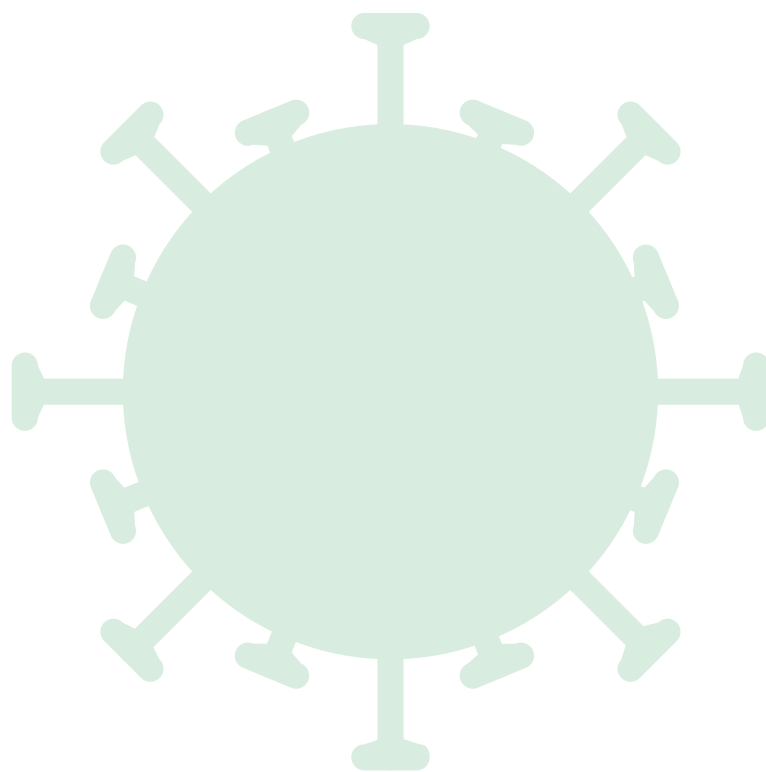
Table 1. Summary of recommendations

The following table summarizes the recommendations provided for each of the 20 PHSM described in this guideline.

	Measure	Recommendations	Certainty of evidence	Strength of recommendation
Personal protection measures	Hand hygiene	WHO recommends performing hand hygiene to reduce the transmission of influenza viruses in community settings during influenza epidemics and pandemics.	Moderate	Strong recommendation for ✓
	Mask wearing	WHO suggests that: - individuals who are symptomatic and/or have tested positive for influenza wear masks at all times when in contact with other individuals to reduce the spread of influenza to others; and - all individuals in the community wear masks in crowded indoor settings to potentially reduce the spread of influenza in such settings, during epidemics and pandemics of high or extraordinary severity.	Moderate	Conditional recommendation for ✓
	Respiratory hygiene and cough etiquette	WHO recommends the practising of respiratory hygiene and cough etiquette by individuals not wearing a mask to prevent the transmission influenza viruses during influenza epidemics and pandemics.	Moderate	Strong recommendation for ✓
Environmental measures	Air purification	WHO recommends against indoor air purification to reduce the transmission of influenza viruses in community settings during influenza epidemics and pandemics.	Moderate	Strong recommendation against ✗
	Modifying indoor humidity	WHO recommends against modifying indoor humidity to reduce the transmission of influenza viruses during influenza epidemics and pandemics.	Very low	Strong recommendation against ✗
	Surface and object cleaning and disinfection	WHO suggests surface and object cleaning and disinfection to reduce the transmission of influenza viruses during influenza epidemics and pandemics.	Low	Conditional recommendation for ✓
	Ventilation	WHO recommends increasing mechanical or natural ventilation in both households and non-residential buildings to reduce the transmission of influenza viruses during influenza epidemics and pandemics.	Low	Strong recommendation for ✓

	Measure	Recommendations	Certainty of evidence	Strength of recommendation
Active case-finding and contact identification measures	Contact tracing	WHO suggests against contact tracing to reduce the transmission of influenza viruses during influenza epidemics and pandemics, except for the first cases of an outbreak of an emerging influenza virus strain in order to collect information on the characteristics of the disease and potentially help reduce transmission.	Very low	Conditional recommendation against ✖
	Isolation of symptomatic and/or infected individuals	WHO recommends voluntary home isolation of symptomatic and/or infected individuals in every circumstance to reduce the transmission of influenza viruses during influenza epidemics and pandemics.	Very low	Strong recommendation for ✔
		WHO suggests mandatory isolation of symptomatic and/or infected individuals at home or in a dedicated facility to reduce the transmission of influenza viruses in exceptional circumstances, such as influenza epidemics and pandemics of high or extraordinary severity.		Conditional recommendation for ✔
	Mass testing	WHO suggests against mass testing in community settings to reduce virus transmission during influenza epidemics and pandemics.	Very low	Conditional recommendation against ✖
	Voluntary self-quarantine	WHO suggests voluntary self-quarantine for individuals exposed to a confirmed case in their households or elsewhere to reduce virus transmission during influenza epidemics and pandemics of high severity.	Very low	Conditional recommendation for ✔
Social measures	Indoor hospitality and recreation measures	WHO suggests against risk-mitigation measures in indoor hospitality and recreational settings during influenza epidemics and pandemics.	Very low	Conditional recommendation against ✖
	Restrictions on gatherings	WHO suggests considering restrictions on gatherings to reduce the transmission of influenza viruses in the community during influenza epidemics and pandemics.	Very low	Conditional recommendation for ✔
	School measures and closures	To reduce the transmission of influenza viruses in the community, WHO suggests that: - the implementation of one or more school measures be considered as sustainable alternatives to full school closure during influenza epidemics and pandemics; and - coordinated proactive school closure be considered during influenza epidemics and pandemics of high or extraordinary severity.	Very low	Conditional recommendation for ✔

	Measure	Recommendations	Certainty of evidence	Strength of recommendation
Social measures	Stay-at-home provisions	WHO suggests against stay-at-home provisions (including recommendations or orders) to reduce the transmission of influenza viruses in the community during influenza epidemics and pandemics.	Low	Conditional recommendation against ✖
	Workplace measures and closures	To reduce the transmission of influenza viruses in community, WHO suggests that: - remote working from home be encouraged where feasible during influenza epidemics and pandemics; - proactive workplace closures be considered during epidemics and pandemics of high or extraordinary severity.	Very low	Conditional recommendation for ✔
Travel-related measures	Entry and exit screening at points of entry	WHO recommends against syndromic entry and exit screening at points of entry to reduce the community transmission of influenza viruses during influenza epidemics and pandemics.	Very low	Strong recommendation against ✖
	Travel advice	WHO recommends that travel advice be used to inform individuals of the risk of infection and of the measures that can be taken to protect themselves against potential exposure to influenza viruses during influenza epidemics and pandemics.	Very low	Strong recommendation for ✔
	Travel restrictions	WHO suggests against travel restrictions (including border closures) to reduce the community transmission of influenza viruses during influenza epidemics and pandemics.	Very low	Conditional recommendation against ✖
	Upon-arrival quarantine	WHO suggests against the use of upon-arrival quarantine of travellers to delay the introduction of influenza viruses into the community during influenza epidemics and pandemics.	Very low	Conditional recommendation against ✖



1. Introduction

1.1 Background and context

1.1.1 Public health importance of influenza epidemics and pandemics

Influenza virus infections cause acute respiratory illness that is usually self-limiting but can be severe in some cases. Influenza viruses infect the upper and lower respiratory tract, and spread between people mainly at close range (18). Seasonal influenza epidemics cause considerable mortality and morbidity each year, while influenza pandemics occur sporadically when a new influenza virus emerges and spreads in populations in which immunity against it is absent or low (19).

Seasonal and pandemic influenza

In temperate locations, epidemics of human influenza A and B occur in the winter months almost every year (20), leading to the commonly used term “seasonal” influenza. In tropical and subtropical locations, influenza A and B epidemics occur either with weaker seasonality (21) or year round (22). In these locations, “interpandemic” influenza may be a more appropriate term than seasonal influenza.

Influenza viruses continually evolve to escape the immunity generated by prior infections or immunization, allowing for their continued circulation in the human population. The specific virus strains included in influenza vaccines are reviewed twice each year and are updated when necessary to maintain vaccine effectiveness against newly prevalent strains. Segments of the population at higher risk of severe outcomes from seasonal influenza infections include young children, older adults, adults with underlying medical conditions and pregnant women (20).

An influenza A pandemic occurs when a new influenza A strain to which the population has little or no immunity emerges. Prior to the 2009 A(H1N1) pandemic, it was believed that pandemics only occurred when new influenza A subtypes emerged in the human population and replaced the previously circulating subtypes – as had occurred in the 1918 A(H1N1), 1957 A(H2N2) and 1968 A(H3N2) pandemics. When influenza A(H1N1) re-emerged in 1977 after a 20-year absence (23) and co-circulated with A(H3N2) rather than replacing it, the re-emergence was not declared a pandemic. However, when the A(H1N1)pdm09 strain emerged in 2009 (24–26), it was declared a pandemic following its global spread, demonstrating that pandemic strains do not need to be a new influenza virus subtype to be antigenically distinct from strains of the same subtype that have circulated previously (27). Influenza A pandemics are associated with higher attack rates because of their relatively rapid mutation rate and the lack of sustained population immunity, and can have a severe public health impact. Some of the key differences between seasonal and pandemic influenza are outlined in Table 2 (20, 28–30).

Table 2. Comparison of seasonal (or interpandemic) influenza epidemics and pandemic influenza

	Seasonal (or interpandemic) influenza	Pandemic influenza
Frequency	Common: every year or almost every year	Irregular: typically, a few times each century
Viruses involved	Influenza A and B ^a	Influenza A
Antigenic characteristics	Relatively small antigenic changes every year (antigenic drift)	Major antigenic change in surface proteins (antigenic shift)
Immunity	Some population immunity from previous infections and from vaccination	Low levels of population immunity
Vaccines	Specific vaccines available, with strains reviewed twice a year and updated as appropriate	Specific vaccines may not be available for the first 6 months
Antivirals	Antiviral drugs available in some locations, and used for the treatment of severe influenza or as clinically appropriate	Large stockpiles of antiviral drugs available in some locations
At-risk groups	Groups at highest risk of severe disease include young children, older adults, adults with underlying medical conditions and pregnant women	Attack rates may be highest in children and young adults; pregnant women are often at higher risk, as documented in several previous pandemics; the population segments at highest risk of severe influenza are unpredictable
Impact	Between 290 000 and 650 000 respiratory deaths each year (20)	Potentially millions of deaths

^a Influenza C virus infections are sporadically detected, but this type has not been linked to large epidemics or to major disease burden.

The three major influenza pandemics of the 20th century were the 1918 “Spanish flu”, the 1957 “Asian flu” and the 1968 “Hong Kong flu” (Table 3). The most severe of these was the 1918 pandemic caused by the A(H1N1) virus, which resulted in 20–50 million deaths and had a particularly notable impact on mortality in young adults (31). The 1957 and 1968 pandemics (caused by A(H2N2) and A(H3N2) viruses respectively) each caused around 1 million deaths worldwide, with the greatest impact being on mortality in older adults (32).

The first influenza pandemic of the 21st century occurred in 2009 and was caused by a new strain of the influenza A(H1N1) virus that was antigenically distinct from the seasonal A(H1N1) strains circulating at the same time but antigenically similar to A(H1N1) strains that had circulated prior to 1950 (33). The virus is thought to have emerged in Central America shortly before it was first detected in North America in April 2009 and subsequently spread rapidly to other parts of the world (34). Because of the similarity with older A(H1N1) viruses, older adults had some immunity

against the pandemic virus, thus reducing the health impact in this age group (35). Globally, the pandemic was estimated to have caused 123 000–203 000 respiratory deaths (36).

Table 3. Influenza pandemics of the 20th and 21st centuries

Pandemic	Influenza A subtype	Mortality impact
1918 “Spanish flu”	H1N1	20–50 million deaths (31)
1957 “Asian flu”	H2N2	1.1 million deaths (37)
1968 “Hong Kong flu”	H3N2	1 million deaths (37)
2009 (A)H1N1 pandemic	H1N1	123 000–203 000 respiratory deaths (36)

Influenza pandemics typically occur in epidemic waves. For example, in 2009, the United States of America (USA) experienced a spring epidemic of A(H1N1)pdm09 that had only a limited impact. However, this was followed by a much larger autumn epidemic that had a major health impact (38).

The origin of pandemics

A much greater range of influenza A virus subtypes circulates in animals, particularly in wild aquatic birds. Although human infections with avian influenza A subtypes are sporadic, there is a risk that these strains will develop the capacity for effective human-to-human transmission, resulting in the next pandemic. Of all the avian influenza A subtypes, the emergence of highly pathogenic A(H5N1) in 1997 has raised most concern because of the severity of laboratory-confirmed human infections (39). In addition, more than 1000 laboratory-confirmed human infections with the avian influenza A(H7N9) virus occurred in China in the period 2013–2018 (40) – though with no indication of sustained human-to-human transmission (41). Several other avian influenza A subtypes, including A(H9N2), A(H6N1) and A(H7N7), have also caused sporadic human infections (42). As demonstrated in 2009, influenza pandemics can also emerge from swine influenza viruses. In all cases, only influenza A viruses are known to have caused pandemics (43).

1.1.2 Human influenza virus transmission

Contact transmission

Contact transmission can be either direct or indirect. Transmission via direct physical contact (for example, kissing) can occur between an infected individual and a susceptible individual. Transmission via indirect contact occurs through an intermediate object (for example, when a susceptible individual touches a contaminated surface or object and then touches their mouth, nose or eyes without performing hand hygiene) (18). Several studies have shown that influenza viruses can survive for prolonged periods on certain types of surfaces and can survive on hands for a short time (44).

Airborne transmission/inhalation

Influenza viruses can be detected in the fine-particle aerosols emitted into the air by infected individuals during exhalation, coughing or sneezing (45). These infectious respiratory particles can then enter the respiratory tract of another person through inhalation, potentially causing infection (18, 46). Although this form of transmission is likely to occur at close range because of virus dilution and inactivation over distance and time, these particles can remain suspended in the air for extended periods and may be responsible for higher rates of transmission, particularly in crowded areas (47).

Direct deposition

Direct deposition (previously known as “droplet transmission”) is the spread of an infectious agent by dissemination of infectious respiratory particles. After emission from an infected person, these particles follow a semi-ballistic trajectory and then deposit on the exposed facial mucosa surfaces (mouth, nose and eyes) of another person (46, 48). Virus-laden particles are expelled into the environment by talking, breathing, coughing or sneezing, usually travel short distances (1–2 metres from the source) and do not remain suspended in the air (47, 49). Although direct deposition is a potential route of influenza transmission, there is limited evidence to support this (50).

Impact of modes of transmission on the effectiveness of PHSM

The various modes of transmission each have implications for the effectiveness of measures against influenza transmission. However, uncertainty over the specific contributions of contact and through the air transmission has hindered the optimization of control strategies. In settings where influenza virus transmission occurs through multiple modes, implementing measures to mitigate one mode of transmission (for example, through frequent hand hygiene) may not be sufficient to reduce overall transmission (51). Isolating infected individuals – that is, keeping them away from others – is likely to reduce transmission by all modes.

1.1.3 Public health and social measures (PHSM)

PHSM refer to non-pharmaceutical interventions implemented by individuals, communities and governments during health emergencies to reduce the risk and scale of transmission of an infectious disease. PHSM decrease the risk and scale of infectious disease outbreaks by reducing exposure to the pathogen or making exposure situations safer. The mode of transmission of a disease (for example, through the air, direct/indirect contact, waterborne or foodborne) will determine the selection of interventions and their combination. PHSM are often the first and sometimes the only interventions available in the early stages of a pandemic, when effective vaccines and therapeutics are not yet available or equitably accessible (52). PHSM also play a critical role throughout the different stages of health emergencies and act in concert with medical countermeasures, when available.

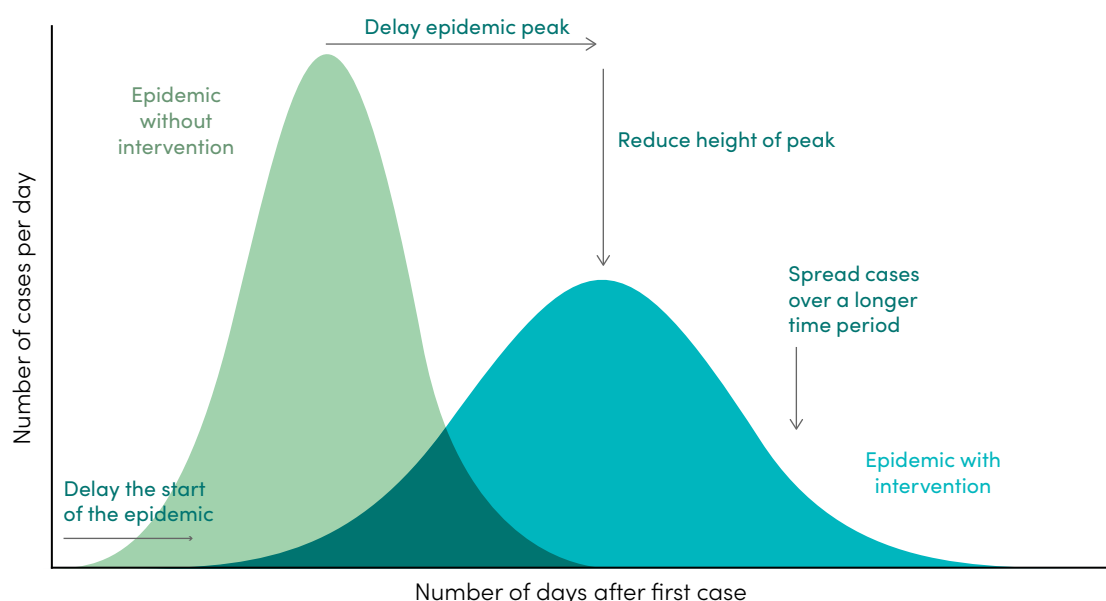
In order to protect individuals and communities during the first and then subsequent waves of an epidemic or pandemic, PHSM aim:

1. *To delay the start of an epidemic or pandemic in unaffected countries* – this is particularly important if the resulting delay is long enough to allow for effective vaccines to be produced and distributed to reduce the impact of the outbreak.

2. *To delay the peak of the epidemic or pandemic* – once an epidemic has started, PHSM may be used to delay the peak of the epidemic, again allowing time for vaccines to be produced and distributed, and/or for the health-care system to better prepare for a surge in cases.
3. *To reduce the peak of an epidemic or pandemic* – by reducing transmission in the community, the outbreak may be spread out over a longer period, with a reduced epidemic or pandemic peak. This can be particularly important if the health-care system has limited resources or capacity (for example, in terms of hospital beds and ventilators). When health-care systems maintain their capacity to manage and treat symptomatic and severe cases, overall morbidity and mortality can be reduced even if the total number of infections across the epidemic or pandemic is not reduced.
4. *To reduce the total number of infections* – some interventions (such as physical distancing measures) may aim to reduce the total number of infections, which in turn will also reduce the total number of severe cases, hospitalizations and deaths.

A graphical summary of the above aims and intended impacts of PHSM during an influenza epidemic or pandemic is presented in Fig. 1.

Fig. 1. Intended impact of PHSM on an influenza epidemic or pandemic by reducing human-to-human transmission^a



^a Adapted from: US Centers for Disease Control and Prevention and European Centre for Disease Prevention and Control guidelines (7, 53).

Each of these objectives should contribute towards reducing the overall impact of the epidemic or pandemic. PHSM used in community settings could focus on reducing transmission-relevant contacts or making them safer through personal protection measures (such as hand hygiene and mask wearing), reducing disease spread in the community (for example, by closing schools and placing restrictions on gatherings) and/or limiting international spread (for example, through the imposition of travel restrictions) (5).

Determining the suitability of individual PHSM will depend upon the objectives (and specific transmission routes to be acted on), as well as contextual factors, and equity and human rights considerations. To avoid exacerbating existing health and social inequities as an unintended consequence of PHSM, health, equity and social justice considerations should be placed at the core of decision-making and implementation. A fair and equitable response will require that PHSM are designed, implemented, adjusted and lifted with the needs of communities, and in particular vulnerable and marginalized populations, in mind. In addition, there will be a need to ensure the involvement of all affected communities in the decision-making process. Social protection policies and programmes such as paid sick leave or unemployment benefits should be implemented alongside PHSM to reduce negative consequences such as loss of income, food insecurity, gender and social inequity, and slowed economic productivity. Other mitigation measures led by communities, such as food delivery services for groups at high risk or child care initiatives, can further alleviate the socioeconomic burdens of implementing PHSM.

1.1.4 PHSM for the management and control of influenza epidemics and pandemics

With no vaccine available during the 1918 A(H1N1) pandemic, its management relied on the implementation of PHSM. Measures included isolation, quarantine and restrictions on gatherings and were implemented on a large-scale and likely saved lives (54, 55). In contrast, PHSM were only used in the first few months of the 2009 A(H1N1) pandemic due to its lower health impact compared to the three influenza pandemics of the 20th century (56).

The limited evidence available on the relative importance of each of the potential modes of influenza transmission limits the strength of recommendations for some PHSM aimed at blocking specific transmission routes. For example, enhancing hand hygiene will reduce indirect contact transmission but it is unclear whether indirect contact transmission is a major contributor to transmission overall in the community. The literature suggests that influenza virus transmission mostly occurs indoors at quite close range through the respiratory route, involving infectious respiratory particles of various sizes including very small particles that can remain suspended in the air for a prolonged period. If this is the case, measures to reduce transmission could aim to increase the physical distance between individuals, reduce the number of individuals in the same location at the same time and improve indoor ventilation.

The effectiveness of PHSM is also influenced by the transmission dynamics of the epidemic or pandemic influenza virus strain. As a significant proportion of influenza virus infections are asymptomatic (57), the isolation of sick and/or symptomatic patients may only capture a fraction of the total cases. Different influenza subtypes and lineages also have different attack rates, transmission potential and severity profiles in different age groups. For example, children tend to shed more influenza viruses in general and do so for longer than adults throughout the course of an infection (58). Influenza B virus infections also tend to be more severe in children than adults. Previous studies have suggested that seasonal influenza epidemics could be mitigated by time-limited school closures (59, 60). Therefore, from an epidemiological perspective, the selection of PHSM to control influenza epidemics and pandemics needs to take into consideration the transmission dynamics of the specific strain.

1.1.5 PHSM for the management and control of the COVID-19 pandemic

The emergence of the severe acute respiratory coronavirus 2 (SARS-CoV-2) in late 2019 (61) resulted in the coronavirus disease 2019 (COVID-19) pandemic, with over 776 million infections and over 7 million deaths having occurred as of 18 August 2024 (62). The rapid emergence of this novel coronavirus meant that no vaccines or effective antiviral treatments to mitigate its public health impact were available during the first year of the pandemic, with access to such medical countermeasures remaining inequitable even after their development and deployment. Consequently, PHSM played a key role in the pandemic response – with the need for particularly stringent PHSM diminishing once antivirals and vaccines became readily available. In comparison, influenza vaccines and antivirals are likely to become available earlier due to ongoing preparedness activities that aim to reduce the time needed to develop safe and effective vaccines to 100 days – potentially alleviating the need for stringent PHSM during an influenza pandemic.

In the early stages of the COVID-19 pandemic, PHSM such as restrictions on international flights and the use of upon-arrival quarantine were put in place with a view to preventing the introduction of cases into regions with little to no reported community transmission. However, once local transmission was established, measures were focused on reducing person-to-person contact. Such measures included limiting the size of gatherings, and workplace and school measures and closures to slow down the community transmission of SARS-CoV-2. Moreover, in some locations, more stringent measures (such as stay-at-home provisions or movement restrictions) were also implemented to reduce and halt community transmission, and reduce the burden on health-care systems.

In some locations, individuals adopted risk reduction measures such as mask wearing, practising hand hygiene, and/or cleaning and disinfection of surfaces or objects they came into contact with. Mask wearing was already a common voluntary practice among some communities, especially those with previous experience of the 2003 SARS epidemic, and during the COVID-19 pandemic, many governments and health authorities worldwide recommended or even mandated the wearing of face masks in community settings.

At the same time, in several locations, the rapid development of laboratory assays to detect SARS-CoV-2 in respiratory samples allowed for the rapid identification and isolation of cases, and subsequent contact tracing and quarantining of contacts. The implementation of these measures facilitated research into key transmission dynamics, including the occurrence of pre-symptomatic transmission (63), estimation of the serial interval of infections (64) and the clinical presentation of an evolving pandemic virus (65). These findings allowed for further optimization of isolation and quarantine programmes, including determining the optimal duration of quarantine and appropriate time frames for contact tracing.

As information on the different routes of transmission of SARS-CoV-2 became available, multiple interventions were introduced and implemented in concert for varying periods. This has presented challenges in evaluating the effectiveness of individual or specific combinations of measures in reducing SARS-CoV-2 transmission. Additionally, some PHSM that had not commonly been implemented in previous pandemics due to cost (such as widespread polymerase chain reaction (PCR) testing) or to a lack of infrastructure (such as special isolation wards and quarantine centres, the development and use of lateral flow tests such as rapid antigen tests (RATs), and real-time digital contact tracing) were used during the COVID-19 pandemic. This provided an opportunity to investigate the effectiveness of such measures.

During the first year of the COVID-19 pandemic, the use of PHSM to reduce SARS-CoV-2 transmission was associated with a concurrent significant reduction in influenza activity globally, with such activity becoming minimal during the second year when the implementation of PHSM was most stringent and widespread.¹ Furthermore, after PHSM were gradually rolled back in the third year of the COVID-19 pandemic, influenza activity levels increased, suggesting a potential causal relationship between the implementation of stringent PHSM and the reduction of influenza transmission in the community. While there are important differences between the transmission dynamics of SARS-CoV-2 and influenza, the near-complete suppression of influenza activity during the COVID-19 pandemic is instructive and has informed the systematic evaluation of the scientific literature that forms the basis of the current document.

The widespread use of PHSM during the COVID-19 pandemic also highlighted a number of contextual factors that significantly impacted the effectiveness of individual measures. For example, the capacity of the health-care system to isolate and effectively treat infected individuals differed significantly between and within countries. In addition, cultural norms and the uptake of, and ability to adhere to, PHSM varied significantly across different communities – for example, individuals in precarious working conditions who were dependent on daily wages for onsite work were unable to adhere to isolation recommendations in the absence of paid sick leave or protection from job loss.

