

## Appendix

### A list of societal options to reduce SARS-CoV-2 transmission and spread

We have identified 519 societal options to reduce transmission or spread of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2).

This list can help inform management of the ongoing COVID-19 pandemic, including transition to a more normal but pandemic-resilient society. For any particular problem or risk, this long list of options will quickly be winnowed down to a much shorter list based on relevance and practicality alone. We have created an online application to help with this process: [https://alecchristie888.shinyapps.io/Covid\\_19\\_options/](https://alecchristie888.shinyapps.io/Covid_19_options/). The bespoke shortlist will then be the subject of more detailed consideration. In the longer term, we hope this list will stimulate research into the options (e.g. efficacy, side effects, cost) and, together with such research, provide a starting point for management of future pandemics involving respiratory viruses.

This list is meant to contribute to the production of guidance and should not replace it. We stress that the listing of a measure should not be seen as a recommendation or a suggestion that it is effective. Implementation of actions should be based on the best available evidence and guidance. In addition to assessing likely effectiveness at reducing transmission or spread, it is important to consider if actions are likely to have negative environmental, social or economic consequences.

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**MAIN HEADINGS** group the options into eight key areas, such as physical distancing, reducing transmission through contaminated items, and enhancing cleaning and hygiene.

**Subheadings** identify broad societal features or behaviours that may reduce viral transmission or spread.

- Bullet points identify potential actions or measures for achieving those societal features.

Illustrative examples are given throughout, to highlight where options have been implemented or considered at some point during the COVID-19 pandemic. Examples do not necessarily convey the current status of biosecurity measures. Implementation is not a prerequisite for inclusion on this list: it includes some novel options that have not, to our knowledge, been tried in practice.

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Accompanying paper: Sutherland WJ, Taylor NG, Aldridge DC, Martin P, Rhodes C, Shackelford G et al. A solution scan of societal options to reduce transmission and spread of respiratory viruses: SARS-CoV-2 as a case study. *J Biosaf Biosecurity*. <https://doi.org/10.1016/j.jobb.2021.08.003>.

## 1. PHYSICAL DISTANCING

SARS-CoV-2 is transmitted through respiratory fluids carrying infectious virus.<sup>1,2</sup> This includes liquid droplets (>5 µm diameter) and finer aerosols (≤5 µm diameter) that are released when people breathe, cough, talk, sneeze or raise their voice. SARS-CoV-2 can also be spread through direct physical contact with infected individuals.<sup>2</sup>

Physical distancing is a central component of much government guidance or legislation, with a recommended spacing of 1–2 m (although some studies<sup>3</sup> have shown that droplets can travel up to 8 m). The risk of transmission through droplets or aerosols increases when people are close together: the concentration of virus in the air declines with distance as larger droplets fall to the ground and aerosols are diluted.<sup>1</sup> Strategic distancing of certain aspects of society can maintain some interactions that are critical to many aspects of economic and social life, and may minimize compliance fatigue.<sup>4</sup>

### 1.1 Isolate infected or potentially infected individuals

Isolation involves keeping infected or potentially infected individuals separate from other people, until they are no longer infectious. Isolation for SARS-CoV-2 typically involves staying at home for 10–14 days after symptom onset or the first positive test.<sup>5</sup> For measures involving quarantine after international travel, see Section 7.2.

- Routinely test individuals and prevent access of those who test positive to public buildings and workplaces, e.g. in Austria.<sup>6</sup>
- Routinely take temperature and prevent access of those with elevated temperatures to public buildings and workplaces, e.g. in China.<sup>7</sup>
- Encourage individuals to self-isolate if they test positive for COVID-19.
- Encourage individuals to self-isolate if they show symptoms of COVID-19.
- Encourage individuals to self-isolate if they have been in (close) contact with someone who tests positive for COVID-19 or shows symptoms. Contacts can be traced using apps and electronic devices, as in Singapore<sup>8</sup> and New Zealand,<sup>9</sup> using tickets as at the Australian Open,<sup>10</sup> or manually using paper-based forms.<sup>11</sup>
- Encourage individuals to self-isolate if any other household member tests positive for COVID-19 or shows symptoms.
- Encourage individuals to self-isolate based on overall virus risk, integrating factors such as home address, travel history, IT data and self-reported health status, e.g. Chinese health code mini-app.<sup>12</sup>
- Isolate “infection herds”, i.e. groups of people sharing common spaces such as apartment blocks.
- Identify rooms for early isolation of potentially infected persons, and use appropriately.
- Provide self-isolation spaces (e.g. hotel rooms) for front line workers, key workers and workers who need to travel far away from home for their work.
- Prohibit individuals working with infected or potentially infected individuals (e.g. nurses, staff in quarantine hotels) from having second jobs, e.g. in Australia.<sup>13</sup>
- Ensure individuals working with infected or potentially infected individuals (e.g. nurses, staff in quarantine hotels) are paid enough to avoid the need for second jobs.

- Plan for any staff who fall ill at work to have means to return home safely.
- Pay staff to stay at home when infected or potentially infected, to reduce risk of transmitting illness at work.
- Provide state funding for employee sick leave (rather than having the employer pay). This could make workers less hesitant to self-isolate while sick.
- Financially support self-employed who are ill.
- Recruit and train volunteers to facilitate self-isolation and delivery services.
- Clearly communicate symptoms of COVID-19, so public can self-diagnose and self-isolate. Especially useful during early phase of epidemic when testing capacity is limited.
- Encourage infected or potentially infected individuals to call ahead before visiting doctor or hospital, to allow appropriate biosecurity measures to be put in place.

### **1.2 Increase home confinement across society**

*In many countries, there is or has been a policy to make people stay at home as much as possible, even if they are apparently healthy. This may reduce the chance of individuals catching the virus or passing it on to others. The rate of asymptomatic SARS-CoV-2 infection in the general population may be as high as 75%.<sup>14</sup>*

- Require permits, self-declaration forms or letters of authority to leave the house. Sanctions for people without them. Adopted in many countries, including France<sup>15</sup> and Romania.<sup>16</sup>
- Restrict reasons for being able to leave the house, e.g. shopping for essentials, exercise, medical needs or essential work in the UK.<sup>17</sup>
- Allow demographic groups to leave house on specified days or at specified times, e.g. men and women on alternate days in Peru and Panama.<sup>18</sup>
- Use talking drones to encourage people to return home, e.g. in Spain.<sup>19</sup>
- Offer raffles or competitions (e.g. on television or radio) with participation only possible when people are most likely to leave home.
- Reward people who respect home confinement instructions, e.g. financially or with medals.<sup>20</sup>
- Encourage or require working from home for all jobs where possible.
- Encourage or require people in non-essential jobs to stop working, if home working is not possible.
- Fine companies for encouraging or forcing people in non-essential jobs to go into work.
- Pay staff to stay at home even when showing no signs of infection.
- Support development of home-based enterprises by providing training, seed capital or loans, e.g. in Santa Ana, California, USA.<sup>21</sup>
- Increase the amount of calls, texts or data included in domestic telecommunications packages, to encourage people to work or study from home. Implemented by OGERO Telecom, Lebanon.<sup>22</sup>
- Subsidize telecommunications packages (e.g. internet access) to encourage people to work or study from home.
- Increase internet bandwidth or connection speed, to encourage people to work or study from home. Considering offering this free of charge, e.g. OGERO Telecom, Lebanon.<sup>22</sup>