Most importantly, the COVID-19 pandemic highlighted the ways in which the effectiveness of PHSM can be significantly influenced by social inequity, and the ways in which such measures can exacerbate existing inequalities in communities (66). This underlines the importance of incorporating equity and human rights considerations into national pandemic preparedness planning to ensure the effective implementation of PHSM that are both necessary and proportionate to the health impact of the epidemic or pandemic, while respecting international human rights obligations (67).

1.1.6 History of WHO guidance on the use of PHSM during influenza pandemics

WHO guidance on national and regional influenza pandemic preparedness planning, and on the role of WHO in pandemic preparedness and response activities, was first developed in 1999 (68). In 2005, this document was updated to include a pandemic preparedness “checklist” to further guide and refine national planning efforts (69). The checklist included the need to plan for the use of public health measures to prevent the spread of a pandemic pathogen in the community based on the following rationale:

As the access to vaccines and antiviral drugs during a pandemic will be extremely limited, especially in countries with limited resources, nonmedical interventions may be the only way to delay the spread of the disease. However, many of these interventions may affect human behaviour and human rights, and therefore need a strong educational, legal and well-supported basis. Moreover, most of the interventions are based on limited evidence. Therefore, transparent decision-making and frank information-sharing should go hand in hand with the measures discussed in this section.

¹ As monitored and reported by the WHO FluNet platform. Geneva: World Health Organization.

In response to the emergence of influenza A(H1N1)pdm09, WHO then published several guidance documents on PHSM (previously referred to as “non-pharmaceutical interventions”) (70–73). These documents provided recommendations on the measures that could be used to reduce influenza transmission and mitigate the impact of epidemics and pandemics in various settings, with updated recommendations on such measures being published in 2019 following a systematic review of the scientific literature on their effectiveness (74).

Between 2020 and 2023, various such measures were applied by public health authorities to contain and mitigate the impact of the COVID-19 pandemic in community settings. However, due to the extraordinary severity of the COVID-19 pandemic, many governments imposed significant social measures for the first time, such as movement restrictions and stay-at-home provisions. This expansion of measures to include both public health and social measures resulted in wider use of the umbrella term “public health and social measures” to describe the range of measures that could be taken by individuals, communities and governments to prevent or slow the transmission of an infectious disease (75). The current guideline is based upon an updated review of all available evidence on the effectiveness of PHSM in mitigating the risk and impact of influenza epidemics and pandemics (Table 4), and is intended to contribute to preparedness and response efforts for future such outbreaks.

Table 4. Comparison between PHSM included in the current guideline and 2019 guidance

PHSM	2019 guidance (74)	Current guideline
Personal protection measures		
Hand hygiene	Included	Included
Mask wearing	Included	Included
Respiratory hygiene and cough etiquette	Included	Included
Environmental measures		
Air purification	Not included	Included
Modifying indoor humidity	Included	Included
Surface and object cleaning and disinfection	Included	Included
Ventilation	Included	Included
Active case-finding and contact identification measures		
Contact tracing	Included	Included
Isolation of symptomatic and/or infected individuals	Included	Included
Mass testing	Not included	Included
Voluntary self-quarantine	Included	Included
Social measures		
Indoor hospitality and recreation measures	Not included	Included
Restrictions on gatherings (“Avoiding crowding” in 2019)	Included	Included

PHSM	2019 guidance (74)	Current guideline
School measures and closures	Included	Included
Stay-at-home provisions	Not included	Included
Workplace measures and closures	Included	Included
Travel-related measures		
Entry and exit screening at points of entry	Included	Included
Travel advice	Included	Included
Travel restrictions	Included	Included
Upon-arrival quarantine	Not included	Included

1.2 Scope, purpose and target audience

1.2.1 Scope and purpose

This WHO guideline provides recommendations for or against the use of specific PHSM during influenza epidemics and pandemics based on existing guidance on the prevention, control and management of influenza, and on an extensive review of the latest scientific literature on the effectiveness of individual PHSM.

The recommendations provided in the guideline were developed primarily based on epidemiological evidence in the context of pandemic influenza but, where appropriate, PHSM could also be used to mitigate seasonal influenza epidemics of high severity. Since the implementation of some highly disruptive PHSM can have significant negative socioeconomic and health impacts, it is recommended that the implementation of such measures be confined to an influenza pandemic or severe epidemic.

Although evidence on the effectiveness of some PHSM were drawn from lessons learned during the COVID-19 pandemic, the recommendations provided in this guideline relate specifically to their likely effectiveness in reducing or delaying the transmission of influenza viruses only, and thus gaining time for the development of vaccines and therapeutics. As noted above, PHSM implemented during the COVID-19 pandemic resulted in reduced seasonal influenza transmission to the extent of preventing large influenza epidemics in many parts of the world, demonstrating that temporary delays in the introduction of influenza viruses could be achieved, albeit through the use of very costly and highly disruptive measures. In a future influenza pandemic, depending on the degree of transmissibility and severity of the virus strain, some more remote countries or communities might consider attempting temporary prevention measures, as opposed to implementing mitigation measures, but would need to carefully consider the costs and benefits of each approach. However, once such measures were relaxed there would likely still be a need for mitigation measures.

The current document does not provide specific recommendations on the use of PHSM in settings such as hospitals, care homes and detention centres. In addition, strategies based on the use of pharmaceutical interventions (such as vaccines and antivirals) are also not covered in this document, along with health system preparedness measures (such as ensuring sufficient

numbers of hospital beds, essential medicines and medical equipment) as these are outside the scope of the guideline.

1.2.2 Target audience

This guideline is intended for use by national and local health authorities, and stakeholders from other sectors, including the educational sector, involved in the decision-making or implementation of PHSM during an influenza epidemic or pandemic. It is intended that users can use the guideline to determine the most appropriate measures to use, and when, during an influenza outbreak. It could also serve as a supporting resource for the development and updating of national preparedness plans for mitigating the adverse consequences and impacts of influenza epidemics and pandemics.

1.3 International Health Regulations (2005)²

The scope and purpose of the International Health Regulations (2005) (IHR) (10) are to prevent, protect against, control and provide a public health response to, the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade (Article 2). Respecting human rights is a cross-cutting principle of the IHR, which requires that “the implementation of these Regulations shall be with full respect for the dignity, human rights and fundamental freedoms of persons” (Article 3). The IHR aims to protect health for the common good of the international community, taking into account the sovereignty of individual States Parties.

Under the IHR, States Parties are entitled to implement additional public health measures to protect the health of their populations during public health events, provided that such measures are in accordance with their relevant national laws and obligations under international law, are based on scientific evidence, and are neither more restrictive of international trade nor more onerous or intrusive than reasonably available alternatives.

A key obligation of the Regulations for States Parties is that they must develop, strengthen and maintain core public health capacities for surveillance and response. In order to be able to detect, assess, notify and report events and respond to public health risks and emergencies of international concern. States Parties must meet the requirements described in the IHR, including, at the national level, the assessment of all reports of urgent events within 48 hours and the immediate reporting to WHO through the National IHR Focal Point, when required.

In relation to influenza specifically, Annex 1 of the IHR requires States Parties to notify WHO within 24 hours of any laboratory-confirmed case of human influenza caused by a new subtype according to the WHO case definition (76). Human influenza infections caused by a new subtype has been established as being unusual or unexpected, and may have serious public health impacts. For this reason, even a single confirmed case of such an infection that fulfils the WHO case definition must always be notified immediately to WHO, regardless of the context in which

² On 1 June 2024, the World Health Assembly adopted a package of amendments to the IHR through resolution WHA77.17 which were notified to States Parties on 19 September and will normally come into force on 19 September 2025 for 192 States Parties. Revision of the current guideline may be considered, if appropriate, following the entry into force of the said amendments.

it occurs. For events involving suspected cases of human influenza caused by a new subtype (for example, in the absence of laboratory confirmation), States Parties are required to carry out an assessment according to the decision instrument provided in the IHR, and to then notify WHO of all qualifying events within 24 hours of such an assessment. Notifications and other event-related communications under the IHR are carried out (using the most efficient means of communication available) between the National IHR Focal Point on behalf of the State Party concerned and the WHO IHR Contact Point at the respective WHO regional office.

1.4 Pandemic influenza severity assessment framework

The pandemic influenza severity assessment (PISA) framework was introduced by WHO in 2017 and updated in 2024 (77). The severity of an influenza epidemic or pandemic is evaluated and monitored through four indicators: transmissibility (referring to incidence), seriousness of disease, morbidity and mortality, and impact on health-care capacity. Severity for each indicator is categorized into one of five levels – no activity or below seasonal threshold, low, moderate, high or extraordinary in comparison to historical levels. The PISA approach is intended to be used routinely, during both seasonal influenza epidemics and pandemics as a visualization and communication tool to help public health authorities monitor and assess the severity of an influenza outbreak, communicate risk and inform appropriate decisions and recommendations on interventions. Of particular relevance to the current guideline on the use of PHSM, the PISA evaluation of severity may inform the selection and timing of interventions (for example, by providing a rationale for the use of highly disruptive measures).

1.5 Equity and human rights

Human rights are recognized and protected in the WHO Constitution, the IHR and national laws. In addition, human rights are enshrined in a range of international human rights instruments, including international treaties that are binding on countries and overseen by treaty monitoring bodies ([Annex 1](#)).

In the context of a health emergency like a pandemic, public health and human rights are intrinsically linked. As PHSM may require restrictions on individual rights, they must be necessary (following proper scientific evidence), proportionate to the public health threat and time limited, and non-arbitrary (non-discriminatory) (67). PHSM are therefore both required by the right to health and strengthened when implemented in accordance with human rights principles. Moreover, taking into account the impact of PHSM on economic and social rights, and the connection between health and the social determinants of health, their implementation must accord with the International Covenant on Economic, Social and Cultural Rights, including the rights to education, housing, water, an adequate standard of living and social security (78). In these and other respects, PHSM should be grounded in international and domestic human rights laws, and be designed to protect the rights of people to health and life, including by avoiding or minimizing interference with rights such as education, work, protection from violence, housing, food, freedom of movement, assembly and peaceful assembly and privacy.

To prevent inequity including gender inequality, discrimination and stigma arising from the use of PHSM, they should be designed and implemented with full attention to the human rights of all vulnerable and disadvantaged groups (79, 80). Measures should neither directly nor indirectly (that is, explicitly or inadvertently) discriminate against such groups. Moreover, a human rights-based approach includes the participation of vulnerable and marginalized communities in the design, implementation and oversight of PHSM to ensure equitable and effective policies (81). In some cases, positive affirmative measures, mitigations and adjustments may be needed to reduce the disproportionate risks faced by some groups during a severe influenza outbreak. Mitigation measures may include social protection policies and programmes and community-led initiatives to reduce and compensate for any interference by PHSM on human rights including those integrally linked to livelihoods and well-being (82). Building capacity and resources for the right to health care, including access to treatment and vaccines, can also reduce the risk of interference with human rights associated with some PHSM (83).

The United Nations Committee on Economic, Social and Cultural Rights General Comment No 14 (2000), the International Covenant on Civil and Political Rights (1966) and the Siracusa Principles on the Limitation and Derogation Provisions in the International Covenant on Civil and Political Rights (1984) (84) recognize that certain human rights may be restricted to protect public health in emergencies, providing any such measures are:

- in accordance with the law;
- pursue a legitimate aim, that is, to protect public health; necessary and proportionate in relation to that objective (that is, only implemented after a comprehensive examination of less restrictive alternatives and where a failure to act would be even more detrimental to human rights);
- not arbitrary;
- non-discriminatory; and
- subject to review and lifted in the minimum time needed.

The Siracusa Principles further provide that “public health may be invoked as a ground for limiting certain rights in order to allow a state to take measures dealing with a serious threat to the health of the population or individual members of the population. These measures must be specifically aimed at preventing disease or injury or providing care for the sick and injured” and that “due regard shall be had to the international health regulations of the World Health Organization”.

The implementation of PHSM should also be conducted according to principles of least restrictive means, legality, non-discrimination, necessity and proportionality. For example, the use of lawful enforcement should be a last resort and only where strictly necessary for pressing public health purposes and where less restrictive means are ineffective. The use of criminal sanctions should be avoided to the extent possible (85), with any such sanctions subject to review and set at a level that does not lead to hardship. In fact, compulsory restrictive and punitive measures tend to exacerbate barriers for the people most in need and potentially increase their vulnerabilities (86). Instead, building trust and empowering communities with the information they need to both protect themselves and help others are key to an effective response during emergencies.

Where a country implements measures that result in a derogation to human rights based on a state of emergency or similar state of exception, any such measures must meet a specific threat to the life of the nation, be pursuant to a publicly proclaimed state of emergency and must not

interfere with non-derogable rights.³ Such measures should also be temporary, legal, necessary, proportionate and non-discriminatory (84, 87, 88).

Regular review and, where necessary, revision of policies on PHSM implementation should be undertaken to ensure adherence with human rights principles as set out in international treaties. Such processes should be deliberative and involve public participation, including by marginalized and disadvantaged groups. In addition, ensuring access to prompt and effective judicial and/or equivalent administrative remedies is an important guarantee of rights for individuals and populations, including during public health emergencies (85).

1.6 Risk communication and community engagement

Ensuring access to public health information is critical during a pandemic to protect the right to health. However, the dissemination of information alone is not sufficient to ensure that populations at risk of disease will follow public health advice. Those affected by health emergencies should be consulted as important partners in the development of PHSM, and this should be a critical part of all risk communication and community engagement (RCCE) strategies (89).

RCCE is a technical discipline, involving two interlinked concepts:

- Risk communication involves the real-time exchange of information, advice and opinions between experts or officials and those members of the public who are facing health hazards. It enables people to make informed decisions to mitigate the effects of a threat and to take protective and preventive measures, and is particularly important during an emergency such as a pandemic.
- Community engagement brings people into the process by helping them to understand the risks and contribute to the development of acceptable, workable health and response practices. By engaging in two-way communication, public health authorities can gather feedback, address concerns and better tailor their communications to the target audience.

Managing information during a disease outbreak is also crucial. Infodemic management – that is, handling the flood of both accurate and false information in the physical and digital space (90) – is a critical part of RCCE. It aims to create healthy and trustworthy information environments by identifying and addressing concerns, information voids, misinformation and disinformation, and by responding to community concerns.

1.6.1 Promoting acceptance and uptake of PHSM

Effective RCCE, along with infodemic management, is critical in promoting healthy behaviours, preventing the spread of disease and managing public health crises, and is pivotal in promoting

³ Non-derogable rights are absolute rights that cannot be suspended or infringed upon under any circumstances and include the right to life, freedom from torture and cruel, inhuman or degrading treatment, and freedom from slavery or servitude.

the acceptance and uptake of PHSM (91). It helps to build and maintain trust between communities and health authorities, raise awareness of influenza risks and transmission modes, and explain associated PHSM. Reducing confusion and promoting accurate knowledge through effective RCCE also fosters collaboration between health authorities and communities, thus contributing significantly to the overall effectiveness of PHSM (92).

There are numerous theoretical models that can help define “effective” RCCE approaches (92), all which overlap with regard to the need to establish trust with at-risk communities by being transparent, honest and reliable, while ensuring the clarity and consistency of messages (92, 93). The WHO RCCE competency framework provides detailed information on the specific competencies required by RCCE teams to fulfil these actions (94).

The remainder of this section summarizes the key components of RCCE readiness and response actions.

Maintain engagement with communities even in the absence of an emergency

Readiness, in the context of disease outbreaks, is a country’s ability to respond to a health threat quickly and appropriately when required. Readiness activities are a foundation for response efforts when outbreaks occur, and RCCE teams must maintain engagement with communities (95) even in the absence of an emergency. Priming coordination systems in advance helps to prepare responders and communities to work together when disease outbreaks occur, and to effectively harmonize messages, approaches and the dissemination of information in a community. Community engagement involves building long-term relationships between outbreak responders and the community, co-designing solutions and fostering dialogue to understand the community’s needs.

Collect, analyse and use social and behavioural data and evidence

Policy and RCCE during an epidemic or pandemic must be informed by social and behavioural evidence to allow for better understanding of the capacities, expectations and concerns of the public. Social and behavioural data and evidence are important in identifying populations most at risk, and making assessments of what people know and believe. This in turn helps to develop PHSM that align with people’s needs and priorities, and to inform the design and adaptation of communication content.

Rapidly communicate risks and adapt recommendations to the local context

Communication approaches during an epidemic or pandemic should emphasize information sharing and community problem-solving to help people identify actionable ways of protecting themselves and those around them. Communication materials on risks and protective behaviours need to be developed and adapted for different audiences and shared through appropriate and trusted channels for that specific audience. Messages that raise awareness, encourage health care seeking behaviour and explain uncertainty need to take into account the individual and collective capacities within a community to act on the advice being given. The recommended behaviours must be practical and adapted to the local context to ensure their acceptability and promote their wide adoption. There is also a need to ensure that marginalized groups (for example, those living in inadequate or overcrowded housing, and minorities, people with disabilities and indigenous communities) are also engaged in prevention and protection

efforts, have access to information (for example, by making it available in minority languages) and are able to act upon such information. This involves explaining why practising certain behaviours is important. Transparency in sharing information and the underlying rationale helps to build trust and increases the likelihood of cooperation.

Address infodemics through community feedback mechanisms and social listening, and counter misinformation with accurate health information

People and communities generally make health decisions based on their knowledge, personal beliefs, preferences and circumstances. Feedback mechanisms allow community members to provide information on their views, concerns and experiences (96). Social listening, both online and offline, is also essential for understanding the information environment and how it affects health behaviours. It is important to actively seek feedback from different groups, recognize that communities are not homogeneous and where appropriate adjust PHSM interventions based on community input.

2. Guideline development process and methods

2.1 Contributors to the process

This guideline was developed based on the combined contributions of a WHO steering group, evidence review team, guideline methodologist, GDG and External Review Group, in accordance with the *WHO handbook for guideline development* (15). Efforts were made to ensure a broad range of expertise, gender balance and geographical representation across all contributing groups. Details of all non-WHO contributors and their declarations of interests can be found in [Annex 2](#).

2.2 Guideline development steps

This document was developed using the standard procedures described in the *WHO handbook for guideline development* (15) and meets international standards for evidence-based guidelines. In summary, the development process included: (i) defining priority PHSM and developing key questions; (ii) evidence retrieval; (iii) assessment and synthesis of the evidence; (iv) formulation of the recommendations; and (v) planning for the dissemination, implementation, impact evaluation and updating of the guideline.

2.2.1 Defining priority PHSM and developing key questions

The WHO steering group together with the evidence review team developed a list of PHSM which included the measures reviewed in the 2019 WHO guidance and others implemented during the COVID-19 pandemic. A subset of PHSM were deemed to be of high priority for review, taking in account the experiences of the COVID-19 pandemic and previous influenza pandemics. Whenever possible, the key questions were formulated following the recommended PICO (population, intervention, comparison, outcomes) model. These key questions then served as the basis for independent systematic reviews of the literature.

2.2.2 Identifying, appraising and synthesizing evidence

A rigorous systematic review process was conducted by the evidence review team. Evidence was identified, synthesized and presented in a comprehensive and unbiased manner following the process outlined in the *WHO handbook for guideline development* (15). A systematic review based on selected database search terms was conducted for each of the 20 priority PHSM using MEDLINE, PubMed, EMBASE and the Cochrane Central Register of Controlled Trials (CENTRAL). No language restriction was applied in the search. The systematic review explored the evidence base on the effectiveness of each PHSM as determined by transmission-related outcomes (97). Specific such outcomes included reducing transmission, total number of infections,

hospitalizations and deaths, and did not include outcomes such as economic, social and human rights impacts. The effectiveness of each intervention was compared to a period of influenza (or other respiratory viruses) circulation where no intervention was implemented.

This review process, which updates the review process conducted to develop the 2019 WHO guidance, included additional reviews on new PHSM that had been widely implemented during the COVID-19 pandemic. These new PHSM included air purification, mass testing, indoor hospitality and recreation measures, stay-at-home provisions and upon-arrival quarantine. For each PHSM, reviewers first determined whether any relevant systematic review had been published on its effectiveness within the past five years. If there was a recently published review, a systematic review limited to the studies published more recently than the latest review (starting from one year prior to the publication date) was conducted and provided an update to the 2019 review. If a published systematic review of the PHSM within the past five years was not identified, a full systematic review of the PHSM, including all articles published without limitations on publication dates was conducted.

The GRADE (16, 17) approach (Table 5) was used to rate the certainty of the evidence for each PHSM, based on the question of whether the PHSM could reduce influenza transmission in the community. For each included study, the risk of bias was assessed as part of the GRADE certainty of evidence evaluation. In general, randomized controlled trials (RCTs) provided the highest certainty of evidence, followed by observational studies and then simulation studies. The certainty of evidence may also be upgraded or downgraded based on consideration of study design limitations (risk of bias), inconsistency, indirectness, imprecision of results, and publication bias. The final drafts of each review were circulated to the GDG prior to the guideline development meeting.

Table 5. GRADE certainty of evidence rating

Certainty level	Definition
High	We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate	We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low	Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low	We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

2.2.3 Formulating recommendations and GDG decision-making

The GDG formulated the recommendations during a 3-day meeting held in Geneva, Switzerland on 29–31 August 2023. Prior to this meeting, preparatory teleconferences were held for each PHSM category along with a WHO technical consultation in China, Hong Kong Special Administrative Region on 27–28 June 2023 to gather the experiences of international experts on different aspects of PHSM implementation (98).

During the GDG meeting, the evidence review findings were presented and summarized. For each PHSM, the GDG considered the certainty of evidence, values and preferences, balance of benefits and harms, resource implications, equity and human rights, acceptability and feasibility. All of the resulting recommendations developed by the GDG were arrived at through consensus, with no requirement arising for a vote on any of the recommendations provided in this guideline.

2.2.4 Document preparation and peer review

Following all of the above steps and processes, an initial draft of the guideline was sent to all GDG members for further comment. A full draft of the document, including the recommendations and supporting evidence, was then sent to the External Review Group for its consideration and inputs, including the identification of any factual errors, comments on the clarity of language used, and considerations related to the context, implementation and adaptation of PHSM. The full draft was also shared with the WHO steering group and GDG members for any final comments. All comments received were collated and reflected in the current document.

3. Implementation considerations

Each of the recommendations provided in the current document was developed based on the systematic review of supporting evidence for its epidemiological effectiveness and on the literature regarding associated factors such as economic, social and cost benefits and harms. The recommendations are intended to support countries in the developing of national pandemic preparedness plans, and to guide national authorities in the implementation, adaptation, monitoring and evaluation of PHSM during a severe influenza epidemic or pandemic. It should be noted that PHSM decision-making is a cyclical process that will include risk assessments and situation analyses, and implementation monitoring and adjustment (that is, scaling PHSM up or down) according to the evolving circumstances. To ensure context-specific, equitable and effective implementation of the recommendations set out in this guideline, multisectoral collaboration, the involvement of communities, and consideration of other aspects of the national response will be crucial. The successful implementation and effectiveness of PHSM will largely depend on contextual factors such as the local transmission rate, population density, health-care infrastructure, cultural norms, socioeconomic aspects and the extent of societal inequality. In all cases, adequate consideration should be given to each of the aspects set out below before any PHSM is implemented or adjusted. WHO guidance and tools are available to support countries in strengthening systematic, context-specific and evidence-informed decision-making that maximize health benefits of PHSM while reducing unintended negative consequences for individuals, societies and economies during outbreaks with epidemic and pandemic potential (11) and influenza-specific tools will be develop to facilitate the implementation of this guideline.

3.1 Prevention, suppression and mitigation

PHSM can be used to prevent (by delaying virus introduction into the country or reducing the number of cases in the community to zero), to suppress (by reducing the number of infections in the community) or to mitigate impact (for example, by avoiding overwhelming the health-care system) (99). The primary goals of the PHSM recommended in this guideline are to suppress or mitigate an epidemic or pandemic influenza virus, and thus minimize morbidity and mortality before pharmaceutical therapeutics and vaccines become widely available. While it is theoretically possible to prevent the introduction of a virus (or achieve zero community transmission) through the stringent application of some PHSM, this can be highly disruptive to both society and the economy and can lead to widespread violation of human rights, and is therefore unlikely to be acceptable and sustainable over the longer term.

3.2 Complementary effects of PHSM

The evidence base for this guideline mainly comprised observational evidence that estimated the effectiveness of numerous measures implemented in a setting at any one time during the study period. In certain instances, it was challenging to disaggregate the effects of each individual PHSM. However, any single PHSM is likely to have only a small effect in reducing the transmission of influenza viruses, and should therefore be considered as one of a package of measures that will contribute to overall effectiveness.

Determining the optimal timing and duration of implementation is also challenging. In general, the early implementation of PHSM can be more effective at reducing the impact of influenza epidemics and pandemics. However, measures with large unintended negative consequences will be difficult to maintain for long periods. Moreover, if PHSM are implemented too early, are not feasible, or their rationale is not well defined and communicated, a sense of “fatigue” and loss of trust may emerge among the population, limiting adherence and ultimately the effectiveness of the measures. Consideration should also be given to the timing and strategy for relaxing measures. Furthermore, the PHSM for which recommendations were formulated in this guideline are not exhaustive, and focus has been given to measures that specifically aim to reduce the transmission of influenza or other respiratory viruses in the community. There may therefore be other complementary measures available that can alleviate the adverse effects of such PHSM, while other specific measures may usefully be applied in settings such as health and social care facilities.

3.3 Acceptability

The effectiveness of PHSM is highly dependent on their acceptability and uptake by individual and institutional stakeholders. Therefore, the selection and implementation of individual PHSM as part of the package of measures to be taken should be guided by sufficient considerations of the local culture, values and preferences, the existing infrastructure and sociopolitical structures.

3.4 Equity and human rights

Without careful attention, the implementation of PHSM can exacerbate existing inequalities and undermine human rights. Equity considerations, and the following human rights norms and principles should be used guide PHSM design and implementation:

- The right to life
- The right to health (availability, accessibility, acceptability and quality)⁴
- Equality and non-discrimination
- The right to the benefits of scientific progress and its implications
- The right to privacy and confidentiality
- The right to information and freedom of expression

⁴ CESCR General Comment No. 14: The Right to the Highest Attainable Standard of Health (Art. 12).

- The right to education
- Meaningful and effective participation
- Accountability.

This may require the mitigation or adaptation of some measures for certain vulnerable, marginalized or disproportionately affected groups, and/or the implementing of positive targeted measures to redress the impact of such vulnerabilities, disadvantages and discriminatory effects.

3.5 Resource implications and impact on the economy, workforce and access to essential goods and services

PHSM vary with regard to the resource implications of their implementation and subsequent short-term and long-term impacts. For example, PHSM such as mask wearing (supported by mask mandates and regular surface and object cleaning and disinfection) tend to be resource and labour intensive, and require enforcement and high levels of adherence to be effective. However, they may not have significant long-term economic impacts compared with more disruptive PHSM, such as school and workplace closures. Considerations for implementing and adjusting PHSM in the context of the COVID-19 pandemic could, to some extent, also apply to epidemic and pandemic influenza (100). In general, the implementation of any PHSM needs to be balanced against their health and socioeconomic impacts, and with regard to human rights issues, especially in settings with limited or no social protection, where PHSM may increase vulnerability to economic hardship and socioeconomic exclusion. Potential cost and benefit considerations include the likely effectiveness of PHSM, and their implementation costs and opportunity costs resulting from disruptions to daily life. Such costs may include disruption to the education and training of the current and future workforce, livelihoods, businesses and access to essential goods and services. Additional operational costs may also be incurred due to disruptions to the services and supply chains crucial to the provision of essential goods and services.

3.6 Monitoring and evaluation of PHSM

During the implementation of PHSM, periodic monitoring and evaluation of their effectiveness and acceptability, as well as their potential unintended consequences, should be conducted in parallel with epidemiological assessments (101). Plans should also be put in place to gradually relax and lift PHSM when community transmission and the level of impact on the health-care system are reduced to acceptable levels. Independent review will enable the identification of gaps, challenges, and areas for improvement, allowing policy-makers to make informed decisions and to adjust strategies accordingly. Where possible, national-level or regional-level monitoring and analysis of PHSM effectiveness on the community transmission of epidemic or pandemic influenza should be implemented alongside PHSM to ensure their optimal timing, duration, and stringency, commensurate with the public health risk to the population and health-care system. Infodemic and behavioural insights and data from other sectors (such as education and housing) should be used to complement PHSM effectiveness monitoring, and

to understand potential barriers to adherence in the population. Pandemic preparedness planning should include the identification of data sources to support the calculation of a PHSM severity⁵ index (102) and the stringency of PHSM regularly reviewed and adjusted based on local and regional influenza epidemic and pandemic severity (77). By continuously monitoring and evaluating PHSM, policy-makers can enhance accountability, transparency and evidence-based decision-making, ultimately leading to improved health outcomes for individuals and communities.

⁵ PHSM severity can be defined as: *the extent to which measures restrict or require certain actions that disrupt day-to-day life. The stricter the measure (that is, the more it restricts or requires certain actions), the higher the severity score.*

4. Personal protection measures

4.1 Hand hygiene

Strong recommendation for – moderate certainty evidence

WHO recommends performing hand hygiene to reduce the transmission of influenza viruses in community settings during influenza epidemics and pandemics.

Remarks

- Hand hygiene is considered to be a standard precaution shown to reduce the spread of other infectious diseases. Although the published scientific evidence from RCTs on the efficacy of hand hygiene alone in reducing laboratory-confirmed influenza virus infections remains only moderate, it is an important intervention in reducing the risk of other common infectious diseases. Good hand hygiene should be recommended regardless of influenza activity in the community due to its general effectiveness in preventing infectious disease transmission through indirect contact with contaminated surfaces or objects.
- The effectiveness of hand hygiene increases when used alongside other measures.
- No evidence was found to support the superior effectiveness of one type of hand hygiene method over another in reducing influenza virus transmission. However, handwashing with soap and water is preferred in the case of visibly soiled hands – in circumstances where this is not possible or feasible, alcohol-based handrub (ABHR) can be used (3).
- Gloves are used in medical settings but there is insufficient evidence to support the regular use of gloves as a preventive measure for influenza epidemics and pandemics for the general population.

Summary of evidence

Hand hygiene is an essential community-based measure for preventing the transmission of many infectious diseases. It is a general term referring to any action of hand cleansing to remove, inactivate or neutralize pathogens using soap or other substances, such as ABHR (103). Influenza viruses can survive for a short time on human hands and can be transmitted from contaminated surfaces to hands, supporting the potential for indirect contact transmission to occur (104–106). Hand hygiene can inactivate or reduce influenza viruses on human hands (107–109) and thus in theory prevent their indirect contact or fomite transmission.

Thirteen articles describing 12 RCTs on hand hygiene and influenza transmission were included in the systematic review, and a meta-analysis undertaken for 11 of these studies that had each included more than 22 000 participants (110–122). In the studies that examined the effectiveness

of hand hygiene together with face masks, no statistically significant protective effects were observed in household, school and residential hall settings (110–115). RCTs conducted in elementary school settings indicated varied effects (116, 117, 122). The efficacy of hand hygiene in household settings – with or without face mask use – was not significant (112–115, 118, 119). Several trials reported that poor adherence to hand hygiene might have contributed to the low efficacies observed (112–114).

Other evidence from outside the above review included the finding of one trial that handwashing with soap compared to no intervention significantly reduced the incidence of any acute respiratory infection (123). Another systematic review of observational studies found that among nine studies assessing hand hygiene practices in the community setting, six had observed reductions in laboratory-confirmed influenza or possible influenza infections (124). Influenza transmission events were also estimated in a case-control study carried out at the household level, where participants self-reported their handwashing frequency. It was estimated that handwashing three or more times a day significantly reduced the risk of household transmission of 2009 pandemic influenza A(H1N1) (125).

Relevant evidence from the COVID-19 pandemic

The systematic review did not identify any RCTs that quantified the effectiveness of hand hygiene in reducing SARS-CoV-2 transmission. Seven observational studies on the effectiveness of hand hygiene in reducing laboratory-confirmed SARS-CoV-2 infections were identified outside the review (126–132). Four of these studies identified risk factors for SARS-CoV-2 acquisition among the general public, and found that frequent use of ABHR or hand washing was associated with lower odds of infection (126, 128, 129, 131). The other three studies identified risk factors for SARS-CoV-2 transmission in community and household settings and found that frequent handwashing was associated with a lower risk for SARS-CoV-2 infection (127, 130, 132).

4.1.1 Justification and summary of considerations of GDG members

The moderate certainty of evidence and the absence of harm when implementing hand hygiene supported the decision of the GDG for a strong recommendation. The members judged the intervention to be in accordance with universal human rights standards while equity considerations in the context of performing hand hygiene were judged to vary, given the known differential access to clean water and hand hygiene products in different settings. The GDG found hand hygiene to be generally a cost-effective intervention in health-care settings though financial implications and affordability in community settings could vary. Overall, the GDG considered performing of hand hygiene to be highly feasible in most settings since public campaigns have been already conducted in most countries to reduce the transmission of other common communicable diseases. The members debated about socio-cultural acceptability of the intervention and thought that most communities would understand the importance and effectiveness of hand hygiene in preventing common infections and would agree with the concept of encouraging hand hygiene to prevent the transmission of infectious diseases. The GDG noted that adherence to proper and effective hand hygiene practices may be low in general given the difficulty in ensuring the adoption and sustaining of substantial behavioural changes. However, communication strategies aimed at informing the public on the benefit of the intervention could improve adherence in the general population.

Certainty of the evidence

It is challenging to test the efficacy of hand hygiene in RCTs, partly because it can be unethical to recommend comparison groups to stop washing their hands. Therefore, the intervention in RCTs is typically based on increasing the frequency of hand hygiene actions or on non-inferiority trials focusing on specific products (for example, ABHR use in combination with handwashing versus handwashing alone), making it difficult to estimate the efficacy of hand hygiene alone. In this context, existing hand hygiene study findings are of moderate certainty overall, and do not provide strong evidence that increased handwashing or other hand hygiene modalities are highly effective in reducing influenza virus transmission. However, several experimental studies (107–109, 133) have provided evidence that hand hygiene can inactivate or remove influenza virus particles from human hands, and therefore reduce transmission. Observational studies using data from self-reported hand hygiene practices and increased frequency of handwashing have also found reductions in influenza infection (124). In addition, four observational studies on the effectiveness of hand hygiene in reducing laboratory-confirmed SARS-CoV-2 infections found that frequent use of ABHR or handwashing was associated with lower odds of infection.

Values and preferences

It is well established that good hand hygiene can substantially reduce the incidence of many important infectious diseases, particularly diarrhoeal diseases (134). There is also evidence that hand hygiene can reduce the incidence of respiratory illnesses – though evidence of its effect in reducing laboratory-confirmed influenza is lacking. Hand hygiene is most commonly performed with water and soap, especially in case of visibly soiled hands, although ABHR provides another option for waterless hand disinfection in some locations. The GDG considered that most communities would understand the importance and effectiveness of hand hygiene in preventing common infections and would agree with the concept of encouraging hand hygiene to prevent the transmission of infectious diseases. However, education campaigns on effective hand hygiene might still be needed, particularly for some communities in low-resource settings.

Balance of benefits and harms

Evidence from RCTs showing a significant benefit of hand hygiene on reducing laboratory-confirmed influenza is lacking. However, hand hygiene has been shown to be beneficial in preventing the transmission of diarrhoeal diseases and acute respiratory illnesses (123, 134, 135), thus helping to reduce the overall burden on health-care systems. The GDG concluded that it is possible that major improvements in hand hygiene adherence might reduce influenza virus transmission. There are no known adverse effects when performing hand hygiene other than possible allergic reactions to soap or ABHR (136). Overall, there is an absence of harm when implementing hand hygiene.

Resource implications

Hand hygiene is one of the most cost-effective measures for preventing infections in health-care settings (137). It is also an important component of general hygiene campaigns in communities and can reduce the incidence of a variety of infections, and thus reduce associated morbidity and mortality, and associated economic burden. In some settings, especially rural or remote locations, where clean running water, soap or ABHR may not be available, alternative traditional hand hygiene methods may be considered (138).

Equity and human rights

Equity considerations in the context of performing health hygiene were judged to vary by the GDG and include the known differential access to clean water and hand hygiene products in different settings. People living in informal settlements, detention settings, indigenous populations, refugees and internally displaced people are among those lacking such access (139). However, the promotion and facilitation of hand hygiene, including through the provision of water, soap, washing facilities and/or ABHR to communities that lack them (140), could help to increase equity. Some individuals may also be reluctant to use ABHR on religious grounds. However, where the use of alcohol as a medicinal agent is permitted in such cases, improving awareness of the health dimension of ABHR use may help to increase acceptance (141).

Acceptability

Given its limited cost and broader impact on preventing infections, hand hygiene would seem to be a very acceptable intervention. However, the GDG noted that compliance and adherence to proper and effective hand hygiene practices may be low in general given the difficulty in ensuring the adoption and sustaining of substantial behavioural changes.

Feasibility

No research was identified regarding the feasibility of implementing hand hygiene. Nevertheless, the GDG considered this intervention to be highly feasible in most settings as many countries have already conducted public campaigns to reduce the transmission of communicable diseases through the performing of hand hygiene.

4.1.2 Knowledge gaps

- There are important knowledge gaps regarding the mechanisms of human-to-human transmission of influenza viruses, including the importance of direct and indirect contact, the degree of viral contamination on hands and various types of surfaces in different settings, and the potential for contact transmission to occur in different locations and under different environmental conditions. Additional research on how best to increase hand hygiene adherence would also be valuable.
- There is little information on whether greater reductions in virus transmission could be possible using other interventions in combination with hand hygiene (for example, hand hygiene combined with mask wearing and isolation of infected individuals from other household members) and more research is required.

4.1.3 Implementation considerations

- Education campaigns on effective hand hygiene practices might be needed to address misinformation and myths, and to improve compliance and adherence in the general population.
- Consideration should be given to subgroups that are more vulnerable to infection, and on the importance of different groups in the community transmission of influenza.
- To help address issues of equality and ensure non-discrimination in relation to the right to health, accurate and helpful information, including on the use of alternative traditional methods for hand hygiene, should be provided.

4.2 Mask wearing

Conditional recommendation for – moderate certainty evidence

WHO suggests that:

- individuals who are symptomatic and/or have tested positive for influenza wear masks at all times when in contact with other individuals to reduce the spread of influenza to others; and
- all individuals in the community wear masks in crowded indoor settings to potentially reduce the spread of influenza in such settings during influenza epidemics and pandemics of high or extraordinary severity.

Summary of evidence

The literature review included studies that provided evidence on the effectiveness of mask wearing in reducing influenza virus transmission in the community (that is, settings outside the health-care system). In particular, twelve RCTs, involving a total of more than 20 000 participants, were identified and a meta-analysis conducted to quantify the effectiveness of mask wearing in the community (110–115, 118, 142–146). All studies assessed the effectiveness of medical masks, and one study also had an intervention group using P2 face respirators. Ten studies had asked every participant in the mask intervention group to wear a medical mask. One study had enrolled families in which one person had laboratory-confirmed influenza, and only required the household contacts to wear a medical mask or P2 face respirator (143). In the remaining study, ill hospital patients were required to wear medical masks to evaluate their protective effect through source control (144). In the pooled analysis, the point estimates suggested a relative risk reduction in laboratory-confirmed influenza of 12% among the mask-wearing group (risk ratio (RR) = 0.88; 95% confidence interval (CI) = 0.61–1.27; I^2 = 22%; P = 0.25) and a reduction of 10% in the mask-wearing group regardless of whether or not hand hygiene was also enhanced (RR = 0.90; 95% CI = 0.68–1.18; I^2 = 22%; P = 0.23). However, the evidence was insufficient to exclude chance as an explanation for the reduced risk of transmission.

Relevant evidence from the COVID-19 pandemic

The systematic review identified one RCT that had quantified the effectiveness of face masks in reducing SARS-CoV-2 infections during the early stage of the pandemic (145). This study had found that community-based face mask usage in Denmark did not reduce laboratory-confirmed SARS-CoV-2 infections in the masked group. To date, an RCT carried out in Bangladesh has been the largest trial assessing the effectiveness of face masks in reducing SARS-CoV-2 infections. However, this study was not included in the systematic review because the outcome was not laboratory-confirmed infection. Study results indicated a 9.5% reduction in symptomatic seroprevalence for SARS-CoV-2 among surgical mask wearers in rural areas of Bangladesh (147). Another review carried out earlier in the COVID-19 pandemic had included observational studies and two RCTs, and found evidence of a 6–15% reduction in the risk of influenza-like illness (ILI) associated with the use of face masks in the community setting (148). Another review based on 39 studies estimated that the wearing of face masks had reduced the risk of infection with SARS-CoV-2 or other betacoronaviruses by 14.3% (95% CI = 10.7–15.9) (149).

4.2.1 Justifications and summary of considerations of GDG members

The GDG decision for conditional recommendation for mask wearing was supported by the moderate certainty of evidence and the probably positive balance between desirable and undesirable health effects at societal and individual level. The members noted the potential negative impact of mask wearing in some specific population subgroups (e.g. individuals with hearing disabilities) which would require special attention from policymakers to ensure equality and non-discrimination. The members judged the intervention to be probably in accordance with universal human rights standards. The GDG discussed about resource implications and found the balance between the cost of masks and the costs of potential treatment in the absence of mask wearing to probably favor the intervention. The GDG noted that adherence to mask wearing may not always be high in some areas and among some populations and recognized the importance of tailored communication strategies to inform the public on the benefit of the intervention. Overall, the GDG considered this intervention to be feasible, especially as a form of infection source control for symptomatic individuals.

Certainty of the evidence

Overall, there is moderate certainty evidence indicating that medical masks have a small to moderate effect on reducing the transmission of influenza in the community instead of a substantial effect. Adherence and small sample sizes have hindered the study of mask efficacy, along with the ethical implications of conducting trials in which a control group is recommended to not wear a mask while influenza is circulating. However, some RCTs have reported a significant reduction in ILI associated with mask wearing. While there is evidence overall of only a modest effect in reducing transmission, there is mechanistic plausibility for the potential effectiveness of this measure.

Values and preferences

The use of medical masks to prevent the transmission of respiratory infections in health-care settings is common around the world, and is also a measure used by healthy individuals in some communities, particularly in East and South-East Asia.

Balance of benefits and harms

Adverse effects may result from the prolonged and widespread use of medical masks in the community. During the COVID-19 pandemic, an adverse impact was noted on individuals with hearing loss, where facial cues and lip reading are needed for everyday communication. In one study, deaf or hard-of-hearing individuals in Spain and the United Kingdom reported feeling disconnected from society, with subsequent negative impacts on their well-being (150). There are also concerns that mask wearing in young children could have a negative effect on early childhood development and social-emotional skills (151, 152). Allergic reactions to mask materials may also occur in some individuals, while prolonged use in general could generate difficulty of breathing, facial irritation and discomfort (153).

Resource implications

Medical masks are generally not reusable, and an adequate supply would be essential if their use was recommended. If worn by a symptomatic case, that person might require multiple masks per day for multiple days of illness. The balance between the cost of masks (borne either by the individual or government) and the costs of potentially needing to treat more cases in the

absence of mask wearing should be considered. Costs can also vary for the different types of masks, and on levels of demand and supply, and a rapid scale-up of production (with or without managed distribution) during a pandemic could prevent masks from becoming cost prohibitive to specific segments of society (154). Reusable non-medical masks made from household fabrics are less effective compared to medical masks – however in low-resource settings they could be an acceptable option when washed prior to reuse (9).

Equity and human rights

In line with the need to ensure equality and non-discrimination, the rights of individuals with certain health conditions or disabilities (such as hearing loss or autism) should be taken into consideration. Where this involves exemptions from any face-covering requirements, the rationale should be clearly communicated to counter stigma and exclusion (155). Furthermore, the variable affordability and accessibility of different masks can negatively impact equitability. Where possible, masks should be made accessible (free of charge) to individuals with social vulnerabilities and limited resources, and in settings such as schools, homeless shelters and prisons. Mask wearing can potentially protect both the wearer and others in the community, and may be more culturally acceptable in some locations as well as indicative of the adoption by individuals of other beneficial hygiene practices and behaviours (156).

Acceptability

Medical masks are widely used in health-care settings to prevent infections and are used in the community in some parts of the world (157). Mask wearing appears to be associated with high levels of acceptability, particularly when recommended during epidemics and pandemics of high severity such as the COVID-19 pandemic. However, during the COVID-19 pandemic, a significant proportion of the population (around 18% in some countries) were resistant to mask wearing (158). In Canada and the USA, it has been suggested that this derived from the belief that masks were ineffective in preventing infection or that the threat of the virus had been exaggerated (158). The GDG noted that adherence to mask wearing may not always be high in some areas and among some populations.

Feasibility

Feasibility can be enhanced through the use of education campaigns to improve mask use and adherence. The GDG considered this intervention to be feasible, especially as a form of infection source control for symptomatic individuals. Moreover, in case of limited supply, particularly at the initial phase of an influenza epidemic or pandemic, medical masks should be prioritized for health-care workers and individuals at high risk.

4.2.2 Knowledge gaps

- Important knowledge gaps remain with regard to the precise mechanisms of human-to-human transmission of influenza viruses, including the importance of transmission through the direct deposition of infectious respiratory particles on the mucosa or through inhalation. More information is needed on the potential for these modes of transmission to occur in different locations and under different environmental conditions. Additional high-quality RCTs of the efficacy of mask wearing against laboratory-confirmed influenza and SARS-CoV-2 would also be valuable.

- The currently available evidence is insufficient to determine the relative effectiveness of different types of masks.

4.2.3 Implementation considerations

- Mask wearing must be paired with educational materials/campaigns to ensure both adherence and proper use.
- The use of masks in the community should be considered as a complementary measure and not as a replacement for other preventive measures recommended to reduce community transmission.
- Face shields⁶ commonly used in healthcare settings to prevent exposure of mucosal surfaces on the face to potentially infectious droplets, are rarely used in non-healthcare. However, during the COVID-19 pandemic, the use of face shields in community settings was significantly higher on its own or along with face masks, often motivated by perceptions of the additional protection that could be provided or as an alternative to face masks. Informed public health messages would be needed to clarify that face shield should not be used as a replacement for masks in the community (8).
- Implementation of mask wearing recommendations during influenza epidemics and pandemics should take into account the availability of face masks in the community during the start of an epidemic or pandemic due to supply or cost.

⁶ A face shield is a personal protective equipment device used to protect the facial area and associated mucous membranes (eyes, nose and mouth) against exposure to the respiratory secretions of other individuals. Face shields can be of different types (such as headbands, pivot or disposable shields) and of varying shapes and lengths.

4.3 Respiratory hygiene and cough etiquette

Strong recommendation for – moderate certainty evidence

WHO recommends the practising of respiratory hygiene and cough etiquette by individuals not wearing a mask to prevent transmission of influenza viruses during influenza epidemics and pandemics.

Summary of evidence

The systematic review identified one RCT that studied the effectiveness of using ABHR and respiratory hygiene education classes among school-aged children compared to no intervention. A statistically significant reduction was observed in the number of laboratory-confirmed influenza cases among the students from the 12 schools that had received the intervention (122). Another study, not captured in the current review, reported a reduction in self-reported respiratory illnesses associated with the practising of cough etiquette among American pilgrims to the 2009 Hajj (159). However, another observational study reported that respiratory hygiene was not effective in blocking the release of droplets during coughing (160).

Relevant evidence from the COVID-19 pandemic

No study was identified that quantified the effectiveness of respiratory hygiene and cough etiquette in reducing the number of laboratory-confirmed SARS-CoV-2 infections.

4.3.1 Justifications and summary of considerations of GDG members

The moderate certainty evidence and the absence of harm when implementing respiratory hygiene and cough etiquette supported the decision of the GDG for a strong recommendation. The members judged the intervention to be in accordance with universal human rights standards. Overall, the GDG did not identify any major concerns in terms of resource implications, equity, acceptability and feasibility of respiratory hygiene and cough etiquette.

Certainty of the evidence

Overall, there is moderate certainty evidence indicating that respiratory hygiene and cough etiquette combined with hand hygiene has a beneficial effect in reducing the incidence of laboratory-confirmed influenza cases.

Values and preferences

Respiratory hygiene and cough etiquette is recognized as important in many communities. Improvements to respiratory hygiene in communities could also prevent the spread of respiratory infections other than influenza.

Balance of benefits and harms

There are no anticipated harms associated with the practising of respiratory hygiene and cough etiquette.

Resource implications

Efforts to improve respiratory hygiene and cough etiquette in communities would not be expensive and could be included as part of broader public health campaigns. In addition, although there may be costs borne by the individual (for example, in purchasing tissue paper) these are likely to be minimal.

Equity and human rights

There are no major equity and human rights considerations in relation to respiratory hygiene and cough etiquette. Cultural contexts may be considered when recommending specific actions such as covering coughs with hands or tissues.

Acceptability

Improved respiratory hygiene and cough etiquette is likely to be acceptable in most locations.

Feasibility

Respiratory hygiene and cough etiquette campaigns are considered to be highly feasible.

4.3.2 Knowledge gaps

- One RCT quantified the effectiveness of respiratory hygiene and cough etiquette combined with hand hygiene against laboratory-confirmed influenza infection. More RCTs on the effectiveness of combining interventions to improve the impact of respiratory hygiene and cough etiquette are needed.

4.3.3 Implementation considerations

- The effectiveness of respiratory hygiene and cough etiquette increases when used alongside other measures. If individuals are wearing a mask, hand hygiene should be performed, while symptomatic individuals not wearing a mask should practise respiratory hygiene and cough etiquette alongside hand hygiene.

5. Environmental measures

5.1 Air purification

Strong recommendation against – moderate certainty evidence

WHO recommends against indoor air purification to reduce the transmission of influenza viruses in community settings during influenza epidemics and pandemics.

Remarks

- Air purification combined with other environmental control measures could be considered in specific settings (such as hospitals) to reduce the transmission of respiratory viruses. However, in community settings, at large scale, ventilation is preferable to air purification.

Summary of evidence

An existing systematic review was identified that had been based on search dates to December 2022 and that had incorporated the grey literature (161). Studies had been included in which: (i) air purification had been implemented in non-laboratory settings; (ii) the intervention group had been present during air purification for at least a mean of 20 hours a week during the monitoring period; (iii) the comparator was routine ventilation; and (iv) outcomes were related to respiratory or gastrointestinal illness. Among these studies, three RCTs (162–164) and two cohort studies (165, 166) had assessed the effectiveness of air purification on influenza or acute respiratory infections. In two of the RCTs, the effectiveness of high efficiency particulate air (HEPA) filtration devices had been evaluated (162, 164). One of the studies had been carried out in an office building in which a breathing-zone filtration system had been installed on one floor. Using another floor as the control, comparison surveys were conducted between pre-installation and 3 months post installation that indicated improvements in sick building syndrome symptoms associated with the filtration system (162). In the other study, randomized households in various parts of the USA that had a wood stove, and in which one or more children < 5 years of age lived, received the air purification intervention. The risk of lower respiratory tract infections among children in households using the portable HEPA filtration devices was found to be similar to the control group (OR = 1.23; 95% CI = 0.46–3.32) (164). The third RCT had assessed the effect of germicidal ultraviolet light (GUVL) on work-related respiratory symptoms in three office buildings in Canada (163). GUVL had been implemented by directly irradiating the cooling coils and drip pans in the ventilation systems supplying the selected floors. These interventions were staggered to ensure that GUVL was only implemented in one building at any one time.

Study results indicated that, following adjustment for worksite environmental covariates, the use of GUVL had reduced the frequency of work-related respiratory symptoms (adjusted OR = 0.6; 95% CI = 0.4–0.9).

Relevant evidence from the COVID-19 pandemic

One relevant outbreak report was identified for reducing SARS-CoV-2 transmission (167) – however several RCTs were under way on the use of HEPA filtration or GUVL air purification methods in settings such as care homes and primary schools (161).

5.1.1 Justifications and summary of considerations of GDG members

There was moderate certainty evidence, and the balance of health benefits probably favor air purification. However, the GDG deliberated against this intervention supported by financial and economic considerations, given that the costs associated to the purchase, usage and maintenance of air purifiers could not be affordable for the general population in several settings. The GDG judged the intervention to probably be in accordance with universal human rights standards but expressed concerns in terms of equity due to the economic aspects associated to the implementation of this measure. The members valued the acceptability of key stakeholders as uncertain and expressed concerns about the overall feasibility of this measure due to issues with affordability and availability of these devices during an influenza pandemic.

Certainty of the evidence

Overall, there is moderate certainty evidence that air purification has an effect on reducing the transmission of influenza viruses.

Values and preferences

Air purification to remove microorganisms and air contaminants is a common practice in many locations.