- Encourage people to exercise restraint when using domestic internet connections (e.g. reducing quality of streamed videos), to maintain bandwidth for people who need to work and study at home. Implemented by OGERO Telecom, Lebanon.<sup>22</sup>
- Move lectures and teaching to a home-based setting, for instance through greater use of distance and online learning (“virtual schools”) and self-study.
- Provide lessons in various formats to facilitate home study for all students, e.g. on TV and radio (not just online) in Japan,<sup>23</sup> Ghana, Madagascar and Côte d’Ivoire.<sup>24</sup>
- Develop remote-desktop technology to allow workers and students to connect to work/school computers from home.
- Provide employees and students with adequate hardware and software for remote working.
- Ensure adequate IT and other technical support to enable remote working or studying.
- Encourage use of online systems as much as possible e.g. for personal banking.<sup>25</sup>
- Provide virtual reality alternatives to visits outside the home, e.g. virtual museums.<sup>26</sup>
- Provide accommodation and support for rough sleepers and those without permanent accommodation.
- Provide home-testing kits, self-testing equipment, self-injecting medicines and other home-based medical services to reduce need to visit medical facilities.
- Encourage volunteer community groups to “adopt” healthcare workers, or anyone else whose work requires them to leave home, to assist with groceries, laundry and other essential tasks.
- Develop or modify technology platforms to be more accessible and intuitive, to help people who are less comfortable with technology adjust to its increased use during confinement.
- Provide additional remote support for people who are less comfortable with technology, e.g. *Cibervoluntarios Responde* (Cybervolunteers Respond), Spain.<sup>22</sup>
- Ensure information is available remotely to isolated groups, e.g. those without internet at home who would normally use library services, or those who don’t speak the official language.
- Provide mental health support for people facing extended periods of confinement. Could help to maximize compliance (alongside health and social benefits).
- Encourage people to maintain routines (e.g. keeping alarms set to normal times, maintaining set working hours) during extended periods of confinement, to help maximize compliance.
- Clearly explain the consequences of not respecting confinement for self and others.
- Advise medically vulnerable individuals, such as the elderly and those with existing medical conditions,<sup>27</sup> to stay at home unless for essential reasons (“shielding”).
- Advise people who live with medically vulnerable individuals to reduce their own movement outside of their house.
- Create lists of people who are medically or socially vulnerable (including disabled people, key workers and those with caring responsibilities) to facilitate them in receiving deliveries (food or medicine) without leaving the house.

### **1.3 Reduce local movement**

*If and when people are allowed to leave the house, it may be desirable to limit the time they can do so, distance they can travel and/or activities they can carry out. This could minimize the number and duration of close interactions in public.*

- Encourage minimal movement in communities.
- Advise and support all workers who are unable to work from home in minimizing movement and interactions outside of house and work.
- Advise people living with workers who are unable to work from home to minimize movement outside of their home.
- Limit distance people can move from their home, e.g. 200 m in parts of Italy,<sup>28</sup> 1 km in France in 2020<sup>15</sup> and 10 km in France in 2021.<sup>29</sup>
- Add prescriptions on outdoor activity to aid policing, e.g. requirement to keep moving when out for exercise in Belgium.<sup>30</sup>
- Limit frequency and duration of excursions from house, e.g. for 1 hour, once per day in France.<sup>31</sup>
- Impose an evening curfew, e.g. in Peru<sup>32</sup> and South Africa.<sup>33</sup>
- Impose a daily curfew, for example on weekends or specific days when people gather.
- Discourage or prohibit individuals (e.g. staff, students) from going out to buy lunch.
- Provide longer prescriptions for people on repeat prescriptions to limit number of trips to pharmacies and hospitals, e.g. extended from 1 month to 3 months in China.
- Prohibit travel to areas where physical distancing is likely to be difficult to maintain.
- Suspend or reduce public transport services when not needed for essential travel, e.g. during Eid al-Fitr holiday in Egypt.<sup>34</sup>
- Use mobile phone tracking to check if restrictions are being followed.

#### **1.4 Reduce number and duration of shopping visits**

- Create ways for people to share shopping trips so fewer trips need to be made (e.g. through community groups or one shopper per community).
- Encourage or allow only one person per household out to shop.
- Increase delivery service from shops, food banks and other providers, e.g. veg box schemes.
- Improve infrastructure to enable people to obtain groceries, medicines, and other essential goods by delivery, e.g. by recruiting more delivery agents.
- Where the capacity is available, make home delivery more attractive, e.g. by waiving delivery fee or offering discounts (perhaps just on first order by a customer each week or month).
- Companies who deliver to the hospitality trade convert or expand to home deliveries.
- Encourage or enforce 'minimum spend' or 'minimum number of items' to encourage people to combine trips to obtain goods.
- Share surveillance among shops, including CCTV and monitoring for people making excessive visits.
- Discourage or restrict people from buying 'non-essential' or luxury items, including removing them from stock, limiting their availability or preventing people from only buying them.<sup>35</sup> The definition of 'non-essential' may vary over time and space.
- Create pre-assembled baskets of goods for customers to collect, reducing need to move around shop/marketplace.
- Improve ease of finding goods in shops, e.g. with maps, beacons or apps.<sup>36</sup>
- Avoid rearranging products in shops, especially large-scale movements between aisles or floors.

### **1.5 Reduce physical contact**

- Avoid physical contact, such as shaking hands, kissing or hugging, outside household members or social bubble.
- Identify and encourage alternative methods for greeting people that reduce the risk of virus transmission such as ‘elbow bumping’ rather than shaking hands.
- Encourage household members to carry out activities involving close contact, such as hairdressing, with guidance provided by a professional via video link.
- Create meeting rooms with airtight partitions, e.g. modified containers placed in the courtyards of Dutch care homes to allow safe meetings between residents and family.<sup>37</sup>
- Wear disposable gloves if physical contact must be made, to avoid skin-to-skin contact.

### **1.6 Avoid situations that involve close interactions**

*These options involve completely removing events, situations or facilities that would involve close interactions between people.*

- Close places of public gathering (e.g. restaurants, shops, parks, workplaces, schools, places of worship), depending upon their importance to society and degree of likely close physical spacing.
- Remove, block off or close facilities that encourage groups to form, such as park benches or play equipment.
- Close facilities that do not have and use a biosecurity plan.
- If workplaces are still open, close canteens and other non-essential common spaces.
- Encourage employees to eat at their own desk, rather than in communal spaces.
- If schools are still open, reduce inter-class and after-school activities, as in Singapore.<sup>38</sup>
- Deter mixing at start or end of day, e.g. by staggering hours or discouraging non-essential contact.
- Advise people to avoid crowds.
- Discourage or ban events where many people gather, e.g. concerts, sports events, markets, conferences and religious ceremonies.<sup>39</sup>
- Offer online alternatives to public events, e.g. #PhilharmonicAtHome concerts<sup>22</sup> and online religious lectures in Indonesia.<sup>22</sup>
- Offer drive-in alternatives to public events, e.g. concerts,<sup>40</sup> music festivals,<sup>41</sup> film screenings.<sup>42</sup>
- Provide and encourage alternatives to voting in person, e.g. postal voting.
- Discourage or ban actions that may cause crowds to form, e.g. playing amplified music in public in Bouches-du-Rhône, France.<sup>43</sup>
- Use stewards or ushers to prevent crowds from forming, or dissipate them if they do form.
- Send public service agents door-to-door, rather than encouraging people to come to a crowded central facility.
- Provide information remotely rather than face-to-face, e.g. using notice boards, e-mail, telephone calls or leaflets.
- Minimize face-to-face interactions at work, e.g. meetings, co-working, on the job training and direct supervision.
- Use video-calling or voice-calling technology instead of in-person meetings.

- Provide virtual reality alternatives to in-person interactions, e.g. robot shop workers in Japan.<sup>44</sup>
- Provide automated alternatives to in-person interactions, e.g. bank cashiers replaced by ATMs in Rio Grande do Norte, Brazil.<sup>45</sup>
- Ban or discourage cosmetic treatments, e.g. facial beauty treatments, tattoos, piercings.
- Offer takeaway options to discourage people from visiting restaurants.
- Offer table service only in restaurants.
- Require that food is consumed along with alcoholic drinks in bars/restaurants, to avoid alcohol-related breakdown of physical distancing.<sup>46</sup>
- Ban consumption of alcohol or other intoxicating substances in public, e.g. at football games in Germany,<sup>47</sup> to avoid breakdown of physical distancing.
- Close pubs and bars early each day (e.g. 10 p.m. in UK<sup>48</sup>) to reduce alcohol-related breakdown of physical distancing. Consider that this may encourage unsupervised drinking in the streets or at home, and create close interactions as all customers leave at one time.
- Require that drivers wait in car when dropping off or picking up objects or people.
- Place items on an isolated table/counter for customers to pick up, rather than delivering directly to customers.
- Use robots, drones or driverless vehicles to deliver items, e.g. food within restaurants or from supermarkets,<sup>49</sup> consumer goods,<sup>50</sup> sports trophies during presentations.<sup>51</sup>
- Drop-off of groceries outside property, to be brought in by customer later (rather than carrying goods indoors).
- Avoid restocking shops when customers are inside the building if it causes congestion.
- Avoid picking items for delivery or collection orders during peak times in supermarkets.
- Encourage or require use of stairs rather than lifts for those able to do so.
- Only allow disabled/elderly people to use lifts.
- Discourage or ban walking on escalators.
- Encourage use of personal transport (walking, bicycles, scooters, cars) rather than public transport.
- Provide extra parking for additional cars and bicycles.
- Offer free bicycles to reduce the use of public transport, e.g. in London, UK.<sup>52</sup>
- Widen/install new bike lanes to make cycling a more attractive transport options (and expand space available), e.g. Berlin, Germany<sup>53</sup> and Paris, France.<sup>54</sup>
- Lower speed limits to encourage walking/cycling rather than use of public transport (pedestrians/cyclists feel safer).
- Prohibit motorcycles or similar small vehicles from carrying passengers, e.g. in Rwanda.<sup>25</sup>
- Limit or prohibit standing on public transport, e.g. in Malta.<sup>55</sup>
- Avoid sharing bedrooms (except for individuals from same household).
- Phase in spacing methods, e.g. by initially only opening public spaces at less popular times and with stringent conditions.

### **1.7 Maintain or increase physical spacing**

*Options to maintain or increase distances between people or social bubbles, given a fixed number of people, time and space for an activity (e.g. 30-minute bus ride, 90-minute football match or eight-hour working day).*

- Encourage people to observe physical distancing, with effective messaging.
- Use clear, colourful markings on the ground to space people out (e.g. grid to show where to eat lunch or spaces in queues). Tactile markings would include people with limited vision.
- Mow grass in a checkerboard of short and long patches, e.g. garden in Elblag, Poland.<sup>56</sup> People occupy short patches and leave long patches empty.
- Employ dedicated staff to help people observe physical distancing in queues and enforce norms where necessary.
- Use apps or other devices to detect when individuals break physical distancing guidelines and emit a warning signal, e.g. Bluetooth®-based 1point5 app <https://onepointfive.app/> and echolocation-based Sunu Band <https://www.sunu.com>.
- Fine people who do not maintain physical distancing.<sup>57</sup>
- Send off sports players who do not maintain physical distancing.<sup>58</sup>
- Reward people who maintain physical distancing, e.g. financially or with medals.<sup>20</sup>
- Maintain gaps between workspaces, e.g. only opening every second checkout, increasing space between desks in open plan offices.
- Move tables (e.g. in restaurants) further apart.
- Provide “bumper tables”, where user stands in centre of table on wheels.<sup>59</sup>
- Provide wearable items that mark out safe distances between individuals e.g. pool-noodle hats<sup>60</sup> or personal laser projectors.<sup>61</sup>
- Deliver items on long wooden planks, e.g. within restaurants in the Netherlands.<sup>62</sup>
- Increase spacing on escalators, e.g. paint out alternate steps with steps shared only by people from the same household.
- Increase the number and/or size of access points to reduce congestion.
- Separate walkers, runners and cyclists.
- Remove standing options at public events; audience/spectators must be seated.<sup>47</sup>
- Block out alternate seats or alternate rows of seats, e.g. with signs, tape, mannequins or stuffed toys.<sup>63</sup>
- Restrict groups of seats (e.g. around a table on trains or coaches, or in bars), to social groups (e.g. households or bubbles).
- Alternate seats on each side of narrow tables (i.e. avoid seats directly opposite each other).
- Encourage people to leave spaces between themselves, e.g. on public transport.
- Block out seats close to driver (e.g. front few rows) of public transport.
- If seats are pre-booked (e.g. on planes or in theatres), distribute individuals and groups to optimize spacing.
- Fill space using a system that minimizes close interactions, e.g. fill window seats before aisle seats, or fill planes from back to front rather than by zones or by passenger status.<sup>64</sup>
- Alternate distancing when purchasing items, e.g. customer approaches counter with items while assistant distant, then customer backs off while items are scanned, then assistant backs off while customer pays and takes items.

### **1.8 Limit number of people in a location**

*Options to allow for greater distances between individuals by limiting the number of people allowed in a given space (e.g. shop, canteen, doctor’s surgery, park, or train carriage). Once a limit has been reached, access may be limited to one-in one-out.*



- Set upper limit for number of people allowed in premises, e.g. no more than 50 people at a time in restaurants, churches and cinemas in South Africa.<sup>65</sup>
- Set upper limit for number of people using a lift at one time e.g. one person or household or one person in each corner if large lift.
- Reduce class sizes in schools.
- Prohibit parents from entering schools, e.g. in Denmark.<sup>66</sup>
- Reduce prison population by managing new entries and/or releases. For example, in the Netherlands, people convicted of minor offences were not brought to court and low-risk prisoners were allowed to stay at home under electronic monitoring.<sup>67</sup>
- Reduce number of players on sports teams, e.g. 7-vs-7 rather than 11-vs-11 football in Vermont, USA.<sup>58</sup>
- Restrict capacity on public transport, e.g. limiting flights to/from China to 75% capacity.<sup>68</sup>
- Limit number or type of people at essential events such as weddings or funerals. In Australia, 5 people for a wedding, 10 for a funeral.<sup>69</sup> In Kenya, 15 close family members at a funeral.<sup>70</sup> Encourage people to send wishes and condolences via social media instead.
- Limit group sizes for people not from the same household or social bubble in public.
- Only allow single individuals at one time to use public spaces (such as a shop), except where assistance is needed.
- Limit the number of accompanying persons, e.g. when shopping or attending a doctor's appointment.
- Set security access pass system or QR codes to limit numbers.
- Use security personnel, or designated staff members, to monitor numbers inside a space, and limit access when necessary.
- Use an entry and exit ticket system with barriers similar to those operated in car parks.
- Use an entry and exit system where people must swipe in and out, e.g. with ID cards or tokens.
- Design system so doors automatically shut once numbers exceed a given threshold, e.g. detected by phone signals.
- Restrict activities that can be carried out in public places to reduce the number of people there, e.g. beaches in Rio de Janeiro, Brazil, can only be used for sport/exercise and not for sunbathing.<sup>71</sup>

### **1.9 Spread out use of shared space**

*Options to reduce the number of people using a shared space of a given size (e.g. restaurant, supermarket, office block, doorway, train carriage) at any one time, without necessarily reducing the total number using the space over longer timescales (e.g. per day or week). Options here generally involve distributing people evenly across space or time.*

- Extend opening hours, e.g. of supermarkets.
- Run activity for longer, e.g. increase canteen hours, allow early voting.
- Repeat events, e.g. church services, seminars, film screenings.
- Require pre-booking of time slots to use or enter facilities, e.g. supermarkets, golf courses, parks, museums, tourist attractions,<sup>72</sup> football stadiums.<sup>73</sup>

- Require appointments for use of services, e.g. doctors or hairdressers, to avoid crowds forming at peak times.
- Stagger start and finish times of users, staff or students, so they are not all using entrances or exits at the same time.
- Stagger activities such as lunch breaks.
- Divide into groups and rotate use of shared space, e.g. office staff alternate attendance, students attend classes every two or three weeks. Use verifiable groups such as first letter of surname, identity card number, house number (e.g. odd/even), car registration number, social group (e.g. families with children, retired individuals).
- Limit time inside shared space, e.g. 30-minute shopping visits in Mauritius.<sup>74</sup> Consider that this might result in more frequent visits.
- Individuals queue online and are told when their turn is to leave house, office or desk, e.g. for doctor's appointment or lunch.
- Individuals queue in car: they text the facility they want to use, sit in car, then get an alert when it is their turn to go inside. Trialled for supermarkets in New Zealand.<sup>75</sup>
- Use cellphone signals, WiFi, GPS, Bluetooth® or similar technology to detect congested areas (e.g. roads, shops or exercise areas) and share this information with users.
- Provide live video/webcam feeds that allow assessment of spacing, e.g. showing how many people are in the coffee room or in each train carriage.
- Use an automated system to direct individuals to less-occupied spaces, e.g. to distribute train passengers amongst carriages (already available in many countries, e.g. UK and Germany).
- Advise people to travel at off-peak times, if possible.<sup>76</sup>
- Offer financial incentives to travel at off-peak times, e.g. reduced fares.
- Standardize fares across transport services or operators, to avoid crowding on cheaper options.
- Advise people to wait for next service if physical distancing cannot be maintained on first available bus, train etc.<sup>76</sup>
- Provide live announcements on spacing, e.g. how crowded the canteen is.
- Discourage lingering in popular locations, e.g. viewpoints, photo spots, school gates.
- Run election/polling days on public holidays, so people can visit polling stations throughout the day.<sup>77</sup> This avoids congestion before and after working hours.