Balance of benefits and harms

Air purification may benefit the health of those who suffer from allergies or are sensitive to air pollutants. In general, there are no major harms to the health of individuals or society associated with air purification, though there might be safety concerns.

Resource implications

Installing and maintaining air purification devices can be costly (168, 169). Both implementation and ongoing maintenance can thus incur substantial costs that can negatively impact businesses and other stakeholders.

Equity and human rights

Air purification may benefit the right to health, particularly for individuals who suffer from allergies or who are sensitive to air pollution. However, cost implications mean that it may not be accessible to all.

Acceptability

The acceptability of air purification is uncertain.

Feasibility

Air purification may not be feasible due to issues of affordability, availability and safety. Direct evidence on potential feasibility issues when implementing air purification in community settings is lacking.

5.1.2 Knowledge gaps

- In general, there is insufficient evidence of the effectiveness of air purifiers in reducing infectious agents rather than pollutants. The effectiveness of air purification in reducing influenza virus transmission requires further research.
- Potential safety issues are an important consideration and more scientific evidence is needed to confirm the effectiveness and feasibility of this approach as a community mitigation measure during influenza epidemics and pandemics.
- Studies examining the interaction between air purification and other measures (such as ventilation) are also required.

5.2 Modifying indoor humidity

Strong recommendation against – very low certainty evidence

WHO recommends against modifying indoor humidity to reduce the transmission of influenza viruses during influenza epidemics and pandemics.

Summary of evidence

Increased humidity has been correlated with reduced influenza virus transmission in cold and dry climates (170, 171), while very high humidity has been associated with increased virus transmission in hot and humid climates (22). In one study identified in the systematic review, the humidity in two preschool classrooms at a community school in the USA was modified using an electrode steam humidifier with steam blower (171). Samples taken from paper-wrapped fomites handled by students (such as marker pens and wooden toy blocks) and from the air were tested for influenza A using PCR. The study noted that the number of positive tests for influenza A was lower for both fomites (odds ratio (OR) = 0.51; 95% CI = 0.33–0.78) and air samples (OR = 0.51; 95% CI = 0.29–0.89) in the humidified classrooms compared to the control classrooms. Results also indicated that there were 2.3 times as many ILI cases in the control classrooms compared to the humidified classrooms. However, whether or not this indicates a causal relationship between the number of such cases and the levels of influenza viruses detected in the rooms is unknown.

Two intervention studies, not included in the current review, have investigated the modification of humidity in the environment and found that a reduction in absolute humidity has been associated with influenza outbreaks. For example, one prospective cohort study found that lower indoor absolute humidity in individual households was associated with a higher risk of acute respiratory infection in community-dwelling older adults in Hong Kong SAR, China during cold seasons (172). A second study conducted in eight schools in China reported no association between relative humidity and self-reported respiratory infections. Positive associations were observed between indoor relative humidity in schools and the onset of daytime attacks of breathlessness, nocturnal cough and nocturnal wheeze or breathlessness (173).

Relevant evidence from the COVID-19 pandemic

No studies were identified that quantified the effectiveness of modifying indoor humidity in reducing laboratory-confirmed SARS-CoV-2 infections.

5.2.1 Justifications and summary of considerations of GDG members

The limited availability and the very low certainty evidence caused the GDG to conclude with a strong recommendation against modifying indoor humidity. Members judged the balance of health benefit and harms to be variable and alignment with human rights as probable. The GDG discussed the financial and economic considerations and found to probably favor the comparison given that the costs associated to the purchase, usage and maintenance of humidifiers could not be affordable in several settings. The members valued the acceptability of key stakeholders as uncertain and expressed concerns about the feasibility of this measure overall.

Certainty of the evidence

Overall, there is very low certainty evidence that modifying indoor humidity has an effect on reducing the transmission of influenza viruses.

Values and preferences

Values and preferences with regard to modifying indoor humidity are uncertain and are likely subject to individual preferences for ambient humidity. This measure has yet to be implemented on a large scale and there are few intervention studies.

Balance of benefits and harms

Humidification may increase the growth of mould and mildew, which could cause health problems (174). According to WHO, indoor dampness or mould creates a considerable health burden (for example, asthma) in children (175). The GDG expressed concerns about potential safety issues related to the implementation of this measure.

Resource implications

Humidifiers may not be affordable to purchase and can be costly to run and maintain. The GDG also expressed concerns about the cost of implementation of this measure.

Equity and human rights

Increasing moisture levels in the air may adversely impact the health of some individuals, particularly those who may be more vulnerable. Those with asthma often experience problems in very cold or hot temperatures, which can increase airway irritation. Mild temperatures and low levels of humidity might decrease the risk of such irritation.

Acceptability

Modifying humidity is likely to be acceptable, but subject to individual preferences for ambient humidity.

Feasibility

During an outbreak, there may be insufficient availability of humidifiers at short notice, and it may not be logistically feasible to humidify all buildings in a community. Modifying humidity in indoor community settings (such as classrooms, offices or households) has yet to be implemented on a large scale. The GDG expressed concerns about the feasibility of this measure.

5.2.2 Knowledge gaps

- The precise biological mechanism by which humidity affects the survival of influenza viruses is unclear (170, 171). Many studies have looked at this effect under laboratory conditions but very few have tested it in real-life settings. RCTs would provide more compelling evidence with regard to the effectiveness of this measure in reducing influenza virus transmission.

5.3 Surface and object cleaning and disinfection

Conditional recommendation for – low certainty evidence

WHO suggests surface and object cleaning and disinfection to reduce the transmission of influenza viruses during influenza epidemics and pandemics.

Summary of evidence

Four studies were included in the systematic review of the effectiveness of surface and object cleaning and disinfection in reducing influenza transmission (176–179). An RCT of the disinfection of toys and linen in daycare facilities in Denmark found reduced detection of some respiratory viruses in the environment but no statistically significant effect on laboratory-confirmed influenza or acute respiratory illness among children in the post-intervention period (176). Another RCT conducted in an elementary school in the USA reported that surface disinfection combined with hand hygiene could reduce absenteeism due to gastrointestinal illness, but not absenteeism due to respiratory illness, among students (177). A cross-sectional study in school-age children in Spain, Netherlands (Kingdom of the) and Finland showed that passive exposure to sodium hypochlorite (bleach) in households was significantly associated with an increase in the rate of parent-reported influenza infections. It was hypothesized that this could be related to the irritant properties of bleach (178). A cluster RCT conducted in primary schools in the Lao People's Democratic Republic reported that the receipt of water supply, sanitation and handwashing facilities, drinking water filters, and behaviour change education and promotion had no impact on self-reported symptoms of respiratory infection in participating schools (179).

Influenza viruses can survive on surfaces and objects for at least several hours and up to one week (104, 105, 180–182). Although influenza virus RNA has also been detected in various community settings, it is not usually viable (176, 183–187). Surface and object cleaning and disinfection can be effective at inactivating or reducing viable influenza viruses on surfaces (188–190). Theoretically, surface and object cleaning and disinfection could thus prevent the indirect contact transmission of influenza.

Relevant evidence from the COVID-19 pandemic

Two studies included in the systematic review attempted to quantify cleaning and disinfection frequency against SARS-CoV-2 transmission (191, 192). One of these studies was a retrospective cohort study conducted in Beijing, China that reported that the use of chlorine- or ethanol-based disinfectant in households was associated with a reduced risk of confirmed SARS-CoV-2 secondary household transmission (191). However, a cross-sectional study that surveyed on-site camps in the USA reported that increased cleaning frequency was not associated with a reduced risk of SARS-CoV-2 infection among campers or staff (192).

5.3.1 Justifications and summary of considerations of GDG members

The GDG decision for conditional recommendation for surface and object cleaning and disinfection was supported by the low certainty of evidence and the probably positive balance between desirable and undesirable health effects of the intervention. Nevertheless, the members

noted the potential negative impact related to the safety of some cleaning products. The members judged the intervention to be in accordance with universal human rights standards. Overall, the GDG did not identify any major concerns in terms of resource implications, equity, acceptability and feasibility although these considerations could vary across different setting.

Certainty of the evidence

Overall, there is low certainty evidence that surface and object cleaning and disinfection can reduce laboratory-confirmed cases of influenza virus infection. However, experimental studies have suggested that surface and object cleaning and disinfection could effectively inactivate or reduce viable influenza viruses on surfaces. Due to mechanistic plausibility, this intervention could reduce the indirect contact transmission of such viruses.

Values and preferences

A telephone survey conducted in Europe found that 82% of respondents believed that cleaning or disinfecting objects might reduce the risk of influenza infections (193). Environmental cleaning and disinfection is also a common strategy for reducing the risk of a variety of infections.

Balance of benefits and harms

Cleaning with detergent-based cleaners and disinfecting with bleach can inactivate or remove influenza viruses on surfaces and objects, and could in theory reduce influenza transmission. However, most disinfectants (such as bleach) require a pre-cleaning step before the disinfectant is applied (194). In addition, the incorrect use of disinfectants, including poor ventilation during their use, can be harmful (7).

Resource implications

The cost of disinfectants is relatively low and/or affordable in many locations. However, high demand for such agents during a pandemic can drive costs up.

Equity and human rights

Cleaning product selection can be an issue as some disinfectants are irritants and may lead to adverse effects in some groups (178). Alcohol-based disinfectants may not be universally accepted in the context of the prohibition on alcohol consumption under some religions, including Islam (141). However, most countries have no legislation restricting the use of alcohol as an ingredient in household cleaning agents, and in Muslim tradition, alcohol is permitted as a cleansing ingredient (141). The safety of cleaning personnel should always be considered when making recommendations for surface and object cleaning using disinfectants.

Acceptability

This intervention is accepted by policy-makers and health-care workers worldwide. However, its acceptability in the general population may vary across different countries.

Feasibility

This intervention is considered to be feasible, with both cleaning and disinfection products readily available from a variety of sources, such as supermarkets and convenience stores.

5.3.2 Knowledge gaps

- Touching contaminated surfaces and subsequently transferring respiratory viruses to the nose, mouth or eyes through the hands is believed to be a route of transmission but its relative importance compared to other transmission routes is unclear, and is likely smaller than close contact with infected individuals.
- Evidence on the effectiveness of surface and object cleaning and disinfection in reducing influenza virus transmission is limited. More trials are needed to study the effect of this measure.
- Studies in which the outcome is laboratory-confirmed influenza, rather than acute respiratory infection, would provide the best evidence on effectiveness.
- Studies in various settings (for example, households, schools, workplaces and public places), along with investigation of the different types and concentrations of cleaning products used, and how often, are also needed.

5.3.3 Implementation considerations

- Cleaning and disinfection practices are important to reduce the potential for influenza virus contamination in community settings, such as the home, offices, schools, gyms, publicly accessible buildings, faith-based community centres, markets, transportation settings, restaurants and other workplaces.
- High-touch surfaces in all such settings should be identified for priority disinfection.
- Disinfection should be carried out using products such as sodium hypochlorite (bleach) or alcohol at the recommended concentrations.
- Surfaces must first be cleaned with water and soap, or a detergent, to remove dirt prior to disinfection.
- Disinfectant spraying or fumigation, either outdoors or in large indoor areas (such as meeting rooms or classrooms), are not recommended due to their likely lack of effectiveness, possible damage to the environment and the potential exposure of humans and animals to irritant chemicals (195).

5.4 Ventilation

Strong recommendation for – low certainty evidence

WHO recommends increasing mechanical or natural ventilation in both households and non-residential buildings to reduce the transmission of influenza viruses during influenza epidemics and pandemics.

Summary of evidence

Three studies were included in the systematic review (196–198). Of these, one cohort study compared two college residential hall buildings in Maryland, USA using multi-zone airflow modelling and swab-based testing. A lower incidence of laboratory-confirmed respiratory virus infections (including influenza A and B, human coronavirus and other common respiratory viruses) was observed in the building that had a dedicated outdoor air system compared to the building with air conditioning but no outdoor air supply (196). A cross-sectional study conducted in a Chinese university also indicated that students living in rooms with lower ventilation rates were associated with a higher incidence of self-reported common colds and influenza (197). A community-based case-control study in Southern Ethiopia found that the probability of acute respiratory infection was four times higher in children who lived in poorly ventilated houses compared to those who lived in houses with good ventilation (198).

Relevant evidence from the COVID-19 pandemic

Only one study was identified that quantified the effectiveness of increased ventilation in preventing SARS-CoV-2 infection (199). This internet-based nationwide prospective cohort study evaluated the effectiveness of preventive behaviours against self-reported COVID-19-like symptoms among working adults in Japan. Significantly higher levels of all COVID-19-like symptoms except fever were observed in participants who reported rarely or never opening windows and doors during the study period (199).

5.4.1 Justifications and summary of considerations of GDG members

The GDG decision on strong recommendation for increasing ventilation was supported by the low certainty evidence and the likely absence of major harms among the general population when implementing this measure. Members acknowledged the importance of ventilation as a key strategy for infection prevention and control in health-care setting as well as in community settings. The GDG judged the intervention to probably be in accordance with universal human rights standards. Overall, the GDG did not identify any major concerns in terms of resource implications, equity, acceptability and feasibility although these considerations may vary across different setting.

Certainty of the evidence

Despite the above findings on the beneficial effects of good ventilation in reducing respiratory virus transmission, there is low certainty evidence overall that introducing mechanical ventilation or increasing the air flow rate to non-residential buildings and increasing the natural ventilation of households would reduce influenza virus transmission. However, there is mechanistic support for the potentially beneficial effect of this measure given that increasing indoor ventilation

rate will increase the dilution of infectious particles in the air and thus decrease the risk of infection transmission (13).

Values and preferences

Increasing ventilation is a common practice in office buildings (using mechanical ventilation) and households (by opening windows).

Balance of benefits and harms

Regions in which vector-borne diseases are prevalent will require consideration to be given to the use of complementary measures (such as mosquito screens). However, as airflow pattern and direction are important considerations (200), care must also be taken to avoid such measures adversely affecting these properties (14). In addition, if the outdoor temperature is often very low (for example, during winter), the use of increased ventilation may lead to thermal discomfort for some individuals. There is also a risk of increased exposure to air pollution and allergens that may trigger asthmatic attacks or allergies if the outdoor air quality is poor. However, the GDG considered that there is likely to be an absence of major harms among the general population when implementing increased ventilation measures.

Resource implications

Increasing indoor ventilation by opening windows is likely to incur minimal additional direct costs. However, direct costs (both installation and running costs) can arise when implementing mechanical ventilation for buildings or homes. In cold climates, both increased natural or mechanical ventilation could result in increased indirect costs (for example, heating costs).

Equity and human rights

The direct and/or indirect costs of mechanical or natural ventilation could be a barrier to affordability, which may disproportionately affect certain population groups. The GDG considered that there were no other major equity and human rights concerns associated with the use of increased ventilation.

Acceptability

Increased ventilation does not affect daily activities and may reduce the transmission of influenza in the community. As a result, the level of acceptability is likely to be high.

Feasibility

Increased ventilation is likely to be feasible in most settings. However, feasibility may be lower in crowded or low-income settings.

5.4.2 Knowledge gaps

- Evidence of the effectiveness of increased indoor ventilation on reducing influenza virus transmission is limited.
- RCTs would provide more compelling evidence with regard to the effectiveness of this measure in reducing influenza virus transmission.

- Improved understanding of how to increase the feasibility of this intervention in some settings would be helpful.

5.4.3 Implementation considerations

- Optimal natural and mechanical ventilation requirements adapted to different indoor settings have been outlined by WHO (14). For example, the minimum recommended ventilation rate for non-residential buildings is 10 litres per second per person.
- Implementing proper ventilation systems requires specialist engineering knowledge and consideration of factors such as energy conservation, prevalence of vector-borne diseases and outdoor air pollution levels.
- Consideration should also be given to vulnerable populations (such as those living in crowded conditions) that do not have access to good ventilation.
- Increasing natural ventilation by opening the windows may be a valid approach in some settings with poor ventilation but not necessarily in buildings with adequate ventilation (201).

6. Active case-finding and contact identification measures

6.1 Contact tracing

Conditional recommendation against – very low certainty evidence

WHO suggests against contact tracing to reduce the transmission of influenza viruses during influenza epidemics and pandemics, except for the first cases of an outbreak of an emerging influenza virus strain in order to collect information on the characteristics of the disease and potentially help reduce transmission.

Remarks

- The short serial interval of influenza makes contact tracing inefficient, and it is highly resource intensive. Identifying close contacts would also quickly overwhelm the public health resources available to manage them.

Summary of evidence

Since no observational evidence was available on the effectiveness of contact tracing in mitigating the public health impact of influenza, four simulation studies were included in the systematic review (202–205). Contact tracing was studied in combination with other interventions such as quarantine, isolation and provision of antiviral drugs. Evidence on the overall effectiveness of contact tracing varied. One simulation model ($R_0 = 1.8$) indicated that the combination of contact tracing, quarantine, isolation and antiviral drugs could reduce the infection attack rate by 40% (202), while another study predicted that it would be difficult to control influenza spread even with 90% contact tracing and quarantine because of a presumed high level of pre-symptomatic or asymptomatic transmission (204). A combination of isolation, treatment of cases, contact tracing, quarantine and post-exposure prophylaxis was predicted to delay the epidemic peak for 6 weeks, assuming a case detection rate of 30% (205). In addition, it has been suggested that for influenza viruses, the combination of contact tracing with quarantine would be more effective than contact tracing combined with symptom monitoring (203).

Relevant evidence from the COVID-19 pandemic

The systematic review identified seventeen observational studies that estimated the effectiveness of contact tracing in reducing the transmission of SARS-CoV-2 (206–222). Three of the studies found a beneficial effect associated with the use of digital contact tracing applications (208, 210, 214). Using an unexpected delay in contact tracing in parts of the United Kingdom compared to parts that were not affected by the delay, it was estimated that every case referred late to contact tracing was associated with 18.6 additional infections in a 6-week period (208). Another study assessed the overall impact of contact tracing apps in the United Kingdom, and estimated that a total of 594 000 (317 000–914 000) cases had been averted over a 5-month period (214). Four studies found that contact tracing also shortened the delay between symptom onset and case isolation (207, 209, 211, 213). Among the remaining studies, one retrospective investigation of the testing-tracing-treatment response to COVID-19 in the Republic of Korea estimated that due to prompt tracing, the instantaneous reproduction number had been more than halved during the study period (from 1.3 to 0.6) (212).

6.1.1 Justifications and summary of considerations of GDG members

The evidence identified was limited and was rated of very low certainty. The GDG judged the balance of health benefit and harms to be variable, noting that there may be a possible benefit in the early phases of a pandemic for outbreak investigations purposes and for the characterization of the emerged virus. The GDG discussed the resource implications and found to favor the comparison given the large amount of economic and human resources required when contact tracing is implemented on a large scale. Members agreed that contact tracing might not be cost-effective also considering the short serial interval of influenza. Identifying close contacts would also quickly overwhelm the public health resources available to manage them. The GDG debated the implications on equity and human rights, values and preference and acceptability and recognized that these may vary. They thought that some individuals may anticipate stigma or privacy-related risks and refuse to be contact traced. The members expressed concerns about the feasibility of this measure overall valuing contact tracing probably not feasible in several settings. The very low certainty evidence and these considerations caused the GDG to conclude with a conditional recommendation against contact tracing.

Certainty of the evidence

Overall, there is very low certainty evidence that contact tracing has an effect on reducing the transmission of influenza. All included studies for influenza were simulation models. Evidence for SARS-CoV-2 estimated a modest effect when combined with follow-up measures such as isolation and quarantine; however, the individual effect of these measures is not known.

Values and preferences

There is uncertainty surrounding community values and preferences with regard to the use of contact tracing for the control of influenza as different populations and cultures may have different perceptions and value preferences when balancing individual privacy and public health safety and security. Mandatory contact tracing may cause concerns and uneasiness among some cases and their contacts.

Balance of benefits and harms

Contact tracing allows for the rapid identification of individuals who have potentially been exposed to respiratory viruses through contact with a confirmed or suspected case. This intervention can reduce the delay between symptom onset and treatment, as well as the implementation of preventive measures for onward transmission (223). However, contact tracing on a large scale can lead to challenges such as privacy concerns, the need to expend significant resources to track down contacts instead of providing care to the sick, and the placing of an undue burden on potentially very ill individuals to remember and document their contacts (224). Follow-up actions among those testing positive, or quarantining exposed individuals, may also have negative consequences for the individual. However, contact tracing could be beneficial in the early phases of a pandemic for outbreak investigations and for the characterization of the emerged virus.

Resource implications

Following up the potentially exposed contacts of an infected individual often has low cost-effectiveness in the control of influenza, resulting in high direct costs to national authorities implementing contact tracing. Considerable human resources are also needed to maintain intensive contact tracing and to deal with the resulting influx of people needing to be isolated or quarantined. To alleviate the burden on resources, digital contact tracing and voluntary adherence to preventive measures can be effective in reducing the onward transmission of a respiratory pathogen during a pandemic, as was highlighted during the COVID-19 pandemic (208, 210, 214).

Equity and human rights

Identifying the contacts of infected individuals may raise privacy concerns, particularly in relation to digital contact tracing and where appropriate privacy safeguards are not in place and upheld (224, 225). Some individuals may anticipate stigma or privacy-related risks and refuse to be contact traced. Nevertheless, with appropriate safeguards, contact tracing may be justified during epidemics or pandemics of high severity as it allows for the identification of persons at risk, and for the timely provision of treatment and care (223, 224). Human rights risks, including risks to the right to privacy, can be reduced through the use of digital contact tracing approaches that are: (i) designed and used exclusively for public health aims and only when necessary for those aims; (ii) used for a limited duration of time and linked to the use of sunset clauses; and (iii) supported by safeguards to prevent the collection of private information for unrelated purposes by governments or other actors (226). Contact tracing can substantially increase the proportion of people quarantined, but may not offer much additional benefit to existing interventions (202). In addition, reliance on digital contact tracing has equity implications insofar as it relies on access to resources and digital technologies, and strategies should be deployed to ensure equity in relation to people who lack such access or are unaware of how to use the required technology.

Acceptability

The acceptability of contact tracing among the public can vary between cultures and populations depending on overall value preferences in balancing individual privacy and public health safety and security. Studies that have assessed the acceptability of contact tracing apps in different countries have noted that the national culture, level of general trust in authorities and individual

factors (such as perceptions of power-distance and individualism) can all influence individual and collective sentiment towards the implementation of contact tracing initiatives (227, 228).

Feasibility

Contact tracing requires large numbers of trained personnel and considerable resources (for example, in telecommunications) and as a result may be less feasible in low- to middle-income countries in which resources are limited. In addition, the implementation and effectiveness of contact tracing both rely on the capacity to detect cases, and efforts are likely to be hampered by the short incubation and infectious periods of influenza (204). The triggers for activating and deactivating contact tracing for optimal effect *in* controlling influenza outbreaks remain unknown.

6.1.2 Knowledge gaps

- There have been very few studies on the effectiveness of contact tracing in reducing influenza virus transmission in the community, and none that have studied contact tracing as a single standalone intervention.
- Knowledge of the specific impact of contact tracing on disease transmission might be useful in modifying public behaviour and reducing the frequency of interpersonal contacts in the community during an outbreak.
- Currently available studies in community settings are all simulation studies and evidence of greater strength is needed to provide a more robust understanding of the effectiveness and value of contact tracing in reducing influenza transmission.
- Data are also lacking on the impacts of different intensities of contact tracing, and on its optimal timeframe, feasibility and cost-benefit.
- Real-world assessment of digital contact tracing as a standalone measure to inform public health authorities and the public about exposure risk would also be valuable.
- Investigation of the use of digital contact tracing applications to modify contact patterns in the community to reduce influenza transmission is also required.

6.1.3 Implementation considerations

- Contact tracing could be considered where there is sufficient digital (or other) contact tracing capacity. However, this would need to be implemented alongside sufficient data protection and human rights safeguards.
- To the extent possible, when implementing contact tracing, governments should seek prior and informed consent from the infected individual. Where informed consent is not possible or advisable, then at a minimum people should be informed about what data will be used, how and by whom.
- In the case of low incidence, contact tracing may be considered as part of a suppression strategy in countries with sufficient contact tracing capacity, testing capacity and quarantine facilities.

6.2 Isolation of symptomatic and/or infected individuals

Strong recommendation for – very low certainty evidence

WHO recommends voluntary home isolation of symptomatic and/or infected individuals in every circumstance to reduce the transmission of influenza viruses during influenza epidemics and pandemics.

Conditional recommendation for – very low certainty evidence

WHO suggests mandatory isolation of symptomatic and/or infected individuals at home or in a dedicated facility to reduce the transmission of influenza viruses in exceptional circumstances, such as epidemics and pandemics of high or extraordinary severity.

Summary of evidence

Isolation is a fundamental public health measure to prevent the transmission of many infectious diseases. However, the impact of isolation on influenza transmission has rarely been studied in detail. The systematic review identified four studies that assessed the effectiveness of isolation on influenza virus transmission (55, 229–231). Two of these reported reductions in the observed attack rate when isolation was used as part of a package of measures in a physical training camp and in a residential home for older adults (229, 230). In addition, a review of the interventions implemented during the 1918 Spanish influenza pandemic noted that excess death rates due to pneumonia and influenza decreased in New York City and Denver after isolation and quarantine measures were implemented (55). Another outbreak investigation reported a reduction in the cumulative incidence of influenza A(H1N1)pdm09 cases on a navy ship that had implemented an isolation policy (231).

Relevant evidence from the COVID-19 pandemic

Eight studies have been identified that assessed the effectiveness of case isolation in reducing SARS-CoV-2 transmission during the early stages of the COVID-19 pandemic (232–239). Of these, two studies found an association between case isolation and epidemiological trends suggesting suppression of disease spread (232, 238). One study compared the difference between countries implementing isolation measures in health-care facilities and at home, and found that the daily number of new SARS-CoV-2 cases fell more rapidly in countries with strict isolation policies (233). Other studies in the review have reported that the reproductive number took longer to fall below one when cases were isolated according to disease severity rather than universal case isolation (234, 235).

6.2.1 Justifications and summary of considerations of GDG members

The GDG decision to recommend isolation of symptomatic and/or infected individuals was supported by very low certainty evidence and the balance between health benefits and harms favoring the intervention. The members found that evidence on cost-effectiveness of isolation alone was limited; however, voluntary isolation appeared to be more effective and less costly when compared to other PHSM, such as school closure. The members agreed that isolation is a

fundamental public health measure to prevent the transmission of several infectious pathogens and judged voluntary isolation to be in accordance with universal human right for health. Nevertheless, the GDG noted human rights concerns when isolation measures are mandated, such as restriction of freedom of movement or access to food. Therefore, the GDG debated and deliberated for a strong recommendation for voluntary isolation of symptomatic and/or infected individuals and a conditional recommendation for mandatory isolation to only limit mandate to exceptional circumstances, such as epidemics and pandemics of high or extraordinary severity. They highlighted the need for governments and communities to consider the impact of this intervention on affected individuals and mitigate it through the implementation of social security policies. Members recognized that values and preferences and acceptability of individuals and groups assigned to undergo isolation may vary; however, members believed that acceptance of isolation policies may also depend on the severity of infection, with very severe infections likely to increase acceptance when linked to timely and adequate care. Overall, the GDG thought that feasibility of isolation may vary across different setting and be related to the stringency of the intervention.

Certainty of the evidence

Overall, there is very low certainty evidence that the isolation of symptomatic and/or infected individuals substantially affects the transmission of influenza viruses, except perhaps in closed settings. However, four observational studies reported that isolation was effective at reducing influenza virus transmission in combination with other PHSM. Eight observational studies reported that isolation was effective at reducing the transmission of SARS-CoV-2, again in combination with other PHSM, and suggested that centralized out-of-home isolation may be more effective than home isolation. One limitation of isolation in terms of reducing influenza virus transmission is the effect of delays in recognizing symptoms and/or receiving a laboratory diagnosis, particularly as contagiousness likely peaks around the time of symptom onset, with some individuals potentially contagious even prior to symptom development (240).

Values and preferences

There may be variability in the values and preferences of groups assigned to undergo isolation. Isolation can cause distress through fear and risk perceptions, especially when people face unclear information and communication during a disease outbreak (241). In addition, health-care workers and contacts related to those isolated may report social stigma and emotional strain due to loss of anonymity (242). However, individuals who have no close relationship with isolated cases, may consider isolation to be an effective intervention in reducing their own chances of becoming infected (241). Experiences during the COVID-19 pandemic revealed specific concerns around mandatory isolation policies, such as loss of income or employment. Individual acceptance of isolation policies may also depend on the severity of infection, with very severe infections likely to increase acceptance of isolation policies when linked to timely and adequate care.

Balance of benefits and harms

The objective of isolation is to reduce virus transmission by reducing contact between contagious and susceptible individuals (6). The overall effectiveness of isolation is likely to be moderate and likely to be greater when combined with other PHSM. Individuals who live with an isolated person could be at higher risk of infection during home isolation due to increased contact (243). Several studies have indicated that countries that implemented more stringent isolation policies were more successful in reducing the impact of the COVID-19 pandemic (233–235). However,

greater stringency (for example, longer duration or very severe movement restrictions) could reduce the overall feasibility and acceptability of isolation policies due to the high social and economic impact on people's lives.

Resource implications

Evidence of the cost-benefit and cost-effectiveness of isolation is limited across all settings, and all evaluations to date have been qualitative rather than quantitative. One stochastic simulation model indicated that encouraging the voluntary isolation of patients is a more effective and relatively inexpensive strategy compared to school closure (244). Another modelling study based on the population of Canada indicated high cost-effectiveness of a combination of community-contact reduction measures, including personal protection measures, voluntary isolation and antiviral therapy (245). However, the cost-effectiveness of isolation alone was unclear. Direct costs might also have a disproportionate impact on low-income groups – though this is considered to likely be moderate and mainly related to income losses through people staying at home for 7–10 days (243, 246). Isolating individuals may also increase the workload of health-care workers or family members, while the implementation of widespread isolation without risk stratification could be economically costly.

Equity and human rights

Home isolation in general does not raise significant equity and human rights concerns as this measure is often undertaken voluntarily in non-outbreak situations by individuals who do not feel well enough to work or engage in other daily activities (247, 248). Concerns may arise when isolation is mandatory either at home or in a designated facility away from an individual's residence. These concerns relate mainly to the restriction of individual freedom of movement (249) and its consequences, including potential loss of income, and increased risk of gender-based or other interpersonal violence, and stigma (242). People who are reliant on home-based care and support, including older adults and persons with disabilities, may not receive sufficient care when home isolation is implemented (250), and there would then be a need to safeguard the provision of food, medical supplies and other forms of care and support during isolation (251–254). In China during the COVID-19 pandemic, concerns were also raised by parents when they were separated from their children due to stringent isolation policies even for mild cases (255, 256). However, for homeless people or those living in crowded conditions who may not be able to isolate at home, facility-based isolation may protect the health of community members.

Although isolation is an important intervention, some individuals may face economic pressure to go to work rather than stay at home (257) and may therefore need financial support or compensation to isolate. Home isolation may also increase the risk of infection among household members. Conversely, despite limited evidence, isolation could reduce the rate of infection in settings with poor sanitation and high levels of vulnerability, thereby promoting the right to health of the community at large. However, lower-income and informal employment (such as informal trading, waste reclamation or sex work) is more likely to require in-person attendance (rather than working from home) and therefore mandatory isolation policies could have a greater economic impact on lower-income groups.

Acceptability

The isolation of sick individuals is generally widely accepted by policy-makers and health-care workers, while acceptability and adherence among the public varies. It may become increasingly less accepted during prolonged periods of isolation or implementation, as evidenced by the onset of “pandemic fatigue” as the COVID-19 pandemic progressed. One survey conducted among the parents or guardians of university students in the USA during the 2009 H1N1 influenza pandemic indicated that a majority of respondents envisaged isolating themselves away from others should they become ill (258). However, in a separate survey of university students, only 6.4% of respondents reported remaining in home isolation when ill (259). In a review of five studies, it was reported that 50–96% of respondents intended to stay home rather than go to work if they became symptomatic. However, in another six studies covered by the same review, the reported values for individuals who had actually done so were significantly lower (1–26%) (260). Family structure or the presumed infection status of family members can affect whether people accept isolation plans; for example, young children are less likely to be isolated alone at any stage of an epidemic (202).

Feasibility

The isolation of sick individuals may not be feasible in certain circumstances and there are likely to be at least some obstacles to isolation in some locations. For example, it may not be straightforward for families of low socioeconomic status or other vulnerable groups to isolate individually at home, or to even have a home. In addition, infected individuals unaware of their infection status (for example, pre-symptomatic or asymptomatic) could perpetuate transmission in the community (7). The effectiveness of case isolation as a PHSM is also sensitive to the response time, with delays potentially inevitable in many situations (261). In addition, ethical and social issues related to isolation may contribute to variable acceptability and adherence among the community.

6.2.2 Knowledge gaps

- Available epidemiological studies looked at isolation combined with other interventions or did not use laboratory-confirmed influenza as the outcome of interest. Although it is difficult to study isolation using RCTs, such studies would be very valuable.
- The understanding of virus transmission dynamics is incomplete, including the importance of pre-symptomatic contagiousness for influenza (262) and the proportion of infections that are asymptomatic (57). The optimal duration of isolation is also unclear. Research to identify an optimal strategy for the isolation of asymptomatic but potentially contagious individuals would be valuable.
- Due to the short incubation and latency period (time from infection to infectiousness) of influenza viruses, the isolation of sick individuals may not be as effective or feasible as it would be for other respiratory virus infections with longer incubation and latency periods. Studies on the feasibility and cost-effectiveness of case isolation measures during influenza epidemics and pandemics would thus inform decision-making.

6.2.3 Implementation considerations

- Addressing the practical needs of isolated individuals is crucial, especially for those more vulnerable, such as people living alone or the elderly. Ensuring access to necessary medical supplies and adequate food is essential.

- When healthy individuals live with someone who is isolating, the implementing of personal protection measures to help reduce the risk of household transmission is very important.
- The duration of isolation should be guided by the duration of infectiousness of the disease. Early studies on the course of infectiousness over time can thus inform this decision.
- Focusing on the initial days when infectiousness is highest and medical attention may be most needed is essential. Monitoring symptoms during this period will be crucial.
- During continued community transmission, mandatory isolation could become increasingly challenging to enforce and may have limited measurable impact on overall mitigation, whereas voluntary self-isolation should always be part of the strategy.
- Isolation has significant social and economic consequences for affected individuals. Governments and communities should consider these impacts and aim to mitigate them through the implementation of social security policies.
- For individuals who find it difficult to home isolate, facility-based isolation can be considered, provided that appropriate care and support is provided in such facilities.
- In the absence of widely available rapid diagnostic tests for a newly emerged influenza virus, isolation recommendations may need to rely on symptomatic illness rather than laboratory results.

6.3 Mass testing

Conditional recommendation against – very low certainty evidence

WHO suggests against mass testing in community settings to reduce the transmission of influenza viruses during influenza epidemics and pandemics.

Remarks

- Mass testing may be implemented using any laboratory or over-the-counter test with sufficiently high sensitivity and specificity, which includes laboratory PCR tests and over-the-counter lateral flow tests such as RATs. If available at scale, over-the-counter tests could be used to facilitate the self-testing of symptomatic or asymptomatic individuals in the community. Test results can then inform subsequent behaviours or further actions such as mask wearing or isolation of infected individuals from the community to reduce virus transmission.

Summary of evidence

The systematic review did not identify any published evidence on the effect of mass testing on reducing influenza virus transmission. To date, several commercial RATs for diagnosing seasonal influenza are used in clinical settings (263) but are not widely available to the general public. Thus, the evidence on community use of RATs is derived from experience gained during the COVID-19 pandemic.

Relevant evidence from the COVID-19 pandemic

A total of 22 studies that had assessed the effectiveness of mass testing in reducing the impact of SARS-CoV-2 were identified in the review (264–271). Twenty studies were observational and two were modelling studies. Eleven studies from six countries reported on the impact of population-level rapid antigen testing as a screening measure (264–274). The other eleven studies reported on the impact of PCR testing in the community (275–282) or the impact of pooled PCR testing in schools and universities (283–285). All identified studies showed a beneficial effect of mass testing typically combined with other PHSM such as isolation of infected individuals and quarantine of their contacts to prevent further transmission. The outcomes of the studies included reduction in SARS-CoV-2 transmission (264, 265, 272–274, 279), incidence (265–268, 270, 275, 276, 282), prevalence (269) and test positivity (277, 278, 281, 283–285), and hospitalizations (270, 271).

6.3.1 Justifications and summary of considerations of GDG members

The evidence identified was limited and was rated of very low certainty. The GDG judged the balance of health benefit and harms to be variable. The GDG discussed the resource implications and found to probably favor the comparison given the large number of economic resources required when mass testing is implemented on a large scale. Members agreed that such a measure could be implemented if a test with a sufficiently high sensitivity and specificity would be available during an influenza pandemic. They noted that currently most RATs only differentiate between influenza subtype A and B; therefore, if both seasonal and pandemic influenza A strains were co-circulating, it would not be possible to determine if the cases were

positive to seasonal or pandemic influenza, and this would require PCR confirmation. The GDG debated the implications on equity and human rights, values and preference and acceptability and recognized that these may vary and would depend on factors such as the modality, the frequency or the cost associated to testing. The members judged the feasibility to be variable across different settings and be dependent by the resources available in a country, the capacity to test at large scale and to handle positive individuals and their close contacts. The very low certainty evidence together with these considerations caused the GDG to conclude with a conditional recommendation against mass testing.

Certainty of the evidence

Currently there is no evidence on the effect of mass testing on reducing influenza virus transmission, while the corresponding evidence for SARS-CoV-2 is of very low certainty overall. All 22 studies estimated the effect of mass testing on SARS-CoV-2 transmission and its impacts, all of which showed a beneficial effect. Three studies indicated that the use of mass testing using pooled PCR testing reduced test positivity in schools. Eleven studies suggested a beneficial impact of population-wide rapid antigen testing, when combined with other PHSM such as isolation and quarantine.

Values and preferences

Although mass testing in many locations has met little resistance, concerns could arise if such tests were mandatory and the consequences of reporting a positive case significant (for example, isolation of the positive individual and quarantine of close contacts away from their home). Allowing the voluntary reporting of test results may allay such concerns. One survey carried out in Indonesia found that upon receiving a positive test, 86% of respondents would report it, 97% would self-isolate and 90% would warn their close contacts (286).

Balance of benefits and harms

Reducing the onward transmission of respiratory viruses by quickly identifying cases in the community, followed by isolation and treatment, is a benefit to society. Even without isolation or quarantine, individuals could still voluntarily change their behaviour to reduce their own risk of infection if negative or the risk of transmitting an infection to others if positive (287) – though this would not be as effective. There are no apparent harms to the health of an individual as a result of testing, which can instead allow for quick treatment if the test is positive. However, some tests may have adverse effects, such as discomfort, headaches and nosebleeds resulting from nasopharyngeal swabs (288). The cost-effectiveness of implementing mass testing should be weighed against the current or expected prevalence in the community as high positive predictive values may only be achieved (for example, for RATs) when the prevalence is high. If the sensitivity and/or specificity of a test are poor then significant numbers of false positives may be unnecessarily isolated while false negatives would result in infectious cases remaining in the community to transmit infection (289). Virus mutations and population immunity may also undermine the effectiveness of mass testing. Currently most RATs only differentiate between influenza A and B. Therefore, if both seasonal and pandemic influenza A strains were co-circulating, as was the case in the early phase of the 2009 H1N1 pandemic, it would not be possible to determine if the positive cases had seasonal or pandemic influenza, and this would require PCR confirmation. This will be an important consideration when mass testing for pandemic influenza using RATs.

Resource implications

Mass testing can incur considerable direct costs, particularly when carrying out numerous rounds of the whole population. This could be made less resource intensive depending on the test that is used and its administration. One proposed method from the SARS-CoV-2 evidence is pooling PCR tests and only testing the individual samples if a pool is positive. A study carried out in the USA estimated that pooling up to 24 samples for RT-PCR did not decrease the sensitivity of tests and decreased the associated costs. It was estimated that individual nasopharyngeal swab PCR testing would cost a school with a student population of 500 approximately US\$ 63 500 per week (US\$ 254 000 per month) compared to US\$ 11 250 per week (US\$ 45 000 per month) for saliva pooled testing (285). However, high incidences of SARS-CoV-2 infections would yield a larger number of positive pools, subsequently increasing the number of follow-up PCR tests required. This in turn would reduce the benefit of the pooling strategy and limit its applicability in high-incidence settings. Whether tests are distributed to the population for self-testing or are carried out by health-care personnel will also have its own resource implications. In addition, if policies require positive RAT results to be confirmed using PCR, then cost-effectiveness may decrease, unless the prevalence in the community is low.

Equity and human rights

Mass testing may reveal a concentration of infections among subgroups of the population, such as those with lower socioeconomic status and/or high-risk workplaces. In such contexts, care must be taken to avoid discrimination and stigmatization (290). Protections (such as safe reporting schemes) may also be needed for irregular migrants, including their children, and others with unclear legal status. Where resources are low, consideration may need to be given to which groups to prioritize for testing, taking into account equity, non-discrimination and equality aspects. Mass testing in schools can positively impact on human rights by keeping schools open, thereby allowing children their right to an education. RATs can provide quick results at lower cost than PCR, making them more accessible if testing is funded out of pocket.

Acceptability

Mass testing may not be readily accepted if it is very frequent and/or if the cost is borne by the individual. In one study, acceptability and adherence to a daily at-home mobile app approach was assessed among employees of a media company in the USA (291). Participants were mailed RATs to self-administer at home each day for 21 days, after which they were asked to complete a quantitative survey and qualitative in-depth interview. Among 31 study participants, the acceptability of this approach was high, with 71% reporting a preference for it over weekly PCR testing. Mean adherence to the 21-day testing strategy was also high at 88% (291). Additionally, in schools that implemented saliva-based pooled PCR testing, teachers reported that students found the programme acceptable (292). However, in settings where the prevalence of infection is low, the rate of false positives will be higher, which may reduce the acceptability of such testing and isolation approaches.

Feasibility

Increasing testing capacity to efficiently implement mass testing may be challenging in countries with lower resources, especially if the testing approach of choice requires laboratory testing. Pooling samples or distributing RATs for self-testing may be more feasible alternatives. However, although RATs are simple to complete, users would still require guidance on testing frequencies,

proper testing procedure, interpretation of test results and the appropriate actions to be taken after a result is generated.

6.3.2 Knowledge gaps

- Research on the impact of mass testing in terms of reducing influenza virus transmission in the general population is completely lacking and is required. Studies of the feasibility and cost-effectiveness of mass testing for influenza could provide evidence on whether this measure might be effective (and cost-effective) in reducing the burden of influenza during epidemics and pandemics.

6.3.3 Implementation considerations

- Mass testing can be considered as an approach for reducing the community transmission of influenza viruses during periods of high prevalence if a low-cost test with reasonably high sensitivity and specificity is available.
- Implementation should only be considered if there are sufficient resources and capacities to test at large scale, and to handle positive individuals and their close contacts.
- Where disease prevalence is low, mass testing may be more beneficially targeted to specific subpopulations or settings.
- The effectiveness of mass testing alone is small and requires the implementation of other measures such as isolation of positive individuals and potential quarantining of their close contacts.
- If prevention or suppression is the objective, a highly sensitive test would be required and the cost-benefit ratio may be extremely high.

6.4 Voluntary self-quarantine

Conditional recommendation for – very low certainty evidence

WHO suggests voluntary self-quarantine for individuals exposed to a confirmed case in their households or elsewhere to reduce the transmission of influenza viruses during influenza epidemics and pandemics of high severity.

Summary of evidence

The systematic review identified five studies assessing the effectiveness of quarantine in reducing influenza virus transmission (55, 293–296). Quarantine measures studied included voluntary and mandatory household⁷ or centralized quarantine.⁸ Quarantine was studied either as a single intervention or in combination with other interventions (typically contact tracing, isolation and antiviral prophylaxis). When a combination of isolation and quarantine was implemented in the 1918 Spanish influenza pandemic, excess death rates due to pneumonia and influenza were shown to decrease in New York City and Denver (55). During the 2009 H1N1 influenza pandemic, the use of mandatory quarantine in Beijing, China was shown to reduce (by fivefold) the number of cases at the peak of the epidemic, while also delaying the peak (294). One quasi-RCT in Japan illustrated that voluntarily waiting at home during the 2009 H1N1 influenza pandemic reduced the risk of infection and the number of influenza infections (295). A study in Australia in 2009 estimated that the risk of a household contact who was currently quarantined with the index case patient becoming a secondary case patient increased for each additional day (adjusted OR = 1.25; 95% CI = 1.06–1.47) (296). If quarantine was to be implemented, a reasonable duration would be 4 days after exposure, which would cover two incubation periods of a seasonal influenza virus. If data were available on the incubation period of a new pandemic virus strain, then the quarantine period could be adjusted accordingly.

Relevant evidence from the COVID-19 pandemic

In the systematic review, studies assessing the effectiveness of quarantine during the COVID-19 pandemic found reductions in both impact (297–299) and transmission (211, 237, 298, 300–304), as well as shorter generation times and serial intervals (211, 237). One quasi-experimental study showed that the implementation of mandatory quarantine could reduce transmission and spread cases over a longer period in some but not all of the six Latin American countries studied (299). A population-based study estimating the individual effect of quarantine across 415 sites in early 2020 estimated that quarantine could reduce the effective reproduction number (R_t) of SARS-CoV-2 by 11.4% (95% CI = 9.1–13.7) compared to the R_t in the absence of quarantine (300). Another population-based study conducted in Niger in early 2020 estimated a reduction in transmission, with R_t decreasing from 6.7 to around 1 following the implementing of multiple PHSM, including home quarantine (302). Another study carried out in early 2020 in Wuhan, China reported that R_t declined from a peak of 3.82 to 1.0, and then to 0.3 following centralized quarantine measures –however, this was implemented alongside antiviral treatment and a lockdown (298).

⁷ Household quarantine can be defined the confinement (commonly at home) of non-ill household contacts of a person with proven or suspected influenza (6, 7).

⁸ Centralized quarantine can be defined as confinement at a designated quarantine facility that may be recommended or mandatory for non-ill contacts of a person with proven or suspected influenza.

These studies indicate that the use of a combination of PHSM, including quarantine, was effective in reducing the public health impact of SARS-CoV-2. One strategy that can complement the implementation of quarantine orders or recommendations during a pandemic is the use of RATs to reduce the length of time that individuals need to quarantine. One randomized trial in the United Kingdom compared the use of daily RATs against the standard 10-day isolation of COVID-19 contacts, and found that daily testing (with removal of self-isolation 24 hours after testing negative) was non-inferior to standard self-isolation in reducing secondary attack rates (305).

6.4.1 Justifications and summary of considerations of GDG members

The GDG decision for conditional recommendation for voluntary self-quarantine was supported by very low certainty of evidence and the probable positive balance between desirable and undesirable health effects of the intervention. The GDG debated the implications on equity and human rights, values and preference and acceptability and recognized that these may vary. They noted that compulsory instead of voluntary quarantine carries risks of gender-based violence and violence against children within the home, concerns around freedom of movement and knock-on effects on other determinants of health and other human rights. The GDG discussed the resource implications and found to be variable. The GDG believed that the feasibility of quarantining exposed individuals may vary across settings depending on available resources, space and facilities.

Certainty of the evidence

Overall, there is very low certainty evidence that the quarantining of exposed individuals has an effect on reducing the transmission of influenza or SARS-CoV-2. For influenza, three observational studies, one modelling study and one quasi-RCT estimated the effectiveness of quarantine on influenza virus transmission. Of these, four suggested a beneficial effect in combination with isolation and physical distancing in the community. The remaining study found an increased risk for contacts quarantining in households. For SARS-CoV-2, 10 observational studies indicated a beneficial effect of quarantine in terms of delaying the peak of an epidemic, with some studies suggesting a significant improvement in the effectiveness of quarantine when combined with other interventions such as case isolation, antiviral prophylaxis or school closure.

Values and preferences

Values and preferences among quarantined populations are uncertain and variable. One survey conducted in Türkiye indicated that 69.4% of students believed that quarantine was an effective intervention in reducing the transmission of influenza (306). In other studies, serious concerns were expressed by the public regarding potentially harmful outcomes of mandatory quarantine, such as overcrowding, exposure to infection, and inability to work, shop or contact family members (307, 308). In another study, fear and a sense of shame were also cited as concerns by a proportion of the community, with many also believing it to be impolite to maintain a distance from a sick acquaintance or relative (309). Health-care workers have also reported fears of acquiring infection during quarantine measures (241) though 86.9% of such respondents in another study had positive attitudes towards its effectiveness (310).

Balance of benefits and harms

Although the overall effectiveness of quarantine in reducing the burden of disease and delaying the peak of an epidemic is likely to be moderate, quarantine may be useful when antiviral drug

resources are limited (243). However, quarantine location will be an important factor in deciding whether the intervention will result in harm. During the 2009 H1N1 influenza pandemic, one study from China reported that university students who were quarantined in the same room as a confirmed case were at higher risk of illness (311). In addition, the above quasi-RCT conducted in Japan reported that more home-quarantined individuals fell ill when there was a sick family member present (295). As also noted above, the likelihood of a household contact concurrently quarantined with an isolated individual becoming a second case has been estimated to increase with each day of quarantine (296). Even in designated quarantine facilities, the risk of transmission will remain, especially where these are not purpose built, though such centralized quarantine approaches may also facilitate early diagnosis and timely treatment. It should also be noted that the prospect of isolation or quarantine might negatively affect the behaviour of individuals, for example in reporting their status, seeking health care or promptly reporting close contacts for fear of confinement, with potentially harmful effects on overall suppression or mitigation efforts.

Resource implications

Large-scale centralized quarantine could be resource intensive. Although household quarantine may be more cost-effective in locations with limited capacity, monitoring and enforcing compliance could still be challenging due to resource constraints.

Equity and human rights

As with isolation, a significant concern around the implementation of quarantine is the restriction of freedom of movement of individuals (294) and the knock-on effects of this on other determinants of health and other human rights. Such concerns are more significant for quarantine than for isolation as the measure involves restricting the movement of asymptomatic and mostly uninfected individuals, with the perceived benefits of quarantine potentially declining over time. Compulsory quarantine carries risks of gender-based violence and violence against children within the home. It also requires safeguarding the provision of food, medicines and other needed supplies. In some cases, home care and personal assistance support must also be ensured, and not discontinued, as these are essential for exercising the rights of people with disabilities (251). Quarantine requirements can reduce the capacity of existing shelters for domestic violence victims, or reduce access to such services that have quarantine-prior-to-admission requirements (312). Mandatory quarantine is thus associated with greater ethical concerns compared to voluntary quarantine (249). In addition, household quarantine can increase the risk of household members becoming infected (295, 296, 313). It has been suggested that a combined policy of household quarantine and antiviral prophylaxis can alleviate such concerns (313) but large stockpiles of antiviral drugs may not always be available for prophylactic use.

Acceptability

The acceptability of, and compliance with, quarantine are variable, but are generally moderate (243). In one telephone survey conducted in Australia, more than 90% of respondents reported being willing to stay at home, especially after being given brief information about pandemic influenza (314). Two other studies reached a similar conclusion, with 94% (315) and 92.8% (310) of respondents reporting adherence to a quarantine recommendation. However, a cross-sectional survey in Australia reported only 53% of households being fully compliant with quarantine requirements. In another study, compliance was found to be greater among

individuals with a better understanding of quarantine (OR = 2.27) (316). As with the isolation of sick individuals, the family structure or infection status of family members affects an individual's decision on whether or not to accept quarantine plans (202). Compliance could also decrease as the length of quarantine increases, especially alongside fears of losing employment.

Feasibility

There are several barriers and obstacles to the successful implementation of quarantine of exposed individuals. Home quarantine with infected cases can significantly increase the risk of acquiring infection (243) while centralized quarantine requires more resources. In addition, because the incubation period of a pandemic influenza virus strain may initially be uncertain, home quarantine may at times need to be implemented for an extended period, leading to financial burdens on families due to work absenteeism (317). Although the use of quarantine measures appears in 61% of national pandemic plans, detailed strategies for their implementation are typically not provided and existing infrastructures will vary by country (157). Depending on the severity of the epidemic or pandemic, the costs of implementation may outweigh the benefits of quarantine.

6.4.2 Knowledge gaps

- Most currently available epidemiological studies on the effectiveness of quarantine in influenza control did not rely completely on laboratory-confirmed influenza as the outcome of interest, which would be valuable.
- Although it is difficult to study quarantine using RCTs, robust data from experimental studies would also be valuable.
- In addition, more robust evidence is required to understand the contribution and role of asymptomatic individuals among all infections, the possibility that a “superspreading event” would occur resulting in a higher number of exposed individuals than usual, and the determinants of compliance behaviour (202, 318).
- More evidence on the optimum duration of quarantine is needed.