### **1.10 Expand space available**

*Options to reduce the density of people using a given shared space by increasing the area available. Allows physical distancing to be maintained.*

- Use a larger room, e.g. for meetings.
- Provide larger facilities, e.g. tables for eating.
- Make existing facilities larger, e.g. widen aisles in shops, pavements, bike lanes.<sup>53</sup>
- Increase the number of facilities available, e.g. eating areas, changing rooms, train carriages, entry/exit gates.
- Provide access to alternative spaces (e.g. museums, art galleries, playing fields, golf courses, farms) to reduce demand on popular, crowded alternatives. Access may be free, but there may need to be some compensation to the owners or neighbours.

- Incentivize well-managed access to private land for local communities.
- Create an online platform to enable use of nearby unused gardens or open space, especially where these are limited.
- Exclude traffic from certain roads, so that they can be used for exercise and recreation and to facilitate physical distancing while walking/cycling.
- Remove distinctions between first and economy class seats on public transport as a quick way of increasing capacity.

### **1.11 Reduce counterflow interactions**

*It may be easier to maintain physical spacing if the flow of people through a space is one-directional.*

- Delineate one-way routes around buildings, shops, exercise routes and other spaces using arrows and barriers.
- Encourage or require walking in one direction (e.g. clockwise) around shared spaces.
- Encourage or require walking on one side of paths, pavements or sidewalks (the precise measure may depend on local traffic rules or social norms).
- Pass people coming in the opposite direction in single file, e.g. along a footpath or pavement.
- If there are two staircases in a building, consider making one up and one down.
- Clearly separate entrances and exits (but consider how this impacts flow outside).
- At congested entry points give directions for users to alternate who goes next from a physically-distanced queue on each side.
- Allocate time slots for entry/exit, to avoid the two occurring simultaneously.<sup>73</sup>

### **1.12 Limit intergroup mixing**

*Options to limit mixing between different groups within society. These groups include (a) social bubbles, such as families or households; (b) medically vulnerable individuals, such as the elderly and those with existing medical conditions,<sup>27</sup> who may be more susceptible to infection<sup>78</sup>; and (c) key workers (providing critical services to society such as healthcare, food production, emergency services and waste disposal<sup>79</sup>), who maintain regular contacts with their networks and the wider population throughout a pandemic, and so could form persistent pockets of infection.<sup>80</sup>*

- Ask people to identify, and as much as possible stay within, their bubble: everyone they live with or must have regular contact with. Could be informed by social media. Advice given in many countries, including New Zealand.<sup>81</sup>
- Allow individuals or groups (e.g. students) to choose to be part of a more risk-averse bubble.
- Provide separate facilities for infected or potentially infected individuals, e.g. separate rooms or buildings for testing.
- Retain the same members sharing spaces, e.g. teams at work, production lines, shifts, classes in schools, sports teams.<sup>82</sup> Each team can be isolated if a member becomes infected.
- Alternate presence and virtual learning in schools to be able to limit intergroup mixing and maintain physical distance in small school buildings.

- Avoid or discourage sharing spaces, such as cars, except with usual contacts.
- Designate a time period (e.g. 10 a.m. to 12 p.m.) in which only vulnerable people can leave their houses.
- Encourage vulnerable individuals to visit shared areas early in the day (especially if cleaned overnight) or at other low use times.
- Create a special period for vulnerable individuals or key workers to shop.
- Prioritize vulnerable individuals or key workers for 'click and collect' or delivery.
- Encourage people that can shop in store to do so, to free up delivery slots for vulnerable individuals or key workers.
- Organize distribution times of food or social grants so people who live near each other collect at a similar time.
- Restrict public transport to specified groups, e.g. key workers.
- Where present, use doors away from staff for entry/exit of public transport and keep passengers away from staff (e.g. disable front doors on buses).
- Focus on constraining 'long' connections between people in different social groups who seldom or rarely interact (e.g. people with a shared interest, work visitors) rather than short connections between people in similar social groups who regularly interact with one another (e.g. close family, colleagues, close friends).<sup>4</sup>

## 2. REDUCE TRANSMISSION THROUGH AIR

*This section considers options that may hinder transmission of SARS-CoV-2 through the air, independent of physical distancing measures or when physical distancing is not possible. Options here may reduce transmission via liquid droplets (>5 µm diameter) and/or finer aerosols (≤5 µm diameter).*

### 2.1 Use solid physical barriers

- Install transparent screens, e.g. between cashier and customer in shops, or between driver and passenger in public vehicles, between seats on buses or trains, between contestants on gameshows.<sup>83,84</sup>
- Add signs to remind people to remain behind barriers and not move to speak around them.
- Encourage use of clear visors or goggles where appropriate, perhaps in addition to masks.
- Hug through a plastic sheet or "cuddle curtain".<sup>85</sup>
- Enclose each member of a crowd in a personal plastic bubble, e.g. at concerts.<sup>86</sup> Consider how to regulate temperature and air supply to make this safe.
- Erect compartments to separate groups in settings like restaurants, parks and beaches.<sup>87</sup>

### 2.2 Increase effective use of face masks

*Public use of face masks is or was recommended by the WHO and CDC during the COVID-19 pandemic, as part of a comprehensive suite of measures to reduce SARS-CoV-2 transmission<sup>88</sup> and especially when physical distancing measures are difficult to maintain.<sup>89</sup> Used properly,*

*face masks may reduce viral transmission in respiratory droplets. However, they may result in self-contamination or a false sense of security, potentially reducing adherence to other preventive measures such as physical distancing.<sup>90</sup> Mandatory and voluntary mask-wearing policies may differ in effectiveness, fairness and acceptability.<sup>91</sup>*

- Encourage or require masks to be worn in specific, high-risk areas such as supermarkets, public transport and schools.
- Encourage or require masks to be worn in general areas such as city centres.
- Fine or punish people for not wearing masks when required, e.g. imprisonment in Kuwait.<sup>92</sup>
- Provide a badge or card to those who cannot, for whatever reason, wear face masks. This allows social identification of non-compliers without a valid reason.
- Use talking drones to encourage people to wear face masks, e.g. in China.<sup>93</sup>
- Reward people for wearing masks when required.<sup>94</sup>
- Get famous, high-profile or respected people to pose in face masks to show an example.<sup>95</sup>
- Trim beard close to face to improve fit of mask.<sup>89</sup>
- Make mask-wearing fun for children, e.g. through role play as doctors or nurses, caring for a “sick” stuffed toy.
- Encourage children to decorate their face masks.
- Provide free face masks to all residents, e.g. in Singapore.<sup>96</sup>
- Provide free face masks to employees, e.g. in France.<sup>97</sup>
- Provide face masks on entry to premises and facilities for safe disposal of masks on exit.
- Provide public information and training on the safe and effective application, wearing, removal, cleaning and disposal of face masks and other personal protective equipment.
- Use face recognition technology that works without needing to remove or pull down mask.
- Ensure high standards of consumer protection against the mis-selling of inadequate, overpriced or inappropriate facemasks and other personal protective equipment.
- Require a minimum standard or quality of face masks, appropriate to the context. Consider that this may discourage individuals from wearing ‘substandard’ masks.
- Disinfect high-quality face masks to allow re-use where supplies are limited.<sup>98</sup>
- Prioritize the supply of (high-quality) face masks to key workers.
- Prioritize the supply of (high-quality) face masks to vulnerable groups, including those who may not be able to afford them.

### **2.3 Increase ventilation or airflow**

*Improving airflow may reduce the concentration of aerosols and virus particles in enclosed spaces.<sup>99</sup> A study in a Hong Kong hospital showed that increasing the air exchange rate may reduce the risk of infection from coronaviruses.<sup>100</sup> The WHO recommends a minimum airflow of 10 L/s/person in non-healthcare settings.<sup>101</sup>*

- Open windows when indoors or in vehicles,<sup>76</sup> ideally for a few minutes before use.<sup>101</sup>
- Install new windows or doors.
- Make existing windows or doors larger.
- Create cross ventilation rather than single side ventilation, e.g. by opening windows on opposite sides of a room rather than all on one side.<sup>101</sup>

- Place pedestal fan next to open window to increase air movement.<sup>101</sup>
- Use fans to increase air mixing within a room, to avoid pockets of stagnant air.<sup>101</sup>
- Install extractor fans or other mechanical ventilation systems.
- Hold events or carry out activities outdoors where possible, e.g. restaurant dining, school lessons, concerts, queuing.<sup>64</sup>
- Use surface transport such as buses or trains rather than underground transport, which is more difficult to ventilate.<sup>102</sup>
- Use CO<sub>2</sub> monitors to warn room occupants when air becomes stagnant, so they can take appropriate corrective action.

## **2.4 Clean or modify use of ventilation systems**

*Coronaviruses may be spread through ventilation systems. Studies in China<sup>103</sup> and Sweden<sup>104</sup> have found SARS-CoV-2 particles in the ventilation systems of COVID-19 wards.*

- Keep buildings well ventilated to reduce need for recirculating air conditioning systems.
- Ensure ventilation rates are adequate for the number of people in a room or building.<sup>101</sup>
- Disable automatic demand control ventilation if this is leading to inadequate ventilation rates.
- Ensure air conditioning has an effective filtration system.
- Ensure air flow in buildings is from clean to dirty areas.
- Regularly clean and maintain air conditioning ventilation systems.
- Open exhaust vents on air conditioning systems to avoid recirculating air.
- Ensure that air conditioning exhaust vents are located away from public areas.
- Ensure that air conditioning exhaust vents cannot feed in through open windows.

## **2.5 Avoid behaviours that could transmit virus through air**

- When working close to others, stay back-to-back or side-to-side rather than face-to-face.
- In shared accommodation, arrange beds so that individuals lie toe-to-toe or head-to-toe.
- When exercising close to others, avoid slipstreaming.<sup>105</sup>
- Avoid live singing or chanting, especially in large groups.<sup>106</sup>
- Avoid screaming or shouting, e.g. on rollercoasters.<sup>107</sup>
- Avoid playing wind instruments, which produce aerosols, in groups.<sup>106,108</sup>
- Avoid (unnecessary) eating or drinking in confined spaces, e.g. on public transport in UK.<sup>76</sup>
- Avoid (unnecessary) talking in confined spaces, e.g. on public transport in Japan.<sup>109</sup>
- Avoid smoking in confined spaces.<sup>110</sup>
- Reduce noise, e.g. background music in bars, to avoid need to raise voice or move closer when talking.
- Encourage people having a conversation to stand along one side of a footpath or corridor, rather than talking across it.
- Put down toilet seat cover before flushing to contain aerosols; fit covers where missing.
- Replace air hand dryers, which can aerosolize microorganisms from poorly washed hands, with paper towels.

## **2.6 Reduce time in shared space**

*It is likely that SARS-CoV-2 transmission risk increases with the length of time spent in a shared space.<sup>1,111</sup> Reducing the time for which individuals share spaces, especially indoors, may therefore reduce transmission risk.*

- Shorten events when people will be sharing space, e.g. sermons in Aceh, Indonesia.<sup>112</sup>
- Where public transport is operating, reduce hours (e.g. move to Sunday timetable) to reduce duration of contact for staff. Consider that this may increase the number of passengers per vehicle.
- Allow dine-in customers to pre-order, to minimize time spent in restaurant.

## **3. REDUCE TRANSMISSION THROUGH CONTAMINATED ITEMS OR SURFACES**

*SARS-CoV-2 may be transmitted when people touch surfaces contaminated with the virus (fomites) before touching their nose, mouth or eyes. Coronaviruses can survive on surfaces for at least 28 days in controlled conditions between 20°C and 40°C.<sup>113</sup> SARS-CoV-2 may persist for even long at low temperatures, for example on chilled or frozen food and its packaging.<sup>114,115</sup> However, transmission through contaminated items or surfaces appears to be less important than transmission through direct or close contact with infected individuals.<sup>1</sup> The transmission risk in most real-world situations may be confined to the first few hours after an object is contaminated.<sup>116</sup>*

### **3.1 Remove objects requiring physical contact**

- Remove objects likely to be touched by multiple individuals, especially those that are difficult to clean (e.g. water dispensers, public seating, fingerprint scanners, magazines in aircraft, menus, condiment containers).
- Close or turn off facilities that encourage multiple contacts, e.g. water fountains in Windsor, Canada.<sup>117</sup>
- Remove or prop open doors and gates, both indoors and outdoors, to reduce the need to touch handles.
- Encourage customers to remove lid from reusable food container (e.g. coffee cup) before giving it to server.

### **3.2 Replace objects requiring physical contact with contactless options**

- Offer single-use, disposable or electronic replacements, e.g. magazines and menus available as electronic documents, receipts sent by e-mail or SMS rather than being printed.
- Replace physical contact with voice recognition (e.g. for self-checkouts, ticket machines, gym equipment<sup>118</sup>) or face/iris recognition (e.g. for doors, ATMs<sup>119</sup>).
- Replace physical contact with phone apps, e.g. for card payments, ordering in restaurants, calling and directing elevators, signing for packages.

- Replace physical contact with light or pressure sensors, e.g. on doors, taps, soap dispensers, toilet flush, hand dryers, pedestrian crossings.<sup>120</sup>
- Replace systems requiring physical contact with automated systems running on timers.
- Allow courier to take photo of delivery at address showing the door opened, instead of signing for receipt of packages. Already in place for most courier companies in the UK.
- Install wireless charging for appliances and electric vehicles.
- Replace bins with lids in public spaces with open bins.
- Replace kettles, coffee pots and other drink dispensers with automated machines.
- Offer virtual fitting solutions for objects like clothes or glasses, e.g. using apps/online tools or based on body scans.<sup>121</sup>

### **3.3 Increase use of contactless payment**

- Install hardware or software that allows contactless payments, including through phones.
- Inform customers that contactless payment is possible and preferred, e.g. with clear signage.
- Increase maximum allowance for contactless payments, as done in Estonia.<sup>122</sup>
- Remove fee (if present) for minimum payment by contactless.
- Increase maximum number of contactless card payments each customer can make per day.
- Enable small outlets to take payments over the phone (some banks are reluctant to allow this), for example to allow customers to collect goods outside.

### **3.4 Modify or design systems to reduce contact**

*Options to reduce the need to touch objects, when some contact at some point is unavoidable. These could reduce the number or frequency of contacts or increase the intercontact interval.*

- Switch from self-service options (e.g. buffets, salad bars, drink stations) to table service.
- Stack products on shelves with labels and barcodes facing outwards, so information (e.g. nutritional content, allergens) is visible without handling.
- Present barcodes or QR codes on shelf labels so customers can obtain information (e.g. nutritional content, allergens) without having to handle products.
- Encourage use of 'Scan and Go' technology in shops, whereby items are scanned and directly bagged by the customer. Consider use of personal mobile phones as scanners.
- Ask customers to scan their own items at checkouts.
- Print barcodes on all items in shops (e.g. carrier bags, fresh bread, fruit and vegetables) to enable them to be scanned at self-service checkouts rather than selected on touch screens.
- Position bar codes so the cashier does not have to touch goods when scanning.
- Extend conveyor belt in supermarkets to move goods towards customers without the cashier pushing them.
- Make contactless payment the default option at self-checkouts (avoids need to touch screen to select option).
- Install automatic cash acceptors/dispensers at checkouts, to avoid need for cashier to handle cash.
- Remove self-packaging options when purchasing food by pre-packaging at production stage (e.g. for fresh bread and vegetables).