6.4.3 Implementation considerations

- Quarantining exposed individuals may not be feasible in some settings depending on available resources, space and facilities.
- With the availability of RATs of sufficiently high sensitivity and specificity, the daily testing of contacts could be considered in lieu of quarantine measures.
- The duration of quarantine should be informed by the incubation period of the virus.
- Mandatory quarantine at home or in a facility may be considered in exceptional circumstances to achieve suppression or mitigation of virus transmission but may have severe social and economic implications.
- The costs of quarantine to households and wider society can be high. This measure could potentially lead to high levels of absenteeism which could negatively impact business continuity and the provision of essential services during high levels of community transmission. Governments should consider implementing social security policies to mitigate the impact of this measure, especially in terms of addressing wealth inequalities and risk to vulnerable groups such as women and children.

7. Social measures

7.1 Indoor hospitality and recreation measures

Conditional recommendation against – very low certainty evidence

WHO suggests against risk-mitigation measures in indoor hospitality and recreational settings to reduce the transmission of influenza viruses during influenza epidemics and pandemics.

Remarks

- Indoor hospitality and recreation venues (including restaurants, bars, cinemas, gyms and beauty salons) were identified as locations associated with increased risk of virus transmission during the COVID-19 pandemic (319). As policies on face coverings (including face masks) in public places were implemented in many jurisdictions during the COVID-19 pandemic (320, 321), these venues represented locations in which “mask-off” activities such as eating, drinking and exercising still occurred outside individual residences.

Summary of evidence

The systematic review did not identify any published evidence on the effectiveness of indoor hospitality and recreation measures in reducing influenza transmission.

Relevant evidence from the COVID-19 pandemic

Nine studies (five epidemiological studies (167, 322–325) and four simulation studies (326–329)) were identified that investigated the effects of measures implemented in catering and fitness premises. Most of the measures assessed aimed to reduce SARS-CoV-2 transmission by improving indoor air quality and/or limiting the consumption of food and drink on the premises (for example, by limiting business hours, restricting alcohol consumption and encouraging outdoor dining). The effectiveness of such measures in reducing SARS-CoV-2 transmission varied. In China, Hong Kong SAR one study observed reduced secondary attack rates in restaurants after new legislation mandated improved ventilation or installation of air purifiers in dine-in catering premises (167), while another study did not identify any statistically significant changes in R_t when reduced business hours for catering services were implemented (324).

However, two other epidemiological studies conducted in Spain and the USA (322, 323), as well as the simulation studies (326–329), identified negative associations between measures to reduce transmission in catering, fitness and personal care service settings and SARS-CoV-2 transmission.

7.1.1 Justifications and summary of considerations of GDG members

The evidence identified was limited and rated of very low certainty. The GDG judged the balance of health benefit and harms to probably favor the intervention. They noted that there was no evidence on the implementation of indoor hospitality and recreation measures during influenza epidemics and pandemics. The GDG discussed the resource implications and found to probably favor the comparison given the large number of economic losses that could derive from this intervention. The members judged indoor hospitality and recreation measures to probably be in accordance with universal human rights, though the right to health would need to be balance against other right such as to work or access to food. The GDG debated the implications on values and preference and acceptability and recognized that these may vary and would depend on the type of measures and their duration. The members judged the intervention to be probably feasible; however, the implementation of other complementary PHSM may help reducing the impact on businesses. The very low certainty evidence together with these considerations caused the GDG to conclude with a conditional recommendation against indoor hospitality and recreation measures.

Certainty of the evidence

Overall, there is very low certainty evidence on whether indoor hospitality and recreation measures can reduce the transmission of influenza viruses. However, nine studies examining the effectiveness of indoor hospitality and recreation measures in reducing SARS-CoV-2 transmission suggest that such measures could complement other PHSM in reducing the community transmission of respiratory viruses such as influenza.

Values and preferences

There is uncertainty and variability regarding the importance that populations assign to indoor hospitality and recreation measures to reduce influenza transmission. While many populations accepted measures to limit the business hours of catering and fitness service providers during the COVID-19 pandemic as part of a suite of PHSM to reduce community transmission, prolonged and indefinite disruption of these services may have variable consequences. In China, Hong Kong SAR, for example, a temporary ban on dine-in services resulted in the lack of proper dining spaces for workers and residents, some of whom did not have access to such spaces in their workplace or homes (330).

Balance of benefits and harms

Given the potential reduction in the risk of SARS-CoV-2 transmission events associated with indoor hospitality and recreation measures, such interventions may also reduce influenza transmission, especially in combination with other PHSM. However, the current review did not identify any published evidence to determine this effect. The implementation of such measures will need to be carefully considered, with stakeholder consultations held to assess their impacts on the daily lives of the population.

Resource implications

Hospitality and recreation industries make up a significant proportion of many economies. Disruptions to their operations will likely incur significant costs not only to business owners but also to employees and the wider economy in terms of GDP loss. Privately owned small and medium businesses in these sectors are particularly vulnerable to disruption. Statistics Canada reported a 55.8% drop in employment in the food services and drinking places subsector by May 2020 compared to pre-pandemic levels in February 2020, and this only recovered to around a 30% drop by December 2020 (331). The real GDP contribution of food services and drinking places in Canada fell by 39.5% in March 2020 and by another 40.8% in April 2020 following permanent closures, and with surviving businesses operating at greatly reduced capacity (331).

Equity and human rights

The need to prevent the health-care system from becoming overwhelmed needs to be balanced against the potential loss of employment in the absence of any financial support measure for employees and business owners in the hospitality industry, many of whom depend on the industry for their livelihoods (332). Hospitality services in particular can also represent food security and social connection for selected subpopulations, which are crucial for individual physical and mental health.

Acceptability

The acceptability of hospitality and recreation measures among the public may depend on the type of measures undertaken and their duration. Efforts to improve indoor air quality are likely to be accepted as it is the least disruptive to consumers, even though there may be cost implications for business owners.

Feasibility

It is currently not known if hospitality and recreation measures alone would have a large effect in reducing influenza transmission. However, such measures were implemented at large scale, along with other PHSM, in many countries during the COVID-19 pandemic.

7.1.2 Knowledge gaps

- Evidence of the effectiveness of measures that could be implemented in indoor hospitality and recreational facilities (including restaurants, bars, cinemas, gyms and beauty salons) on influenza transmission is needed. However, large-scale RCTs are unlikely to be feasible.
- The effectiveness of some of the measures applied during the COVID-19 pandemic (such as limiting business hours and venue capacity) could usefully be investigated for potential application in reducing influenza transmission during influenza epidemics and pandemics.
- Improved understanding of the dynamics of human-to-human influenza virus transmission would be beneficial.

7.1.3 Implementation considerations

- In indoor settings where mask-off activities can occur, measures to reduce the risk of influenza transmission (for example, restricting business hours, setting maximum capacities, requiring proof of a negative test and/or vaccination, mask wearing where possible and

physical distancing) could be considered based on pandemic severity, the potential for influenza transmission in these settings and desired transmission-related outcomes.

- Often workplace measures applied to customers will also apply to the employees in these settings.
- As potential influenza transmission rates vary widely across different indoor hospitality and recreational settings, countries should consider the probability of influenza transmission for each specific setting.

7.2 Restrictions on gatherings

Conditional recommendation for – very low certainty evidence

WHO suggests considering restrictions on gatherings to reduce the transmission of influenza viruses in the community during influenza epidemics and pandemics.

Remarks

- Influenza viruses are transmitted between individuals through the air (that is, through inhalation or the direct deposition of infectious respiratory particles on the facial mucosa) and to a lesser extent through indirect contact (that is, through fomites) (333). As mass gatherings and crowded areas tend to increase person-to-person close contact, measures that reduce such contact could potentially reduce the community transmission of influenza (333).
- A risk-based approach based on the three steps of risk evaluation, risk mitigation and risk communication to inform the decision to restrict, modify, postpone, cancel or proceed with the holding of any gathering should be applied in the decision-making process.

Summary of evidence

Three observational studies and one modelling study examining the effects of restricting gatherings were identified in the review (55, 334–336). One study of World Youth Day 2008 pilgrims found that sleeping in smaller groups reduced the transmission of influenza compared with sleeping in one large hall (335). Another two studies based on the 1918 Spanish influenza pandemic found that timely bans on public gatherings and the closure of public places appeared to reduce the excess death rate (55, 334). During the 2019–2020 influenza season early in the COVID-19 pandemic, a further study modelled the effects of various PHSM in 33 countries, with mass gathering restrictions identified as the largest potential contributor (37.6%) to the suppression of influenza transmission in these countries (336). In all studies included in the review, the individual effects of restrictions on gatherings could not be disaggregated from those of other PHSM implemented at the same time.

Relevant evidence from the COVID-19 pandemic

Twenty-nine studies that assessed the effects of restrictions on gatherings on SARS-CoV-2 transmission were identified (216, 221, 323, 337–362). Of these, 24 were observational studies and five were modelling studies. A total of 24 such studies reported an association between restrictions on gatherings and the suppression of SARS-CoV-2 transmission. The magnitude of effects associated with the restrictions were generally proportional to the stringency of such measures.

7.2.1 Justifications and summary of considerations of GDG members

The GDG decision for conditional recommendation for restrictions on gathering was supported by very low certainty evidence and the probable positive balance between desirable and undesirable health effects of the intervention. Members discussed the way of influenza virus transmission and agreed that measures that reduce person-to-person close contact such as in crowded areas could potentially reduce the community transmission of influenza. The members debated the implications on equity and human rights and valued as variable; they noted that restrictions on gatherings should serve a strictly necessary public health purpose, be

implemented in accordance with the law and principles of non-discrimination and be subject to regular review to minimize interference with other human rights. Members recognized that resource implications, values and preference and acceptability may vary. The GDG felt that there might be financial losses associated with restrictions on gatherings both for governments and individuals, but this could probably be acceptable if justified on scientific evidence and implemented for a short period of time. The GDG valued restriction of gatherings as feasible though with some variation across settings.

Certainty of the evidence

Overall, there is very low certainty evidence on whether avoiding crowding by restricting mass gatherings and encouraging physical distancing can reduce influenza virus transmission. Four studies estimated the effectiveness of restricting gathering on influenza transmission, with all reporting a beneficial effect. Twenty-nine studies estimated the effect of restricting gatherings on SARS-CoV-2 transmission, with 24 reporting a beneficial effect. Despite only very low certainty evidence of effectiveness with regard to influenza, the timely and sustained application of restrictions on mass gatherings and promotion of physical distancing may reduce influenza virus transmission.

Values and preferences

There is uncertainty and variability in the importance that populations assign to restrictions on gatherings to reduce influenza transmission. For example, one survey in Thailand reported that 54% of respondents believed that avoiding gatherings of five or more people could reduce the spread of diseases during an outbreak (363). Surveys conducted in the United Kingdom and the Netherlands (Kingdom of the) also showed a similar result with around half of all respondents believing that this intervention would reduce the risk of becoming infected with influenza (193, 364). Perceptions of the expected outcomes of measures such as restrictions on gatherings and physical distancing also appear to differ among different groups. Some participants in another survey in the USA approved of avoiding religious activities if this could reduce influenza transmission, while others believed that avoiding such gatherings might prevent them from receiving support from their religious community (for example, by worshipping and praying together) during a crisis (365).

Balance of benefits and harms

Although restrictions on mass gatherings and measures to encourage or enforce physical distancing, in combination with other social measures, may reduce influenza transmission, there is no conclusive evidence of their effectiveness (366). Modification, postponement or cancellation of mass gatherings may also have cultural or religious implications, and may incur considerable costs (250, 365).

Resource implications

The financial fragility of some religious organizations was a concern, and mandatory closure may be seen as a financial hardship for many institutions (365). The GDG also felt that governments might face legal liabilities for financial losses associated with restrictions on gatherings.

Equity and human rights

Restrictions on gatherings should serve a strictly necessary public health purpose, be implemented in accordance with the law and principles of non-discrimination, and be subject to regular review to minimize interference with the rights to freedom of peaceful assembly, association, religion and expression, and to avoid any interference with democratic electoral processes (365). Where restrictions on gatherings are introduced, rights to information, freedom of expression and association online should be guaranteed (367). Gatherings can be a source of information during influenza pandemics, which can comfort people and reduce fear. The cancelling of religious gatherings also has implications for the right to practise one's religion. While it may not be possible to cancel some events (for example, the Hajj), such measures can be implemented when the impact of disease transmission greatly outweighs the social impact of cancellations. During the first year of the COVID-19 pandemic, the government of Saudi Arabia announced very stringent restrictions on the total number of pilgrims attending the Hajj, with zero COVID-19-positive tests subsequently reported among those allowed to attend (368).

Acceptability

Public acceptance of restrictions on gatherings will likely depend on the type and importance of the gathering (243). In one survey conducted in Australia in 2007, 94.2% of respondents reported being willing to avoid public events (314), while a polling study in five countries (Argentina, Japan, Mexico, United Kingdom and the USA) in 2010 found that 11–69% of respondents would prefer to avoid places where many people gather (for example, shopping centres or sports venues) during a pandemic (369). However, some people might oppose the mandatory cancellation of religious gatherings during a pandemic (365). During a WHO consultation on the response to influenza A(H1N1)pdm09, most reporting countries stated that they had not instituted restrictions on gatherings and were taking a wait-and-see approach for any upcoming events (370).

Feasibility

These measures are likely to be feasible in the community. However, not all settings may have the infrastructural capacity to physically separate event attendees by a specified distance.

7.2.2 Knowledge gaps

- Although restricting gatherings and increasing physical distancing may be effective in reducing influenza transmission, it remains difficult to disaggregate their independent effects from those of other PHSM implemented in parallel.
- Significant gaps remain in the understanding of human-to-human transmission dynamics and related behavioural insights.
- Studies are needed to assess the role of gatherings in influenza transmission in the community.

7.2.3 Implementation considerations

- Decision-making process for holding, modifying, postponing or cancelling gatherings during influenza epidemics and pandemics should be risk-based, with an emphasis placed on risk assessment, risk mitigation and risk communication. Risk assessment should involve all relevant stakeholders, including national and local health authorities, as well as event organizers.
- In the decision-making process, aspects such as indoor versus outdoor gatherings, types of activity (for example, singing), timing of the intervention (early in the pandemic versus late) and prevalence of the infection should be taken into account.

- Strategies to reduce risk during gatherings (for example, limitations on the size of gatherings, pre-event testing and mask wearing) should be considered based on pandemic severity, the potential for influenza transmission in these settings and the desired transmission-related outcomes.
- There is a risk that very stringent restrictions could push gatherings underground, as was seen during the COVID-19 pandemic, which may undermine efforts to reduce virus transmission.

7.3 School measures and closures

Conditional recommendation for – very low certainty evidence

To reduce the transmission of influenza viruses in the community, WHO suggests that:

- the implementation of one or more school measures be considered as sustainable alternatives to full school closure during influenza epidemics and pandemics; and
- coordinated proactive school closure be considered during influenza epidemics and pandemics of high or extraordinary severity.

Remarks

- School-age children are particularly important in influenza virus transmission in the community, with attack rates typically highest in this age group during epidemics and pandemics.
- School measures to reduce influenza transmission vary from relatively straightforward interventions (such as increasing the distance between desks) to far more drastic and stringent interventions (such as completely closing schools). Examples of school measures include exclusion policies for ill children, reducing mixing between classes, staggering of recesses and/or lunch breaks, mask wearing, frequent testing, and closure of individual classes or schools triggered by a defined number of cases.
- In principle, the above recommendation refers to all levels of education, from early childhood care and education centres to primary and secondary schools. However, the effect of school measures and closures in reducing the transmission of different influenza subtypes and other respiratory viruses may vary according to the impact of the disease on school-age children and their role in disease transmission.

Summary of evidence

No studies examining the effect of school measures on influenza virus transmission were identified during the current systematic review. For school closures, a previous systematic review of 79 epidemiological studies had suggested that this intervention could reduce the transmission of seasonal and pandemic influenza among schoolchildren. However, due to the heterogeneity of the data, the optimum strategy (such as length of closure, and whether it should be reactive or proactive) remained unclear (60). The current systematic review updated the previous review by identifying 126 additional epidemiological studies that met the inclusion criteria, giving a total evidence base of 205 studies, of which 116 had examined the effectiveness of school closures on influenza virus transmission, 85 on SARS-CoV-2 transmission and four on multiple respiratory virus transmission.

The effectiveness of proactive school closures in reducing influenza virus transmission in schools and the community was estimated in 26 studies. For example, one study investigated the effect of school closures in Switzerland during the 1918 Spanish influenza pandemic and noted reduced epidemic growth in those regions that had implemented this measure (371), while two recent studies in Hong Kong SAR, China observed reduced cumulative incidence (59) and reduced R_t of influenza in the community (59, 372). Other studies conducted during the COVID-19 pandemic found that school closures implemented during the first year of the pandemic were

associated with greatly reduced or eliminated local seasonal influenza epidemic peaks that then rebounded following school reopening (373).

A second group of studies investigated reactive school closures (374–389), with several reporting a reduction in the number of confirmed or ILI cases (374–380). One study showed a reduction in the total number of cases of 32.7% (381), while another observational study indicated a reduction of 24% in the peak of the influenza epidemic curve during a 4-day closure, and a reduction of 8% in the total number of infected students (382). However, two observational studies in China reported no significant difference in total attack rate between the control group (school closure not implemented) and intervention group (school closure) (383, 384). Another study reported low rates of ILI consultations and confirmed cases of influenza in schools and child care centres after schools were closed in response to the COVID-19 pandemic in China, Hong Kong SAR (390).

Of 32 studies in which the school closure was a planned holiday, eight reported that such holidays could reduce influenza transmission (391–398). Two studies in Belgium and the Netherlands (Kingdom of the) suggested that school holidays delayed the epidemic peak by more than 1 week, and reduced the peak incidence by 4–27% (399, 400). One study from the USA indicated that school absenteeism following a planned vacation was approximately 6% lower than pre-vacation levels (401), while another reported no difference between schools that closed and those that did not with regard to post-break pupil absenteeism (402). A study conducted in the Republic of Korea, compared changes in R_t during the 2013–2014 to 2015–2016 influenza seasons and reported a decrease in R_t from 1.13–1.40 before school closures to 0.92–0.90 during school closures, with R_t rebounding to 0.96–1.10 after 2 weeks of school closure, corresponding to an overall 27–36% reduction in transmission during the spring breaks (403). A more recent study in the Republic of Korea examined the effect of school closure on the transmission of seasonal influenza in the community and observed reduced R_t for influenza during such closures (403), while another study in Australia observed a reduced number of confirmed cases in children when extended school holidays were implemented in response to the COVID-19 pandemic, compared with previous seasons (404).

Relevant evidence from the COVID-19 pandemic

The systematic review identified ten studies that assessed the effectiveness of school measures in controlling SARS-CoV-2, one of which was an RCT estimating the effect of daily testing of school-based close contacts for 7 days compared to a standard 10-day self-quarantine. The study concluded that daily testing was non-inferior to self-quarantine in this setting (405). Five studies suggested that despite high community transmission, secondary transmission in schools that implemented control measures remained relatively low and stable (406–410). Two observational studies suggested that in the absence of school measures (such as mask wearing and physical distancing) SARS-CoV-2 infection rates were significantly higher (411, 412). Physical distancing and face mask wearing were assessed in seven of the above studies, with the effectiveness of these two measures investigated in combination with other PHSM in all but two of the studies (410, 412).

Eighty-five studies examined the effects of school closures on SARS-CoV-2 transmission, including 76 studies on proactive closures, seven on planned holidays and two outbreak reports. Although several of the studies noted a clear decline in case numbers during seasonal epidemics of other respiratory viruses (for example, RSV) and, in some cases, the complete elimination of such epidemics during school closures triggered by the COVID-19 pandemic (373), the effect of school closures on SARS-CoV-2 transmission varied. More than half of the studies reviewed ($n = 57$) found that school closure could be effective in reducing SARS-CoV-2 transmission,

epidemic size, incidence rates, and subsequent morbidity and mortality, while most of the other studies ($n = 28$) did not find a statistically significant association between school closure and SARS-CoV-2 transmission, or did not observe any changes in the trajectory of SARS-CoV-2 transmission in the community (413). One study found a *positive* association between school closure and infection rates (337) while another found that school closures were only effective when stringent contact tracing was also implemented (218). As school measures and school closures are rarely implemented in the absence of other PHSM, their effectiveness in reducing the transmission of respiratory viruses cannot always be disaggregated.

7.3.1 Justifications and summary of considerations of GDG members

The GDG decision for conditional recommendation for school measures and closures was supported by very low certainty evidence and the probable positive balance between desirable and undesirable health effects of the intervention. GDG agreed that the effect of school measures and closures in reducing the transmission of different influenza subtypes and other respiratory viruses may vary according to the impact of the disease on school-age children and their role in disease transmission. The members debated the implications on equity and human rights and valued as uncertain since the right to education would need to be balance against the right to health. However, the members recognized that school closures raise major human rights issues for children, their families and communities and may exacerbate existing inequalities. Members agreed that resource implications, values and preference and acceptability as well as the feasibility may vary. The GDG thought that the implementation of one or more school measures be sustainable alternatives to full school closure to minimize the impact on child's education, development and well-being.

Certainty of the evidence

Overall, there is very low certainty evidence with regard to school measures and closures, with published studies reporting or predicting small to moderate effects on reducing influenza virus transmission. Proactive closures and planned school holidays were associated with a moderate impact on influenza transmission, while the observed impact of reactive school closures was generally limited. Improved effectiveness of school closure was seen when the measure was combined with other interventions.

Values and preferences

School closures and class dismissals due to outbreaks of infectious disease have been implemented in many locations before the COVID-19 pandemic as important measures in controlling diseases common in children, such as hand, foot, and mouth disease, measles, and less commonly respiratory virus infections such as influenza (414). Little variability was observed in the importance that populations assign to school closures – for example, in one survey in the USA, 92% of caregivers and 89% of teachers reported the belief that school closures were somewhat effective in reducing influenza cases among school-age children (414). However, the prolonged school closures and class dismissals implemented during the COVID-19 pandemic have influenced parental acceptance and preferences with regard to such measures as they had to balance their child's education, development and well-being against their need to work and provide for their family (415).

Balance of benefits and harms

School closures can reduce influenza transmission in the community, but their timing and duration are critical, and mistimed closures could lack impact. At the same time, closures could have major impacts on the rights of children to education, safety, well-being and nutrition, especially in lower-income families (416). During the COVID-19 pandemic, reduced learning and increased obesity and anxiety among pupils were associated with school closures (417). In addition, parents who have to miss work to take care of children can suffer a loss of income (243), with the loss of access to free school meals being another potential concern for low-income families (418). However, school measures not involving full closure can reduce influenza transmission by decreasing student population density and contact rates among students, with only mild to moderate disruption to schools and communities.

Resource implications

In one systematic review, school closure was been found to be potentially not cost-effective (419). One of the papers included in this review suggested that the cost of proactive school closures in the United Kingdom are significant at 0.2–1.2 billion pounds per week, equating to 0.2–1.2% of gross domestic product (GDP), with similar results found in Australia (243). Proactive closure in the USA for 4 weeks has been estimated to cost 10–47 billion US\$ (420). Similarly, another study in the USA estimated a US\$ 21 billion loss for an 8-week period of reactive school closure (421). One simulation study predicted that school closures could reduce influenza transmission but at an increased cost to society (422). While school measures are expected to be less resource intensive, there are likely to be additional resources required to support measures such as a move to partial or full e-schooling.

Equity and human rights

School closures raise major human rights issues for children, their families and communities (243, 418) and exacerbate existing inequalities. They therefore need to be carefully considered in terms of public health necessity, proportionality and equality and non-discrimination. The right of children to education could be jeopardized if they miss important class work or exams, and do not have alternative learning strategies (70), or do not return to school afterwards. Where schools are closed, accessible and suitably adapted online learning, as well as improved access to the internet and specialized TV and radio broadcasts, may support continued learning (226) – though inequitable access to such resources may increase educational inequalities. School closures also increase the risks of domestic, sexual and gender-based violence for children, child labour and trafficking, and child marriage, and may affect other rights, including the rights to food and to mental health (423).

School closures can also have a substantial societal impact because they may require parents to make other arrangements for childcare or supervision, which may be challenging for some families, especially if closures are prolonged. Social inequities can also be exacerbated when schools are closed as children from lower-income families may receive subsidized free food at school (418). Moreover, media reporting of school closures may increase pandemic-related fears and concerns among the local community (70, 424). Extensions of school holidays might have unintended knock-on effects such as an increase in travel and social gatherings, leading to increased mixing in the community and temporary reductions in available workers in essential services. School measures may not be as stringent as closures but are still associated with considerations such as accessibility to face masks or rapid tests, particularly if these must be funded out of pocket.

Acceptability

Before the COVID-19 pandemic, two studies in the USA and Australia suggested that most families (> 90%) agreed with the implementation of school closures as a potential intervention to reduce influenza transmission (314, 425). To accommodate the closure period, the school may be required to extend the school year or offer alternative learning programmes (for example, online learning) and this may require extensive discussions with local authorities given the extra costs that may be incurred in extending the school year. There are also practical difficulties for policy-makers in communicating at different levels (national to local, with school staff and parents) the risks and need to implement such measures, particularly in situations where the degree of uncertainty and risk assessments may change rapidly (426, 427). Such measures will probably only be acceptable to most stakeholders when the benefits clearly outweigh the negative consequences. During the COVID-19 pandemic, especially at the beginning, the acceptability of school closures and school measures among policy-makers was high and school closures were implemented in more than 190 countries (428). However, the receptiveness of governments and populations to these measures became more nuanced as evidence of the moderate effectiveness of school closures in reducing SARS-CoV-2 transmission emerged later in the pandemic (424).

Feasibility

The feasibility of school closures may vary according to location, education system, and the resources available to schools and teachers. Reactive school closures, rather than proactive school closures, are often implemented for operational reasons (426). However, proactive school closures have been implemented during seasonal epidemics in some locations (426). Although school closures are most effective when children stay at home rather than engage in extracurricular activities, this may be difficult to regulate (429, 430). Around 61% of national pandemic influenza preparedness implementation plans include recommendations on school closures but these often lack detail (157). There may also be considerable variations in social structures and legal frameworks relating to school closures in different countries (431, 432). The GDG noted that a class dismissal intervention could include a provision for children of low-income families or essential workers to attend school, and that this could be a more flexible measure than complete school closure.