- Modify supermarket trolleys so they are no longer coin-operated.
- Use messaging to reduce unnecessary touching, e.g. “touch it and take it” rule in shops.
- Provide a ‘reject’ bin for mouldy/broken items once touched.
- Carry potentially contaminated items (e.g. recently purchased shopping) in bags/baskets/ buckets rather than close to the body.<sup>123</sup>
- Place all rubbish, such as waste after eating, straight into a bin rather than leaving it for someone else to clear up.
- Encourage proper disposal of contaminated items such as tissues, gloves and face masks in sealed and leak-proof garbage bags.
- Delivery drivers avoid touching goods: they are placed in receptacles by warehouse/ restaurant staff, then removed from those receptacles by customer.
- Encourage people to sit down on public transport, to reduce need to use handholds.<sup>102</sup>
- Require that passengers or customers pay with exact change if paying with cash, e.g. on public transport in Malta.<sup>55</sup>

### **3.5 Reduce shared contact of objects or areas**

*Options to keep multiple contacts within individuals or bubbles, when it is difficult to avoid repeatedly touching items.*

- Have only a single person touching objects normally touched by many, e.g. a member of staff to refuel cars to prevent multiple handling of petrol pumps.
- Create convention that different people touch different areas of objects, for example design refuse bins so collectors touch different areas from householders (e.g. centre element of handle red and marked “do not touch” or designed with separate handle).
- Shorten production lines where feasible, or fix working relationships so that each individual in a production line only has to interact with a limited number of colleagues. For instance assign the same individual to production and packaging or always have one worker package another worker’s produce.
- Provide each team or group with their own communal facilities (e.g. tables, washbasins or washrooms, kitchens, communal rooms).
- Remove unnecessary food packaging as soon as possible after purchase, and dispose of (ideally in a lidded waste bin). Replace with clean packaging if necessary.
- Discourage use of personal utensils, such as forks or chopsticks, when taking food from communal dishes.

### **3.6 Increase sole use of items**

- Encourage individuals to use their own rather than shared items, e.g. tools, staplers, water bottles instead of glasses, hand towels.
- Encourage individuals to bring and use their own pen, e.g. to sign for delivered goods, in polling stations, or to sign forms in vaccination centre.
- Encourage workers to bring their own food and pre-prepare items before coming to work.
- Do not provide communal utensils for eating or drinking in the workplace, unless they can be properly cleaned between uses.

- Allocate individuals to specific facilities, e.g. desks, sinks, showers. Avoid hot-desking.
- Ban use of shared items in public places, such as prayer rugs<sup>112</sup> and shisha pipes.<sup>124</sup>
- Ban exchange of recently used items, such as football shirts after matches.<sup>125</sup>

### **3.7 Minimize reuse of objects**

- Provide disposable cups, cutlery and plates (as long as these can be disposed of safely).
- Stop customers from using their own, reusable food containers, e.g. in Starbucks across Europe, Middle East and Africa.<sup>126</sup>
- Ban use of reusable shopping bags, e.g. in California.<sup>127</sup>
- Suspend or postpone plastic bag bans or charges in grocery stores, to discourage use of reusable shopping bags, e.g. in the USA.<sup>128</sup>
- Make single-use bags mandatory for home deliveries.
- Waive single-use bag charge for home deliveries.
- Replace whiteboard erasers in classrooms or offices with disposable wipes.

### **3.8 Use tools to avoid skin-to-object contact**

- Use tools, such as tongs to pick up shopping and probes to enter PIN.<sup>129</sup> Tools ideally designed to be multifunctional. Tool decontamination available at entry and exit.
- Use a personal pointer when touching shared screens instead of fingertips.
- Provide gloves before using common facilities, such as petrol pumps and upon entry to shops. Provide bins to correctly dispose of gloves at end of use.
- Wear gloves during cooking and preparation of food, especially when handling raw produce.
- Use paper towel to turn off tap after washing hands, rather than touching tap directly.
- Eat with utensils rather than fingers.
- Cover objects that require shared contact (e.g. eyepieces on microscopes) with cling film and replace between users.
- Use a sponge or wet cloth to seal gummed envelopes, rather than licking them.<sup>130</sup>

### **3.9 Reduce touching with hands, fingers or palms**

*People generally touch their face or other objects with the palmar surface of their hands.<sup>131</sup> Using other body parts to touch communal objects, where some body contact is necessary, could reduce the chance that an individual deposits or picks up viral particles.*

- Use an elbow or back rather than hands to push heavier items, such as doors.
- Redesign or adapt objects to allow operation with feet or elbows, e.g. hand sanitizer dispensers, water dispensers, taps, bins, gates, doors, in-store customer surveys. Could use 3D-printed parts (e.g. <https://www.materialise.com/en/hands-free-door-opener>).
- Redesign or adapt objects to allow operation with (clothed) forearms, e.g. replace round knob-style door handles with lever handles.
- Where hand contact is unavoidable (e.g. for doorbell or PIN keypad), use a finger joint rather than fingertip to touch objects.

- Where hand contact is unavoidable (e.g. for doorbell or PIN keypad), use non-dominant hand to touch objects.

### 3.10 Use safer surfaces

*Copper is known to inactivate viruses, including SARS-CoV-2, much more quickly than other common surface materials.<sup>132,133</sup> SARS-CoV-2 is also less persistent on paper/cardboard than on plastic.<sup>132</sup>*

- Add copper surfaces to communal/public spaces, especially in high-touch locations.<sup>134</sup>
- Use paper instead of plastic bags.
- Coat surfaces with anti-microbial, water-repellent and/or oil-repellent substances.<sup>135</sup>

## 4. ENHANCE CLEANING AND HYGIENE

*Improved personal hygiene – especially handwashing – is standard guidance to prevent SARS-CoV-2 transmission.<sup>136</sup> It largely aims to prevent indirect transmission through contaminated surfaces<sup>1,2</sup> by reducing the chance of transferring viral particles from the body to surfaces, or from surfaces to the body. Improved personal hygiene can also reduce the risk of transmission during direct physical contact or through airborne particles.*

### 4.1 Improve hand hygiene practice

*This includes increasing the frequency with which people clean their hands and/or the standard of cleaning. The CDC recommend washing with soap and water for at least 20 seconds, or with 60% alcohol-based hand sanitizer.<sup>136</sup> Forearms should also be cleaned if they are kept bare.*

- Encourage regular, effective hand cleaning.
- Encourage or require hand cleaning on arrival to and departure from a new location.
- Encourage or require hand cleaning before and after dealing with potentially contaminated items.
- Encourage or require hand cleaning before and after eating.
- Encourage hand cleaning before putting on or taking off face masks.
- Provide hand-washing facilities at entrances, exits and at areas of potential contamination.
- Provide alcohol-based hand sanitizers at entrances, exits and at areas of potential contamination (including on public transport).
- Move hand-cleaning facilities into more convenient positions, e.g. in centre rather than at side of corridor or doorway.<sup>137</sup>
- Increase visibility of hand-cleaning facilities, e.g. by adding flashing lights.<sup>138</sup>
- Provide low-tech hand-cleaning stations in low-resource communities.<sup>139</sup>
- Improve access to soap and water, or hand sanitizer, to those who lack access to basic hand-washing facilities. For example, the government of Ghana absorbed the cost of citizens' water bills and arranged water tanker deliveries.<sup>140</sup>

- Provide free soap or sanitizer to key workers and volunteers, such as bin collectors and delivery drivers, to encourage regular hand cleaning.
- Replace cheap soap or hand sanitizers with high quality, moisturizing handwash (to encourage regular hand washing).
- Ensure hand cleaning facilities are regularly restocked or refilled.
- Provide training on effective hand cleaning, accepting varying guidance.<sup>141</sup>
- Provide information on effective hand cleaning, accepting varying guidance.<sup>141</sup>
- Use signage in bathrooms that communicates the risks of not washing hands.<sup>142</sup>
- Use simple signage to remind people to regularly clean their hands (not necessarily with any information on how to do so).
- Monitor people during hand cleaning to ensure they are doing it effectively. This could be done, for example, in person or via cameras.<sup>143</sup>
- Provide feedback on hand cleaning performance, to individuals or groups.
- If a tap is programmed to run only for a set period of time, ensure that time is long enough to allow thorough hand washing. Extending the time also reduces the need to press tap again mid-wash.
- Ensure that tap water temperature is not too hot so that hands can be held under whilst washing.
- Replace separate taps with a single mixer tap, to allow user to adjust water temperature.
- Ensure sinks are deep enough to facilitate effective hand-washing and to avoid accidental touching of the sink while washing hands.
- Remind individuals to avoid touching other items or their face during use of communal hand-cleaning facilities. Only touch items/face once hand cleaning is complete.

#### **4.2 Improve other aspects of personal hygiene**

- Encourage people to avoid touching their face.
- Use vibrating band on wrist or elbow (e.g. <https://www.elbaware.nz/>) to discourage face touching.
- Use computer application (e.g. <https://donottouchyourface.com/>) to discourage face touching.
- Treat conditions that may trigger face touching, e.g. itchy skin or dry eyes.
- Clean hands thoroughly before and after touching face.
- Use tools, such as tissues, when scratching an itch on face.
- Use sleeve rather than hands to touch face.
- Discourage spitting in public places.<sup>144</sup>
- Discourage use of saliva on sports balls, e.g. cricket balls<sup>145</sup> and baseballs.<sup>146</sup>
- Sneeze or cough into shoulder or elbow, rather than hand.
- Carry tissues and place them in a bin after coughing, sneezing, or wiping face, rather than using clothing or handkerchiefs.
- Use tissues only once, before throwing away.
- Increase the number of waste bins available for disposing of tissues in public places.
- Facilitate washing and/or disposal of face masks after use.
- Offer personal protective equipment in vending machines.<sup>147</sup>
- Use condoms or dental dams during intimate activities.<sup>148</sup>

- Encourage people to shower upon returning home (particularly healthcare workers, bus drivers, shop workers, etc.).
- Increase the availability of shower facilities at the workplace (particularly for healthcare workers, bus drivers, shop workers, etc.).
- Disinfect shoes in a foot bath when moving between buildings/rooms.
- Install and use alcohol nebulizers in public places.<sup>149</sup>
- Restrict activities to workers who have passed a test of their knowledge of hygiene, as in the Finnish system of Hygiene Passports.<sup>150</sup>
- Make people sign a commitment to good hygiene practices.<sup>151</sup>
- Provide personal hygiene advice in print and broadcast media, via public announcement systems and social media, or through community health workers.

### **4.3 Improve cleaning practice**

*A range of biocidal products are effective against SARS-CoV-2; sources of evidence-based guidance include the European Centre for Disease Prevention and Control<sup>152</sup> and the United States Environmental Protection Agency.<sup>153</sup>*

- Regularly clean high-risk objects, touched frequently by many different people, e.g. taps, petrol pumps, door handles, pin machines, self-service touch screens, shopping trolleys, handrails, desks, keyboards, door handles, printers, water coolers, toys, mobile phones, braille signs.
- Regularly clean high-risk areas, used frequently by many different people, e.g. canteen, toilet and washroom areas, playgrounds.
- Ensure surfaces are visibly free of dirt before disinfecting them.
- Sterilize areas that have been in contact with raw food products, which may be contaminated.
- Use disposable wipes to clean shared surfaces and facilities before use.
- Provide facilities for safe disposal of used wipes.
- Encourage or require people to carry their own disinfectant to routinely use before touching shared objects, such as door handles.
- Provide disinfectant in/near high-risk locations such as card machines, door entry systems, toilets, communal kitchens.
- Provide free disinfectant sprays and refilling stations.
- Make the spaces on public transport and other shared spaces easier to rapidly disinfect or wipe down, for example by using non-absorbent materials.
- Spray outdoor spaces and vehicles with disinfectant, from drones or aircraft.<sup>154</sup>
- Reduce the hours that shops and public transport are open to enable deep cleaning.
- Deep clean any areas used by people who report COVID-19 symptoms.
- Provide clear guidance on effective ways of cleaning at home (including which disinfectants are already available at home, how to create home-made disinfectants, and which solutions are not effective).
- Create clear industry standards and expectations regarding disinfectant use in hotels, take-away restaurants, etc.
- Clean packaging like cans before storing or opening.

- Wash unpackaged produce (e.g. fruit and vegetables) thoroughly under running water before consumption.
- Thoroughly wash reusable items, such as mugs or straws, between uses.
- Thoroughly clean or wash second-hand items (e.g. from thrift stores, garage sales or online auctions) before use.

#### **4.4 Improve laundry practice**

- Change and wash clothing on returning home or after possible contamination (particularly for healthcare workers, bus drivers, shop workers, etc.).
- Avoid shaking dirty laundry before washing to reduce the possibility of dispersing virus through the air.
- Wash and dry laundry bags, or disinfect basket.
- Wash laundry at an appropriate temperature and with an appropriate amount of detergent.
- Dry laundry completely before wearing.
- Fold laundry at home, rather than in public places such as a laundrette.
- Support people whose access to clothes washing facilities may be limited due to economic situation or lockdown regulations.
- Dry laundry outdoors, in sunlight, where possible.

#### **4.5 Use ultraviolet (UV) radiation for disinfection**

*UV-C radiation can inactivate coronaviruses – including SARS-CoV-2 – by destroying their outer protein coating.<sup>155,156</sup> However, it cannot be used safely when humans or animals are present. It is possible that UV-B radiation in natural sunlight can similarly inactivate coronaviruses.<sup>155,157</sup>*

- Disinfect objects such as post, money, phones or keys with UV-C.
- Disinfect food surfaces with UV-C.<sup>158</sup>
- Disinfect high-touch surfaces such as handrails with UV-C.
- Disinfect rooms, vehicles or similar infrastructure with UV-C.<sup>159</sup>
- Increase sunlight in buildings, e.g. by keeping blinds open.

#### **4.6 Leave items or areas to decontaminate**

*Experiments on SARS-CoV-2 show an exponential decay in viral load over time. One study<sup>132</sup> found that the virus remains viable for the longest on stainless steel and on plastic (5–7 hours) but for less time on cardboard and much less on copper. Another report<sup>160</sup> found that SARS-CoV-2 could be detected on surfaces for up to 17 days. When considering how long is needed for decontamination, please check up-to-date guidance on the persistence of SARS-CoV-2 on different surfaces, e.g. from the CDC or WHO.*

- Place non-urgent, non-perishable, post-delivered items (e.g. letters and packages) in bags and wait before opening.
- Use boxes to collect mail, with the opportunity to inspect without touching so the recipient can decide whether to open or leave to disinfect.

- Deliver items into storage lockers, perhaps with an enforced or encouraged delay between delivery and collection.
- Quarantine communal items (e.g. library books or rejected non-perishable items in shops) before re-issue or re-stocking.
- Quarantine second-hand items (e.g. from thrift stores, garage sales or online auctions) before use.
- Double bag personal protective equipment and leave to decontaminate before disposal.
- Store items that could be contaminated (e.g. shopping bags) so the one stored longest is taken first.
- As a principle select the least-recently-used first for anything shared (e.g. hotel rooms or vehicle fleet). Employ a rotation system.
- Where multiple options occur (e.g. bus seats on relatively empty buses) or can be created (e.g. line of chairs in front of someone running a series of one-to-one meetings) allocate seats to minimize overlap and maximize time since last used.
- Encourage or require pause between shared use of common facilities such as toilets.

## 5. REDUCE TRANSMISSION THROUGH WASTE WATER

*The World Health Organization consensus document on a superspreading SARS event in a housing block in Hong Kong concluded that transmission occurred due to defects in the wastewater plumbing system.<sup>161</sup> SARS-CoV-2 genetic material has been detected in faeces and urine<sup>2</sup> and in untreated wastewater.<sup>162</sup> The following options for reducing the risk of SARS-CoV-2 transmission through waste water were suggested in one study.<sup>163</sup>*

### 5.1 Maintain wastewater systems

- Explore and address causes of foul smells in bathrooms, kitchens, or wash areas.
- Fit functioning U-bends on water appliances in bathrooms and kitchens.
- Open a tap on all water appliances for at least 5 seconds twice a day (morning and evening) paying special attention to floor drains in bathrooms and wetrooms to prevent the loss of the water-trap seal within a U-bend.
- If the wastewater pipework from an appliance appears to be disconnected or open, seal it immediately (e.g. use an elastic rubber glove or plastic bag to cover the end).
- Quickly seal cracks or leaks in pipework.
- Continuously monitor whole system performance (for large or tall buildings).