7.3.2 Knowledge gaps

- Despite evidence that school closures may reduce influenza transmission in the community, this intervention can place a huge burden on children and their families, especially if implemented for a prolonged period. Further research on the optimal timing and duration of school closures to reduce influenza transmission in the community is needed to ensure that such closures are timely and implemented for the shortest possible period to minimize any negative impacts on children's education.
- There is insufficient evidence on the effectiveness of school measures in reducing interpersonal contact and influenza transmission among children and staff (such as exclusion policies for ill children, increased desk spacing, and staggered recess or lunch breaks). Studies on the effectiveness of such measures in reducing influenza transmission, as well as their effectiveness relative to school closures, may support the judicious use of school measures and closures during influenza epidemics and pandemics.

- Differences in adherence to school measures between individuals of different socioeconomic status, and the impact of such differences, remain uncertain and need to be investigated.

7.3.3 Implementation considerations

- Policy-makers should consider the implementation of one or more school measures as sustainable alternatives to school closure. The aim of such an approach would be to minimize negative impacts on child protection, education, nutrition and mental health. The negative effects of school measures on children and society are unknown but are unlikely to be of the same order of magnitude as school closures.
- Due to the potential negative impact of school closures, their implementation should be carefully considered by weighing up their expected beneficial impact on the epidemic or pandemic against their unintended consequences on children and the wider community. In this regard, sufficient consideration should also be given to the implementation of strategies to mitigate the negative effects of school closures on children, families and the community.
- When implemented during a pandemic, school closures should be guided by the most recent knowledge on the emerged virus and on the local epidemiological situation in order to limit the implementation period.

7.4 Stay-at-home provisions

Conditional recommendation against – low certainty evidence

WHO suggests against stay-at-home provisions (including recommendations or orders) to reduce the transmission of influenza viruses in the community during influenza epidemics and pandemics.

Remarks

- The timing of stay-at-home provisions can influence the effectiveness of the measure.
- Stay-at-home provisions that are implemented during specified intervals should only be considered during influenza epidemics and pandemics of high or extraordinary severity.
- Complete restriction of movement of populations can aid national or regional efforts to reduce community transmission of respiratory diseases, as well as contain the spread of the disease when implemented early in an outbreak (433).
- Movement restrictions of various levels of stringency were widely used during the global response to the COVID-19 pandemic (434).

Summary of evidence

All studies included in the systematic review were conducted during or after 2020. Two studies assessed the effectiveness of stay-at-home provisions in reducing influenza transmission and one on detection rates of acute respiratory infections. One population-based study used an interrupted time-series analysis (435) and found that the seasonally adjusted incidence rate ratio of seasonal influenza in Northern California after the implementation of shelter-in-place policies in 2020 compared with previous influenza seasons was 0.07 (95% CI = 0.02–0.33). Another study carried out in nine states in the USA observed weaker (and often null) associations between stay-at-home provisions and influenza A and B detections when the effect of the policy was considered alongside other PHSM put in place (436). One study on the effect of stay-at-home provisions on acute respiratory infections observed lower detection rates in American university campus cohorts in the 2020 spring semester (when numerous stay-at-home provisions were implemented) compared with the same period in 2019 (437).

Relevant evidence from the COVID-19 pandemic

The systematic review identified 38 observational and three modelling studies that had examined the effect of stay-at-home provisions in reducing SARS-CoV-2 transmission (338–340, 344, 347, 349, 350, 359, 362, 348–469). Of these, 36 studies observed reductions in SARS-CoV-2 transmission following such provisions, while five showed no association between the measure and SARS-CoV-2 transmission.

7.4.1 Justifications and summary of considerations of GDG members

The evidence identified was limited and rated of low certainty. The GDG judged the balance of health benefit and harms to probably favor no intervention. The members noted that stay-at-home provisions would likely be justifiable only during severe pandemics with high mortality rates and global spread. The members debated the implications on equity and human rights and valued as variable; the right to health would need to be balance against the right to

freedom of movement, gender-based violence, child protection and mental health impacts as well as support needs for persons with disabilities. The GDG discussed the resource implications and valued as variable; they noted that although the direct costs of implementing and enforcing stay-at-home provisions may be minimal, there would be significant resource implications in terms of revenue and income lost by businesses and individuals who rely on on-site work as their main source of income. The members debated the implications on values and preference and acceptability and recognized that these may vary and would depend on several factors, including the nature of the intervention, its stringency, and the impact on daily life. The members judged the feasibility of the intervention as variable; they noted that while stay-at-home provision could be feasible in certain settings it is likely to be highly resource intensive. The low certainty evidence together with these considerations caused the GDG to conclude with a conditional recommendation against stay-at-home provisions.

Certainty of the evidence

Overall, there is low certainty evidence on whether stay-at-home provisions can reduce the transmission of influenza viruses. During the COVID-19 pandemic, the majority of studies reported reductions in SARS-CoV-2 transmission following such provisions.

Values and preferences

There is uncertainty and variability in the importance that populations assign to stay-at-home provisions to reduce influenza transmission. Perceptions of the expected outcomes of stay-at-home provisions differ between different groups. One study of Australian survey data on public attitudes towards health initiatives during the COVID-19 pandemic revealed that around half of all respondents were equally concerned about the health impacts of the pandemic and its economic impact (470). The trade-offs between protecting public health and disruptions to daily and economic activities are often most acutely experienced by disadvantaged subpopulations in both developed and developing economies (471, 472).

Balance of benefits and harms

Stay-at-home provisions, in combination with other social measures, have the potential to reduce influenza transmission in the community, but there is limited evidence to determine the individual effects of such provisions. Severe restriction of mobility can impact individual physical and mental health (473, 474), and affect incomes and access to basic needs, including food, safety, shelter and health care, especially among disadvantaged groups (475–477). Therefore, both the short- and long-term impacts of these extreme measures on society's most vulnerable groups need to be balanced against the impacts of a pandemic on the entire population and its health-care system. As such, stay-at-home provisions will likely be justifiable only during severe pandemics with high mortality rates and global spread. Judicious consideration of the triggers and planned relaxation of such measures, accompanied by steps to protect disadvantaged populations, is warranted.

Resource implications

Although the direct costs of implementing and enforcing stay-at-home provisions may be minimal, there will be significant resource implications in terms of revenue and income lost by businesses and individuals who rely on on-site work as their main source of income. With regard to the COVID-19 pandemic, the European Central Bank noted that although the shock of the early

pandemic lockdowns to the global business environment was relatively short-lived, long-term “output scarring” of economies resulting from the loss of skills and, at times, permanent exit of workers from the labour market during lockdowns can affect post-pandemic labour input and by extension, future total economic output (477).

Equity and human rights

Stay-at-home provisions involve wide-ranging restrictions on human rights (including freedom of movement), interference with privacy and family life, and increased risks of gender-based, sexual and interpersonal violence, as well as violence against children. They may also affect the rights to physical and mental health (473, 474), the right to work, and the right to an adequate standard of living (including rights to food and housing), especially among disadvantaged groups. Such groups can include people with disabilities, older people, women, institutionalized populations, forcibly displaced people and those working in the informal sector (475–477). The short- and long-term impacts of stay-at-home provisions need to be balanced against the public health impact of a pandemic, including its impact on the health-care system. As such, stay-at-home provisions will likely be necessary and proportionate in only the most severe pandemics with high mortality rates and global spread. They should also be implemented in accordance with the law, and based on principles of equality and non-discrimination, subjected to regular review and accompanied by social protection mitigations, particularly for marginalized groups.

Acceptability

The acceptability of stay-at-home provisions among the public may depend on several factors, including individual characteristics (such as political orientation, health vulnerability and age), severity and stage of the pandemic (for example, the first waves of the pandemic versus the time when vaccines and treatment options become available), the precise nature of the provisions (including their communication to the public, duration, stringency and plans for relaxation) and their impact on daily life (478, 479). One study conducted in France noted that people were willing to accept most restrictions and constraints imposed during the first wave of the COVID-19 pandemic but resisted their extension (478).

Feasibility

Stay-at-home provisions were implemented in many settings during the COVID-19 pandemic. Such provisions are more likely to be feasible in jurisdictions where public trust in the authorities is high and justifications for the measures are clearly and effectively communicated to the public. Good practices include clear communication of the public health threat justifying such extreme measures, the envisaged duration of such measures and the criteria for their removal or reduction (479).

7.4.2 Knowledge gaps

- Major gaps remain in the understanding of human-to-human transmission dynamics during the implementation of stay-at-home provisions. These measures are likely to reduce transmission in the community but at a high social and economic cost. Large-scale RCTs are unlikely to be feasible.
- Cost-benefit studies are needed to help balance the public health gains of stay-at-home provisions against their significant socioeconomic impacts.

7.4.3 Implementation considerations

- There may be a gradation of stay-at-home provisions as part of a combination of PHSM, and due to their very high adverse socioeconomic impacts such measures will need to be considered only in the most extreme contexts, and implemented for the shortest possible duration.
- The negative and inequitable impacts of stay-at-home provisions, which particularly affect vulnerable and marginalized groups, may be reduced through social policies.
- Stay-at-home provisions may be more effective earlier in an epidemic or pandemic, and consideration should be given to their duration and gradual relaxation to avoid sudden increases in infections.
- In some countries, stay-at-home provisions may not be legally permitted.

7.5 Workplace measures and closures

Conditional recommendation for – very low certainty evidence

To reduce the transmission of influenza viruses in community, WHO suggests that:

- remote working from home be encouraged where feasible during influenza epidemics and pandemics; and
- proactive workplace closures be considered during influenza epidemics and pandemics of high or extraordinary severity.

Remarks

- Although workplaces can be the foci of influenza outbreaks among the working-age population, the associated levels of morbidity and mortality are relatively low in this population as they tend to experience less severe symptoms compared with school-age children and older adults. However, such outbreaks increase the risks of secondary transmission to family members under their care, many of whom will be school age or elderly.

Summary of evidence

The current systematic review identified three epidemiological studies (295, 480, 481) included in an earlier systematic review (482) of the effectiveness of workplace physical distancing measures as well as three additional studies (483–485). The three epidemiological studies had suggested that physical distancing in the workplace was associated with reductions in ILI or seroconversion to 2009 influenza A(H1N1). In addition, one quasi-cluster RCT in Japan showed that paid sick-leave policies in the workplace reduced the overall risk of influenza A (H1N1) by about 20% in one influenza season (295), with two further epidemiological studies conducted in the USA indicating that the provision of paid sick leave could help to decrease influenza-related absenteeism, thereby reducing transmission rates (480, 481). Workplace measures combined with other interventions (such as school closures, personal protection measures and antiviral drug use) showed greater effectiveness (245).

The current review also identified one ecological study into the role of PHSM including workplace closures in nine tropical Asian countries (486). In this study, seasonal influenza epidemics were either not observed or delayed following PHSM implementation. However, the authors did not find statistically significant associations between workplace closures and reduced influenza transmission.

Relevant evidence from the COVID-19 pandemic

Of 26 studies, identified in the systematic review, that investigated the association between workplace closures and SARS-CoV-2 transmission (including closure of non-essential business sectors) (216, 218, 221, 339, 340, 347, 349, 350, 357, 359, 362, 440, 452, 453, 466, 487–497), 23 reported small to moderate effectiveness in reducing community transmission. The effectiveness of workplace closures in reducing COVID-19 mortality varied, with some studies identifying small to moderate effects while others identified no association between workplace closures and COVID-19 deaths.

As workplace measures were often implemented in parallel with other PHSM, their effects are generally difficult to disaggregate. However, there is a consensus that other PHSM will enhance the effectiveness of workplace measures when implemented in concert.

7.5.1 Justifications and summary of considerations of GDG members

The GDG decision for conditional recommendation for workplace measures and closures was supported by very low certainty evidence and the probable positive balance between desirable and undesirable health effects of the intervention. The members judged workplace measures and closures to probably be in accordance with universal human rights, though the right to work would need to be balanced against the right to health. Workplace measures and closures may, however, exacerbate socioeconomic inequities since loss of income can lead to impoverishment and limited ability to pay for necessities. The members debated the resource implications, and they judged that workplace measures and closures might have significant adverse economic impacts on individuals and governments. Members recognized that values and preference and acceptability as well as the feasibility may vary. Overall, the GDG believed that mandated workplace closure is unlikely to be feasible in the long term. The GDG thought that work measures be sustainable alternatives to full work closure to minimize the impact on adverse effects on individuals, communities, the workforce and the economy. The GDG highlighted the need for policy-makers to implement social protection policies to mitigate the potential adverse effect of work measures.

Certainty of the evidence

Overall, there is very low certainty evidence that workplace measures and closures can reduce influenza transmission. Five observational studies and one RCT indicated that workplace measures such as working from home and paid sick leave can reduce influenza transmission in the workplace. One observational study reported no significant benefit of workplace closures in reducing influenza transmission. Eight of nine observational studies that had estimated the effectiveness of workplace measures in reducing SARS-CoV-2 transmission found beneficial effects. Of the 26 observational studies that had estimated the effectiveness of workplace closures in reducing SARS-CoV-2 transmission, 23 reported benefits when such closures were implemented in combination with other PHSM.

Values and preferences

There is both uncertainty and variability in the reported importance that populations assign to workplace measures to reduce influenza transmission, with responses varying among subpopulations with different employment and socioeconomic circumstances. One study in the Netherlands (Kingdom of the) reported that 30% of respondents believed that staying home from work is an efficacious means of reducing influenza transmission (364). However, in another study, 93% of New York State, USA residents believed that staying home is effective in preventing influenza transmission (498). Another study in the USA showed that 28% of employed respondents reported that they might lose their jobs or businesses as a result of having to stay home from work for 7–10 days in the event of an influenza pandemic (246). This would also cause severe personal economic difficulties among some members of the community – though less so for those who received pay while they worked remotely (246).

Only limited studies have been conducted into the values and perceptions among the population regarding the potential consequences of workplace closures. One study indicated

that large-scale workplace closures might raise concerns among the public in relation to the potential economic and financial consequences (365). Despite the limited evidence, it may be reasonable to expect increased levels of distress among both employers and employees in the event of workplace closures due to the potentially severe operational and financial impacts (499).

Balance of benefits and harms

Workplace measures could potentially reduce transmission by about 20–30%, based on the included studies. A review illustrated that telecommuting without pay would be inequitable, and would impact particularly on self-employed people or low-income families, because they have a higher risk of suffering from severe financial problems as a result of workplace measures (243). Large-scale workplace closures are likely to have substantial economic consequences. However, implementations of workplace and school closures may avoid some of the downsides of both measures, including the need for some working parents to make other child care arrangements.

Resource implications

The GDG judged that workplace measures and closures might have significant adverse economic impacts on individuals and governments. Telecommuting was found to be modestly effective in reducing influenza transmission, but also likely to be economically disruptive (243). The most costly strategy considered in one simulation study was continuous school closure together with continuous 50% workplace non-attendance; this scenario led to both the highest overall cost (US\$ 103 million) and highest cost per prevented case (US\$ 9894 per case) (500). Full workplace closures will also be economically disruptive (243) and the cost of such closures for any length of time will unavoidably have significant economic and other consequences, some of which (such as loss of trained workers) may not be easily recoverable once the measure is lifted (250).

Equity and human rights

Workplace measures and closures can affect the rights to work, food, housing, social security and health, particularly in the absence of measures to protect jobs and income. Those working in the informal economy, where women, minorities and migrant workers are disproportionately represented, may be particularly affected if government social security schemes related to workplace closures do not extend to informal sector workers (501). This may then result in people continuing to work even when unwell, with both individual and public health risks (502). One survey in the USA found that self-employed individuals and those unable to work from home might not be able to comply with recommended workplace measures due to employment insecurity and financial pressures (246). Workplace closures may also limit the ability of inspectorates to monitor places of detention and care homes (503) while access to justice may be affected if courts are not able to convene. Human rights and socioeconomic equity concerns may be exacerbated by workplace closures due to the lack of income leading to impoverishment and limited ability to pay for necessities (such as food, health care and rent) among lower-income individuals and families.

Acceptability

Workplace measures may be acceptable if they are well planned and implemented in selected workplaces. However, most stakeholders are unlikely to find workplace closures acceptable. In addition, isolated and quarantined individuals should be given the opportunity to telework. However, teleworking is not feasible for everyone, including those that lack access to technology,

or for jobs that require hands-on work. Employees may be more willing to accept workplace closures if there is no anxiety regarding their job security and income (250). It is considered likely that employers and national authorities will tend to resist workplace closures due to their high operational costs.

Feasibility

Remote work, paid-leave policies and staggered-shift measures are unlikely to be feasible in many circumstances. Workplace closures are also likely to raise significant feasibility issues, for example where companies provide essential services to the community or facilitate off-site working, and thus cannot be closed. Overall, the GDG believed that mandated workplace closure is unlikely to be feasible in the long term. However, it might be considered in the short to medium term to mitigate the impacts of community transmission during a pandemic. Planning for such a scenario could allow businesses and financial markets to anticipate and prepare for potential disruptions and mitigation measures.

7.5.2 Knowledge gaps

- The systematic review identified some evidence on the effectiveness of workplace measures and closures on influenza transmission. However, measures such as providing segregated working areas for people with mild symptoms have not been studied in depth. More research on the role of the workplace in the transmission of epidemic or pandemic influenza viruses is needed.
- More research is needed on the optimal triggers, timing and duration of workplace closures in order to maximize the impact of this highly disruptive intervention.
- There is a need for a comprehensive review of the ethical issues associated with workplace measures, and for comparisons of the benefits and costs of implementing these measures.
- Studies are also needed on the feasibility of implementation of workplace measures, and the potential socioeconomic impacts on individuals and communities.

7.5.3 Implementation considerations

- When remote working is not feasible, other workplace measures (such as staggering shifts and/or mask wearing) or reactive closures can be considered, with gradation of interventions based on pandemic severity.
- In certain circumstances, workplace measures and closures may exacerbate socioeconomic inequities since loss of income can lead to impoverishment and limited ability to pay for necessities. Consideration should be given to mitigating these and other adverse effects on individuals, communities, the workforce and the economy through the implementation of social policies.
- When considering measures and closures, workplaces might usefully be sub-grouped – for example, into those that may not need to remain open for society to function and those that may have to remain open (such as health care facilities and food shops).

8. Travel-related measures

8.1 Entry and exit screening at points of entry

Strong recommendation against – very low certainty evidence

WHO recommends against syndromic entry and exit screening at points of entry to reduce the transmission of influenza viruses in the community during influenza epidemics and pandemics.

Remarks

- In this guideline, entry and exit screening at points of entry specifically refers to syndromic screening for influenza using one or more methods, such as temperature check, observation and health declaration forms. Although test-based screening methods were also reviewed and discussed by the GDG, the above recommendation only relates to syndromic screening.
- Fever and other symptom screening is not sufficiently sensitive (meaning that infected people will enter the community), and also has poor specificity (meaning that symptomatic individuals not infected with influenza may overwhelm the health system).

Summary of evidence

Four observational studies, two modelling studies and one simulation study included in this review assessed the effectiveness of syndromic entry and exit screening in reducing influenza transmission (398, 504–509). Observational studies conducted at two airports in New Zealand and one in Japan estimated that the sensitivity of entry screening was low (504–506). Another observational study conducted in China during the 2009 H1N1 influenza pandemic found that among arriving international travellers, half of all influenza cases were identified more than a day after arrival (through passive case finding and contact tracing in the community) even though 37% of these cases had been screened while passing through the border entry site (air, sea or land) (398). The two modelling studies estimated that entry screening of international travelers may help to delay local transmission by 1–2 weeks (507, 508). No published studies on the effect of exit screening on influenza transmission were identified.

Relevant evidence from the COVID-19 pandemic

The review identified six studies that assessed the effectiveness of entry and/or exit screening in reducing SARS-CoV-2 transmission (510–515). One observational study assessing symptom

screening on entering the USA from selected high-risk countries between January and September 2020 indicated that this yielded only a very low number of COVID-19 cases (515). Two modelling studies assessed the time to outbreak (512, 513). One of these studies estimated that entry screening alone would delay an outbreak by 2.7 days (from 45 days to 47.7 days to reach 1000 cases) while the other estimated that entry and exit screening, combined with traveller sensitization, could delay an epidemic by up to 8 days (512, 513).

During the COVID-19 pandemic, pre-travel tests were widely implemented and the remaining studies assessed the effectiveness of such test-based screening methods. One study determined that a single test was most effective when carried out 1–2 days before arrival, reducing the risk of SARS-CoV-2 introduction to destination location by 29–53% and 29–51% respectively (511). Another study found that a pre-travel PCR test carried out 2 days before arrival could reduce the number of missed infected individuals reaching the destination to 32.8% of all cases – falling to 20.8% of all cases when the test was performed on the day of travel. The addition of a PCR test upon entry to a pre-travel test had a smaller effect, further reducing the missed infected travellers to 15.2% (510).

8.1.1 Justifications and summary of considerations of GDG members

There was very low certainty evidence and the balance of health benefits did not favor the intervention or the comparison. The GDG considered the asymptomatic period of influenza infections and the low sensitivity and specificity of screening methods and agreed that the effectiveness of syndromic screening of travellers is likely to be very limited for influenza. The GDG discussed the financial and economic considerations and found to be in favor of no intervention; they noted that substantial human and economic resources would be needed to implement syndromic entry and exit screening at points of entry as well as for follow up action which could be rather used to support other critical response actions. The GDG judged the intervention to be probably in accordance with universal human rights standards but expressed concerns related to the respect of privacy of travellers. The members valued values and preferences and acceptability of syndromic screening to be uncertain. They thought feasibility to probably favor the intervention. The very low certainty evidence together with these considerations caused the GDG to conclude with a strong recommendation against entry and exit screening at points of entry.

Certainty of the evidence

Overall, there is very low certainty evidence that syndromic entry screening at point of entry can delay the introduction of infection into a country. Four observational and two modelling studies assessed the effect of syndromic screening at point of entry, including temperature screening and health declarations, to reduce influenza transmission, all of which were ineffective. One study found that syndromic screening to reduce SARS-CoV-2 transmission was also ineffective. There was no evidence found for exit screening.

Values and preferences

Values and preferences related to syndromic screening are uncertain. The sensitivity of syndromic screening will have an impact on the effectiveness of traveller screening at points of entry and exit. Screening measures used have included health declarations, visual observations and thermography to detect disease symptoms (516). One of the major criteria for screening travellers for influenza is fever, with screening sensitivity largely reliant upon detecting fever using the available instruments. Infrared thermometers are used at some borders due to their

instantaneous and non-invasive nature. One study conducted in Japan during the 2009 H1N1 influenza pandemic reported that the sensitivity of infrared thermometers was 50.8–70.4% and their specificity 63.6–81.7% (517). Another study conducted in New Zealand reported that the sensitivity of infrared thermal image scanners was 84–86% and their specificity 31–71% (518). It is possible that some travellers with fever might opt to take antipyretics to reduce their symptoms before travel and thus avoid detection by thermal scanners or thermometers.

Balance of benefits and harms

No literature on the harm of syndromic screening of travellers was identified. As influenza cases may remain asymptomatic for several days (up to 2 days for seasonal influenza) (398), symptom presentation varies and screening methods are imperfect (519), traveller screening for symptoms of influenza virus infection is associated with major limitations in preventing the introduction of influenza into a location or reducing the overall attack rate and duration of an epidemic (506). The GDG considered the asymptomatic period of influenza infections and the low sensitivity and specificity of screening methods, and agreed that the effectiveness of syndromic screening of travellers is likely to be very limited for influenza.

Resource implications

Substantial public health resources would be required, including adequate numbers of trained staff, screening devices and adequate infrastructure to conduct effective traveller screening (506). These resources are often diverted from other critical response actions such as outbreak investigation. Follow-up actions for those screening positive can also incur costs in terms of laboratory resources for confirmation and further treatment. In addition, where syndromic screening methods have poor specificity, the number of uninfected individuals wrongly screening positive could overwhelm the health system.

Equity and human rights

All screening needs to be carefully designed and implemented to respect the dignity and privacy of travellers (520). To the extent possible, when implementing syndromic screening, authorities should consider seeking the prior and informed consent of travellers. Where informed consent is not possible or advisable, then information on what data will be used, how and by whom should be provided.

Acceptability

Infrared thermometers continue to be used in some points of entry to screen travellers, and is generally accepted by policy-makers as a “visible” public health measure. Exit screening was not implemented in the 2009 H1N1 influenza pandemic, and its acceptability in preventing or delaying the introduction of influenza at the destination site is uncertain.

Feasibility

Syndromic entry screening is used in some points of entry and has been shown to be feasible.

8.1.2 Knowledge gaps

- There are no high-quality studies on the effectiveness of entry screening in preventing the importation of influenza infections and reducing influenza transmission, and no evidence at all on exit screening. Quantitative studies evaluating the implementation of screening programmes at different times, in different combinations and for different pathogens are required to estimate the potential value of screening in preventing the importation or exportation of cases and the seeding of epidemics in the population.

8.1.3 Implementation considerations

- Some locations routinely monitor the temperature of incoming travellers in an effort to identify those with symptoms of Ebola disease, Middle East respiratory syndrome or other emerging infectious disease. The above recommendation only applies to influenza epidemics and pandemics.
- Whenever entry and exit screening is implemented, policy-makers should consider allocating additional resources for the follow-up of detected cases or their referral to health-care services or quarantine arrangements as needed.
- To improve screening outcomes, some countries may consider using rapid tests before exit or at arrival – however, high test sensitivity and specificity would be an important requirement. Moreover, rapid tests may not pick up individuals during the incubation period.

8.2 Travel advice

Strong recommendation for – very low certainty evidence

WHO recommends that travel advice be used to inform individuals of the risk of infection and of the measures that can be taken to protect themselves against potential exposure to influenza viruses during influenza epidemics and pandemics.

Summary of evidence

The review identified one study that measured the effect of travel advice on the impact of seasonal influenza across nine countries in Asia (486). This study estimated that for each step increase from advice only to restrictions on internal movements (that is, from no measures, to recommending not to travel domestically in limited geographical areas, to recommending not to travel domestically nationally, to restrictions on internal movements in limited geographical areas and to restrictions on internal movements nationally), the average proportion of respiratory specimens that were positive for influenza virus decreased by 41% (relative proportion ratio = 0.59; 95% CI = 0.36–0.96).

Relevant evidence from the COVID-19 pandemic

The review identified one simulation study conducted during the COVID-19 pandemic in 17 countries and 23 states in the USA. It was estimated that a recommendation not to travel between cities/regions reduced the weekly growth rate of COVID-19 by around 26% (361).