## 6. REDUCE TRANSMISSION THROUGH NON-HUMAN ANIMALS IN THE COMMUNITY

*The latest guidance from the OIE states that “although several animal species have been infected with SARS-CoV-2, these infections are not the driver of the current COVID-19 pandemic which is human-to-human transmission. However, there are valid concerns about the*

*establishment of SARS-CoV-2 reservoirs in wild or domestic animals, which could pose a continued public health risk and lead to future spillover events to humans”.*<sup>164</sup> Reports from infected mink farms suggest the possibility of animal-to-human transmission of SARS-CoV-2.<sup>164</sup> The options listed here are precautionary options for responding to this potential risk.

### **6.1 Physical distancing involving non-human animals**

- Encourage physical distancing measures between humans and wild/pet animals.
- Minimize touching, food sharing and direct contact of suspected infected persons with pet animals, such as cats, to reduce risks of disease transmission.
- Reduce contact between pet animals (e.g. separate food and water bowls; keeping in separate rooms) that have been in contact with people that may/do have COVID-19.
- Keep pet cats indoors when possible,<sup>165</sup> especially when there is a risk they may be infected, e.g. if someone in the household has symptoms of COVID-19<sup>166</sup> or when the infection rate in the general population is high.
- Walk dogs on a leash, physically distant from people.<sup>165</sup>
- Keep dogs close to owner when out walking (whether on a lead or not).
- Avoid taking pets to public places where many people gather.<sup>165</sup>
- Where possible, have another member of household or bubble care for pet if owner has/may have COVID-19.
- Avoid using dog-walkers or pet-sitters that are not part of pet/owner’s household.<sup>165</sup>
- Rescue, treat and rehome feral animals.
- Avoid contact with feral animals otherwise.

### **6.2 Improve hygiene involving non-human animals**

- Disinfect and safely dispose of potentially contaminated matter (e.g. used cat litter) from pets that may be infected with COVID-19.
- Wash pets before handing to others, e.g. veterinarians.
- Wash hands after handling animals, their food or their waste.
- Clean up after pets, especially in public areas.

## **7. RESTRICT DISEASE SPREAD BETWEEN AREAS**

*A common aim of pandemic management is containment within certain areas, preventing spread of the disease to isolated communities and to communities with limited capacity to cope with a disease outbreak. It is also desirable to avoid spread between regions with very different levels of infection.*

### **7.1 Reduce large-scale movement that exacerbates problem**

*Where “large-scale” refers to movements between countries or regions, rather than within a city or region.*



- Impose international travel restrictions or border closures in response to national indicators of infection load or presence of novel viral variants.
- Suspend tourist visas, e.g. in Zambia<sup>167</sup> and for pilgrims entering Saudi Arabia.<sup>168</sup>
- Prohibit international sporting events, e.g. Tokyo 2020 Olympics<sup>169</sup> and general ban in South Africa.<sup>65</sup>
- Ban away fans from sporting events.<sup>73</sup>
- Establish “air bridges” or “travel bubbles” between countries with low, or similar, infection loads.<sup>170</sup>
- Impose regional travel restrictions in response to regional indicators of infection load or presence of novel viral variants.
- Isolate communities and monitor movements in and out through a limited number of checkpoints, e.g. in China.<sup>171</sup>
- Prohibit or discourage travel from urban centres to second/family homes in rural communities, to reduce burden on rural health infrastructure. For example, Norwegians were banned from summer cottages.<sup>172</sup>
- Encourage people to visit recreational sites as close as possible to their home, and ideally those that can be reached by personal transport.<sup>173</sup>
- Suspend intercity travel services, e.g. interstate buses and tourist coaches in Brazil.<sup>174</sup>
- Restrict long-distance travel to specific purposes (e.g. essential work, family emergency, care of relatives) with a clear and enforceable definition of what constitutes long-distance (e.g. a maximum travel radius, crossing local authority boundaries, moving between settlements or going further than strictly necessary for a given task).
- Establish punishments for not obeying rules/guidelines on travel including falsely providing travel history, e.g. in Singapore.<sup>175</sup>
- Provide incentives for avoiding travel (e.g. refunds for booked tickets, coupons for choosing to cancel tickets).
- Make information readily available on infection risk and travel restrictions.
- Stop or restrict contact with societies that currently have minimal contact and so unlikely to be infected.<sup>176</sup>

## **7.2 Reduce transmission risk of those travelling**

- Apply the options described in sections above to transport systems.
- Encourage passengers to arrive well in advance of departure, allowing time to observe hygiene protocols and avoiding last-minute rushing around.
- Encourage passengers not to arrive too early, to reduce the number of people in stations, airports or terminals.
- Encourage or require quarantine *prior to* international travel, especially if recently in contact with an infected individual.<sup>177</sup>
- Encourage or require quarantine *after* international travel (e.g. when arriving in Canada<sup>178</sup> or New Zealand<sup>179</sup>) or intercity travel (e.g. when arriving in Beijing from other cities in China<sup>180</sup>), especially if coming from areas with high number of cases and/or a variant of concern.
- Track individuals (e.g. with phone apps or electronic bracelets) to encourage and monitor compliance with quarantine restrictions.<sup>181</sup>

- Intercept infected, symptomatic individuals before or during international journeys, using testing or thermal screening.<sup>182</sup>
- Provide isolation spaces for individuals who show symptoms of COVID-19 during travel, e.g. last three rows of seats on planes.<sup>183</sup>
- Intercept infected, symptomatic individuals on arrival, using testing, thermal screening or screening with dogs.<sup>184</sup> Consider the risk of false negatives, i.e. failure to detect infected individuals.<sup>185</sup>
- Use separate facilities for travellers arriving from areas with high infection rates or novel variants, e.g. separate terminal for arrivals from “red list” countries, Heathrow Airport, UK.<sup>186</sup>
- Require proof of complete vaccination or recovery from COVID-19 prior to travel.
- Require a negative test for COVID-19 taken shortly (typically 48–72 h) before travel.
- Require self-certification of an absence of COVID-19 symptoms when arriving in a new country, e.g. France.<sup>187</sup>
- Provide special travel passports/stamps/certificates for essential travel. This requires robust evidence that certain people have developed persistent immunity *and* are not infected.
- Provide people travelling with personal protective equipment, such as face masks.
- Encourage or require people to use their own personal protective equipment when travelling.
- Encourage individuals or families to use private transport such as cars, rather than public transport such as buses.
- Tightly supervise travel from origin to destination e.g. for migrant workers in China and Europe.<sup>188</sup> Designated personnel supervise groups of travellers on designated vehicles travelling designated routes; supervision begins at home.
- Charter coaches, trains or planes for a group travelling together, such as sports teams.<sup>189</sup>
- Restrict movements of transit passengers when on ground, e.g. ensure they remain airside in airports.

### **7.3 Reduce transmission risk through contaminated goods**

- Apply the options described in Sections 3 and 4 above to imported and exported goods.
- Regularly test imported food (especially chilled/frozen food), and quarantine or destroy contaminated items.<sup>190</sup>

## **8. MANAGE PUBLIC KNOWLEDGE AND ATTITUDE**

*Public knowledge and attitude can greatly influence compliance with the options listed above. Thus, part of the public health response to SARS-CoV-2 has involved strategic communications with the public. Note that how and when information is communicated can influence the magnitude and even direction of its effects.<sup>191,192</sup> This section lists general options – the previous sections include some more specific options.*

## 8.1 Manage public knowledge and attitude

- Provide information on current local status of pandemic (e.g. colour coding regions or cities, reporting R number) to influence public behaviour.
- Create a hotline communication channel (e.g. telephone line) specifically for information on the pathogen, disease or response.<sup>193</sup>
- Provide clear, memorable instructions about desirable public behaviours.
- Put signs in key locations (e.g. at entrance to building next to hand sanitizer) to remind people of desirable behaviours.
- Use a variety of media to communicate with different groups within society, e.g. including information about desirable behaviours in song lyrics.<sup>194</sup>
- Debunk/correct fake news or misinformation about virus and biosecurity measures.
- Communicate honestly, transparently and proactively with the public, to maintain trust.
- Maintain an appropriate level of fear amongst the public, to avoid complacency with regard to societal biosecurity measures.
- Communicate how biosecurity measures benefit society as a whole, rather than individuals.<sup>195</sup>
- Report when people are successfully following societal biosecurity advice, not just when they are breaking it.
- Involve citizens/stakeholders when selecting measures, designing biosecurity plans and producing guidance.
- Clearly explain the consequences of not following measures for self and others.

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