8.2.1 Justifications and summary of considerations of GDG members

The GDG decision for strong recommendation for travel advice was supported by very low certainty evidence and the balance between health benefits and harms favoring the intervention. The members judged travel advice to be in accordance with universal human right for health and information. The GDG discussed the resource implications and valued as variable; they noted that an economic impact may be associated to the intervention but likely to be cost-effective. The members agreed that travel advice would probably be acceptable for the key stakeholders, including general public, local authorities, governments, national and international travel industry. The GDG considered providing travel advice to be feasible given the absence of any reported feasibility issues to date.

Certainty of the evidence

Overall, there is very low certainty evidence for the effectiveness of travel advice in reducing the impact of influenza or SARS-CoV-2. It is difficult to separate out the role or contribution of travel advice from those of other PHSM implemented at the same time. However, it remains a key recommendation in influenza epidemics and pandemics due to its effectiveness in making people aware of health risks and potentially protective behaviours. There is a lack of evidence on the optimal timing of travel advice in order to achieve the greatest impact.

Values and preferences

Values and preferences related to travel advice are uncertain. Travel advice helps the public make informed decisions when travelling, and offers an objective assessment of the risks involved in travelling during an epidemic or pandemic (521). Travel advice increases the awareness of travellers regarding health risks during travel in affected areas. Moreover, travellers who learn from travel advice that they have recently been in an affected area unknowingly, and who start to present relevant symptoms, can immediately seek medical attention based on this information.

Balance of benefits and harms

Travel advice can potentially reduce the exposure of travellers to influenza viruses and limit their spread by deterring travel to regions affected by epidemics or pandemics (522). However, travel advice that recommends public avoidance of travel or trade may have financial consequences for the local and global economy (520).

Resource implications

The resource implications of providing travel advice are uncertain but will depend on the approach and media used to disseminate such advice.

Equity and human rights

The provision of travel advice accords with the right to freedom of expression, including the right to receive information to protect health. Such advice should be evidence based and communicated transparently to the population. Careful consideration should be given to implementing strategies to maintain public trust and increase adherence to travel advice (520).

Acceptability

Public health authorities have generally included public awareness campaigns as part of their ongoing strategy to increase awareness among travellers of infectious disease risks, including influenza. The GDG considered that significant issues regarding the acceptability of travel advice were unlikely, but the potential economic consequences should be considered.

Feasibility

National health authorities routinely provide travel advice on infectious diseases such as dengue, malaria and Middle East respiratory syndrome, and did so in the early stages of the 2009 H1N1 influenza pandemic. The GDG considered that providing information to travellers is feasible given the absence of any reported feasibility issues to date.

8.2.2 Knowledge gaps

- Evidence of the effectiveness of travel advice in reducing influenza transmission remains limited and more studies are needed.
- Studies of the drivers and determinants of adherence (or non-adherence) to travel advice would be useful for improving the effectiveness of such advice during influenza epidemics and pandemics.

8.2.3 Implementation considerations

- Health authorities are encouraged to provide health information and advice on potential health risks associated with travel to help people understand how best to avoid or minimize such risks, take appropriate preventive measures, and exercise necessary precautions before, during and after travel.
- In a frequently changing local and global epidemic or pandemic situation, a lack of up-to-date information can cause confusion or frustration for travellers, with associated concerns for adherence. Therefore, travel advice should be evidence based and regularly updated according to the most up-to-date epidemiological information.
- Importantly, travel advice should not be biased (deliberately or unintentionally) against any local areas or countries.
- When issuing advice, health officials should take into account the potentially negative economic impacts that recommendations against travel could cause in the affected areas.

8.3 Travel restrictions

Conditional recommendation against – very low certainty evidence

WHO suggests against travel restrictions (including border closures) to reduce the transmission of influenza viruses in the community during influenza epidemics and pandemics.

Remarks

- There is weak evidence, mainly from modelling studies, that points of entry closures may only delay the introduction of infections for a short period, while adversely affecting mitigation programmes and disrupting supply chains. They may also be unacceptable to individuals and communities who may rely on domestic or international mobility for their livelihoods, and for access to essential goods and services. Based on experiences during the COVID-19 pandemic, border controls in sea-locked locations (such as island nations) could be effective in temporarily preventing the importation of cases if such controls are implemented before seeding events in the community. Therefore, such locations may consider border closures during severe pandemics but must weigh the potential impact of a local epidemic against the potentially serious social and economic consequences.

Summary of evidence

Two studies (336, 523) related to the impact of international travel restrictions (including border closures) on influenza epidemics and pandemics were identified. One time-series analysis of ecological data conducted in the USA indicated that the frequency of domestic airline travel was temporally associated with the rate of influenza transmission, and a marked reduction in such travel following the events of 11 September 2001 delayed the epidemic peak by 13 days compared with the average for other years (523). The second study evaluated the effect of 14 PHSM on influenza transmission, including travel restrictions (travel bans and border closure), using influenza virological surveillance data from 33 countries. In this study, banning arrivals from selected high-risk regions was not effective in suppressing influenza transmission. However, complete travel bans or border closure were found to have some effect in suppressing influenza transmission (336).

Relevant evidence from the COVID-19 pandemic

The review identified twenty-six studies that examined the effectiveness of travel restrictions, excluding border closure, on SARS-CoV-2 transmission. Of these studies, four evaluated the effectiveness of such measures in reducing the importation risk of SARSCoV2 or delaying the epidemic. One modelling study and one observational study estimated that the implementation of international or domestic travel restrictions in the early stage of a pandemic would decrease the risk of case importations in places with low epidemic levels, thereby delaying local transmission and gaining time to prepare measures to respond to the pandemic (524, 525). However, one observational study conducted in Japan indicated that international travel restrictions implemented against travel from China in the early stage of the COVID-19 pandemic only delayed a major epidemic by 2 days (526). Similarly, a modelling study conducted across 80 countries suggested that international travel restrictions had only a minimal impact on the risk of virus importation (527).

The remaining 22 studies assessed whether travel restrictions could flatten the epidemic peak or reduce cases, with 12 of these studies concluding that such restrictions had been ineffective in reducing local cumulative numbers of SARS-CoV-2 cases (220, 359, 452, 528–536) except in places with a low incidence of SARS-CoV-2 that were closely connected to restricted areas with high incidence, and places that adopted the travel restrictions early (452, 529, 534–536). The remaining nine studies found reductions in case numbers (361, 362, 537–542). However, none of these study models completely accounted for the impact of other PHSM implemented in source and/or receiving countries.

Evidence for border closures

Twenty-five studies examined the effectiveness of border closures on SARS-CoV-2 transmission – the majority of which were modelling studies. Of five observational studies that assessed the effectiveness of border closures against SARS-CoV-2 transmission, four estimated their effectiveness at the early stage of the COVID-19 pandemic in 2020 and one between May 2021 and June 2021. In general, border closures were not associated with the overall epidemic size or mortality rate (359, 543–545), with one exception when border closure was observed to be negatively associated with daily growth rates (540). However, border closures were estimated to delay the domestic or international spread of SARSCoV2 (540, 543, 544).

8.3.1 Justifications and summary of considerations of GDG members

The evidence identified was rated of very low certainty. The GDG judged the balance of health benefit and harms to probably favor no intervention. The GDG debated the implications on equity and human rights and recognized that potential harms may result from international travel restrictions including the legal and ethical implications of restrictions on the freedom of movement of individuals and economic impact. Considerations were made for vulnerable groups such as migrant workers in foreign countries or the ability of refugees to seek asylum. The GDG discussed the resource implications and found to favor the comparison given the broad economic consequences of travel restrictions, including border closures. The GDG discusses values and preferences, and acceptability of travel restrictions and found to be uncertain. Acceptability could vary depending on the level of stringency and the duration of implementation. The members believed that the implementation of travel restrictions would probably be feasible overall but likely challenging to sustain, and to bear their substantial negative societal and economic costs, over the longer term. The very low certainty evidence and these considerations caused the GDG to conclude with a strong recommendation against travel restrictions.

Certainty of the evidence

Overall, there is very low certainty evidence that travel restrictions can reduce influenza virus transmission in the community. Of the 46 studies included in the review, only two estimated the effect of travel restrictions on such transmission. International travel bans might delay the onset of an epidemic but not for very long, while border closure might have some *effect* in suppressing influenza virus transmission. Generally, only border closures that are applied sufficiently early in an epidemic or pandemic, or before the community seeding of infections has occurred, might be effective in delaying an outbreak but not necessarily preventing it. Based on the currently available evidence, such measures are unlikely to reduce the overall caseload once a major seeding event has occurred in a community.

Values and preferences

Values and preferences related to travel restrictions are uncertain.

Balance of benefits and harms

Potential harms that may result from international travel restrictions include the legal and ethical implications of restrictions on the freedom of movement of individuals (520) and negative economic impacts (546). Border closures may delay an epidemic by a few days (543) but could also have unintended adverse consequences for daily life and the economy. During the COVID-19 pandemic, one study observed larger declines in GDP associated with border closures than with physical distancing in Thailand and Kenya, with the opposite found to be the case in Singapore (547). Such restrictions may also harm individuals seeking safe shelter or access to medical care across an international border.

Resource implications

The cost of enforcing border closures will be prohibitive in some countries. Furthermore, there would be consequences for the supply chains of food and essential medicines due to the disruption of movement, as well as broader economic consequences. Border closures may be more cost effective for island nations during epidemics or pandemics of high severity. One simulation study in New Zealand estimated that such border closures would cost NZ\$ 14 400 per quality-adjusted life year gained in a generic severe pandemic (548).

Equity and human rights

The human right to freedom of movement should be considered (520), as should potential adverse impacts on social and economic rights, particularly among marginalized populations (such as migrant workers and individuals who need to travel to seek medical care) (520), and on international supply chains of medical products and humanitarian aid that might be disrupted by border closures (549). Border closures can also interfere with the ability of refugees to seek asylum, and may lead to a need for refugee detention centres without adequate public health safeguards such as physical distancing, rendering residents vulnerable to infection. During the COVID-19 pandemic, some countries took measures to preserve access to persons seeking international protection (550). Border closures can also reduce the ability of governments and protection agencies to resettle refugees. Interruptions to the regular asylum and migration pathways risks increasing irregular border crossings, which are often dangerous and life threatening, and may involve people trafficking and human smuggling (550). Travel restrictions applied by authorities should be voluntarily to the extent possible, with compulsory interventions seen as a last resort (520). Furthermore, the need to avoid stigmatization and discrimination of individuals from affected areas, and minimize the economic impacts of border closures, should also be carefully considered (520, 551).

Acceptability

There is limited evidence for the effectiveness of internal travel restrictions, and such restrictions will have legal, ethical and economic implications that may impact on their acceptability. One survey carried out in France after the first wave of the COVID-19 pandemic observed that restrictions on leisure travel (no restriction, travel restricted to France and travel restricted to 100 km) were generally well accepted but not when they were at their most restrictive (552). Acceptability may thus be expected to decrease with increasing stringency, especially when

mandatory restrictions separate family members with little to no compassionate exemptions in place. Border closures are likely to be acceptable for short periods of time but not when they are prolonged, and especially when the perceived severity of infection is low (552).

Feasibility

Some countries already include travel restriction plans in their national pandemic preparedness plans, while others cannot implement such plans due to national laws or ill-defined or porous borders. Border closure in a severe pandemic is technically feasible and, to some extent, acceptable to many (552) and may be most effective when implemented in the very early stage of a pandemic. However, travel restrictions (including border closures) may be challenging to implement because of legal, ethical, economic and resource implications. The GDG considered that it would likely be challenging to sustain travel restrictions, and to bear their substantial negative societal and economic costs, over the longer term.

8.3.2 Knowledge gaps

- No high-quality studies on the effectiveness of travel restrictions, including border closures, were identified. Studies assessing the effectiveness of travel restrictions and their cost-effectiveness would be valuable for informing decisions on their use, and to identify potential barriers to their implementation.

8.3.3 Implementation considerations

- Countries (for example, island nations) that can successfully implement travel restrictions (such as border closures aimed at preventing or delaying importation of the virus) could consider the use of such measures in the short term. All countries implementing travel restrictions, including border closure, shall notify WHO as required by the IHR.
- Whenever implemented, such measures should be periodically evaluated and if necessary adjusted to minimize potential negative impacts on the economy and society.
- Whenever such measures are implemented, special consideration should be given to settings in which implementation and/or adherence is likely to be challenging, such as during an ongoing humanitarian crisis. Exemptions should also be made for those seeking medical care abroad or caring for an ill family member, or for family reunifications.

8.4 Upon-arrival quarantine

Conditional recommendation against – very low certainty evidence

WHO suggests against the use of upon-arrival quarantine of travellers to delay the introduction of influenza viruses into the community during influenza epidemics and pandemics.

Remarks

- Upon-arrival quarantine that takes place at a point of entry is defined as border quarantine. Maritime quarantine refers to the monitoring of all passengers and crew for a defined period before disembarkation from a ship is permitted in a jurisdiction (553), while airport or onboard quarantine refers to the monitoring of all passengers and crew for a defined period before disembarkation from a flight is permitted (554).

Summary of evidence

Four studies were identified in the systematic review, two of which were observational. One study assessed onboard/airport quarantine and found only minimal impact on detecting and preventing the entry of cases; however, following up with passengers thereafter was found to be effective in preventing secondary infection from travellers (554). Maritime quarantine in small island nations was reported to have delayed or prevented the arrival of the 1918 Spanish influenza pandemic, indirectly reducing mortality in the region (553). A simulation study in Japan suggested only minimal impact of quarantine at border on the number of cases entering a country (555). However, another simulation study suggested that quarantine at border of 9 days would prevent the entry of 99% of infected travellers into small island nations (318).

Relevant evidence from the COVID-19 pandemic

The review identified fourteen studies that assessed the impact of upon-arrival quarantine on the spread of SARS-CoV-2 (218, 511, 535, 556–566), four of which were observational studies (218, 556, 561, 562). One study analyzed data from the Test and Trace system in the United Kingdom along with genomic surveillance data, and determined that 14-day quarantine was associated with reduced number of contacts and reduced (but not completely eliminated) onward transmission of imported cases (556). A simulation study estimated the time to outbreak in New Zealand (compared to a baseline of 2.4 months) following the implementation of a 14-day quarantine combined with pre-flight testing, and estimated a median time to an outbreak of 4.9 years (565). Another modelling study carried out in Ghana assessed the different periods during which different PHSM were implemented. The period that included mandatory quarantine for all arrivals (among other PHSM) led to a projected 6% decrease in infection rate – however, this was not considered to be statistically significant (561).

8.4.1 Justifications and summary of considerations of GDG members

The evidence identified was rated of very low certainty. The GDG judged the balance of health benefit and harms to probably favor the intervention. The members discussed the resource implications and valued as variable. They noted that the harm on society and the economy may be substantial against a small effect in delaying the start of an epidemic overall.

The GDG debated the implications on equity and human rights and recognized that these may vary; they noted that attention should be given to making quarantine tolerable and safe. Moreover, the mental health of individuals in quarantine should be considered and negative effects mitigated where possible. Values and preference were found uncertain. The GDG valued acceptability and feasibility to be variable. The members thought that adherence to upon-arrival quarantine may decrease as the duration of quarantine period increases. The very low certainty evidence together with these considerations caused the GDG to conclude with a conditional recommendation against mass testing.

Certainty of the evidence

Overall, there is very low certainty evidence for the effect of upon-arrival quarantine on the public health impact of influenza. The review identified five studies on influenza and 14 on SARSCoV-2. Of the three observational studies that evaluated influenza, one estimated a beneficial effect for strict maritime quarantine of all passengers arriving at South Pacific Island nations in delaying the entry of pandemic influenza. Most of the currently available evidence on the effectiveness of upon-arrival quarantine with regard to influenza and SARSCoV-2 was drawn from simulation studies, which have very low strength of evidence.

Values and preferences

Reported values and preferences regarding the quarantining of travellers are inconsistent.

Balance of benefits and harms

The overall effect of upon-arrival quarantine in delaying the start of an epidemic is likely to be small, while it can cause substantial harm to society and the economy. One simulation study in Switzerland estimated that the cost of a 10-day upon-arrival quarantine rule (compared to having no border measures) would be between US\$ 300 000 and US\$ 600 000 per prevented infection (567). The location of upon-arrival quarantine is also an important factor in deciding whether the intervention will cause harm. During the COVID-19 pandemic, one study in China, Hong Kong SAR found that several cases of transmission occurred within quarantine hotels (568), which could lead to significant adverse impacts, particularly where transmission in the community is low.

Resource implications

Large-scale upon-arrival quarantine appears to have only limited effect in delaying the introduction of an influenza virus into a community but can be resource intensive, both for governments and travellers. Household quarantine may be more cost-effective in locations with limited capacities – however, enforcing such quarantine and monitoring compliance could still be challenging in resource-limited settings.

Equity and human rights

As with quarantine in general, the main concern regarding upon-arrival quarantine is its impact on the freedom of movement of individuals, and associated risks such as restricting access to health-care services. Mandatory upon-arrival quarantine could considerably increase such risks compared to voluntary quarantine (569). In addition, if upon-arrival quarantine is implemented using facilities that are not purpose built (such as hotels or households) there may be an

increased risk of virus transmission during the quarantine period (571). Maritime quarantine and onboard quarantine are subject to similar concerns. Although onboard quarantine involves a shorter duration of restriction of movement, currently available evidence suggests that the intervention has low cost-effectiveness and low effectiveness in general for influenza control. Additionally, consideration will need to be given to exemptions for individuals providing essential services or for compassionate reasons. This may include truck drivers, seafarers, air crews and people experiencing family or medical emergencies.

Acceptability

The reported acceptability of, and compliance with, upon-arrival quarantine is varied. In one telephone survey conducted in Australia, more than 90% of respondents reported being willing to stay at home, especially after being given brief information about pandemic influenza (314). Two other studies reached similar conclusions, with 94% (315) and 92.8% (310) of respondents reporting adherence to a quarantine recommendation. However, a cross-sectional survey in Australia found that only 53% of households reported being fully compliant with quarantine. Compliance was better among individuals with greater understanding of the purpose of quarantine (OR = 2.27; 95% CI = 1.35–3.80) (316). Adherence may decrease as the duration of the upon-arrival quarantine period increases.

Feasibility

There are several barriers to the successful implementation of upon-arrival quarantine of potentially exposed individuals. In addition, as the incubation period of a novel pandemic influenza strain may be uncertain, self-quarantining at home may at times need to be implemented for an extended period, and may thus place financial burdens on families due to work absenteeism (317). Depending on the severity of the epidemic or pandemic, the cost of implementing upon-arrival quarantine may outweigh its benefits.

8.4.2 Knowledge gaps

- Evidence for the effect of upon-arrival quarantine on influenza transmission is limited. Although it is difficult to study on-arrival quarantine using RCTs, robust data from experimental studies would be valuable.
- More evidence on the viral shedding patterns of asymptomatic influenza may inform the feasibility and optimal duration of upon-arrival quarantine to delay the importation of influenza cases.

8.4.3 Implementation considerations

- Countries with adequate resources aiming to delay the introduction of pandemic influenza cases could consider implementing facility- or home-based upon-arrival quarantine for all travellers as part of their border measures. However, the successful implementation of upon-arrival quarantine would require significant resources.
- If not implemented properly, there may a risk of introducing an additional source of virus transmission within upon-arrival quarantine facilities.

9. Guideline dissemination, monitoring and updating

9.1 Publication and dissemination of the guideline

This guideline is available on the WHO Global Influenza Programme (GIP) website. To support and facilitate its dissemination to relevant departments in ministries of health, briefing materials will be developed for technical officers in WHO regional and country offices. Moreover, the guideline will be disseminated among the members of the Global Influenza Surveillance and Response System (GISRS) and partner agencies. Originally developed and published in English, the need to translate the guideline into all six WHO official languages will be assessed based on country needs and in collaboration with WHO regional offices.

Derivative products

WHO GIP, in coordination with the WHO Steering Group and technical officers in WHO regional offices will identify and develop suitable derivative products, which may include a policy brief, infographics and training materials to support countries in the implementation of PHSM recommendations during future influenza epidemics and pandemics.

9.2 Monitoring and evaluating the impact of the guideline

WHO will continually collect feedback from guideline implementers and stakeholders to evaluate its usefulness and impact. This information will be used to evaluate the effects of the guideline on health outcomes, ensure the quality of the guidance provided and identify areas for future improvement. In particular, upon implementation of the recommendations during an influenza epidemic or pandemic, the impact of the guideline will be measured using influenza transmission-related outcomes such as the number of infections, hospitalizations and deaths. Ideally, baseline measures will be used to assess performance in relation to the changes resulting from implementation of the PHSM recommendations.

9.3 Updating the evidence

The WHO Steering Group will continue to follow research developments related to the effectiveness of PHSM in mitigating influenza epidemics and pandemics, and will assess the availability of relevant new scientific evidence 5 years after publication. If newly available evidence warrants new recommendations or changes to already published ones, then the potential updating of the guideline will be determined based on a scoping review, in consultation with independent external experts and stakeholders.

In addition to plans to update the recommendations provided in this guideline, any concerns regarding the ongoing validity of the current recommendations will be promptly communicated to guideline implementers.

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Annex 1: Selected human rights treaties and their treaty monitoring bodies

Treaty (in chronological order)	Year of adoption	Year entered into force	Treaty monitoring body
International Convention on the Elimination of All Forms of Racial Discrimination (ICERD)	1965	1969	Committee on the Elimination of Racial Discrimination (CERD)
International Covenant on Civil and Political Rights (ICCPR)	1966	1976	Human Rights Committee (HRC)
International Covenant on Economic, Social and Cultural Rights (ICESCR)	1966	1976	Committee on Economic, Social and Cultural Rights (CESCR)
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)	1979	1981	Committee on the Elimination of Discrimination against Women (CEDAW)
Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT)	1984	1987	Committee against Torture (CAT)
Convention on the Rights of the Child (CRC)	1989	1990	Committee on the Rights of the Child (CRC)
International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families (ICMW)	1990	2003	Committee on Migrant Workers (CMW)
Convention on the Rights of Persons with Disabilities (CRPD)	2006	2008	Committee on the Rights of Persons with Disabilities (CRPD)

Annex 2: Contributors to the guideline and conflict of interest management

This annex provides the name of the members of the Guideline Development Group (GDG) and the External Review Group (ERG) and the summary of the declared interests and how those were managed.

Members of the Guideline Development Group

Name	Affiliation	WHO region of residence	Expertise	Conflict of interest declared	Conflict of interest and management
Morenike Alex-Okoh	Ministry of Health, Nigeria	African	IHR, border health, public health policy in LMIC	None declared	None identified
Judith Bueno de Mesquita	Human Rights Centre, Essex Law School, University of Essex, United Kingdom	European	Health and human rights, economic, social and cultural rights, poverty and human rights	None declared	None identified
Benjamin J Cowling	School of Public Health, University of Hong Kong, China, Hong Kong SAR	Western Pacific	Respiratory virus transmission, epidemiology and medical statistics	Consulting, including service as a technical or other advisor, within the past 4 years by a commercial entity or other organization with an interest related to the subject of the meeting or work	None identified
John Edmunds	London School of Hygiene and Tropical Medicine, United Kingdom	European	Statistical and economic models to design efficient public health policy	None declared	None identified
Guiselle Guzmán Saborio	Costa-Rican Social Security Fund, Costa Rica	Americas	Health service management, health promotion	None declared	None identified

Name	Affiliation	WHO region of residence	Expertise	Conflict of interest declared	Conflict of interest and management
Vernon Lee (Chair)	Ministry of Health, Singapore	Western Pacific	Pandemic preparedness and response, infectious disease epidemiology, health policy and management	None declared	None identified
Hitoshi Oshitani	Tohoku University Graduate School of Medicine, Japan	Western Pacific	Virology, control of emerging and re-emerging viruses	None declared	None identified
Pasi Penttinen	Gulf Center for Disease Prevention and Control, Saudi Arabia	Eastern Mediterranean	Influenza and other respiratory virus epidemiology, global health policy	None declared	None identified
Antso Hasina Raherinandrasana	University of Antananarivo, Madagascar	African	Surveillance of infectious diseases and access to care in LMIC	None declared	None identified
Carrie Reed	U.S. Centers for Disease Control and Prevention, USA (collaboration preceded 20 January 2025)	Americas	Modelling, influenza disease burden, pandemic preparedness	None declared	None identified
Jonathan Suk	European Centre for Disease Prevention and Control, Sweden	European	Public health emergency preparedness, global health policy	None declared	None identified
Muhammad Tariq	National University of Sciences & Technology, Pakistan	South-East Asia	Disease control programme implementation in LMIC	None declared	None identified
Sibongile Walaza	National Institute for Communicable Diseases, South Africa	African	Respiratory virus epidemiology and biostatistics	None declared	None identified
Sonam Wangchuk	Ministry of Health, Bhutan	South-East Asia	Infectious diseases prevention and control, policy	None declared	None identified

Members of the External Review Group

Name	Affiliation	WHO region of residence	Expertise	Conflict of interest declared	Conflict of interest management
Farida Al Hosani	Abu Dhabi Public Health Centre, United Arab Emirates	Eastern Mediterranean	Public health, policy	None declared	None identified
Urtnasan Chuluunbat	National Center for Communicable Diseases, Mongolia	Western Pacific	Communicable diseases control programmes	None declared	None identified
Timothy Fish Hodgson	International Commission of Jurists, South Africa	African	Economic, Social and Cultural Rights	None declared	None identified
Roojin Habibi	Faculty of Law, University of Ottawa, Canada	Americas	International Human Rights Law, Global Health Law, Public Health Law	None declared	None identified
Walter Haas	Robert Koch Institute, Germany	European	Surveillance, prevention and control of respiratory communicable diseases	None declared	None identified
Greice Madeleine Ikeda do Carmo	Ministry of Health, Brazil	Americas	Health and environment, policy	None declared	None identified
Eun-Jin Kim	Korea Disease Control and Prevention Agency, Republic of Korea	Western Pacific	Health Promotion, advocacy	None declared	None identified
Mahmudur Rahman	Eastern Mediterranean Public Health Network, Bangladesh	South-East Asia	IHR; Infectious diseases prevention and control in humanitarian settings	None declared	None identified
Flavia Riccardo	Italian National Institute of Health, Italy	European	Surveillance, prevention and control of respiratory communicable diseases	None declared	None identified
Marta Raquel von Horoch	Ministry of Public Health and Social Welfare, Paraguay	Americas	Infectious diseases surveillance programmes, policy	None declared	None identified

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