

## Reducing within- and between-household transmission in light of new variant SARS-CoV-2.

This document summarises the current scientific evidence on actions that would serve to reduce household transmission of SARS-CoV-2. It is largely based on previous SAGE papers and takes account of the potential impacts of the new variant of the virus.

### Executive summary

1. **Within-household transmission is a very common setting for SARS-CoV-2 transmission.** During lockdown, this becomes a more important environment for transmission as most activities beyond the household are subject to restrictions.
2. **The risks from transmission within households are likely to be elevated for the new variant (B1.1.7)** due to its increased transmissibility (medium confidence).
3. **Transmission from a case to others within a household is not inevitable**, and measures can be taken to reduce the risk of secondary infection (high confidence).
4. **Transmission between household members can be mitigated through the application of a combination of personal, procedural, and environmental controls**, both as pre-emptive measures and as enhanced measures implemented immediately when any household member has symptoms or is a possible or confirmed close contact of a case. Enhanced measures are also likely to be beneficial when a household member is vulnerable (high confidence).
5. **A whole-population communications campaign** to increase awareness of the necessity, feasibility and effectiveness of implementing household measures to reduce transmission, is likely to improve uptake of these measures and reduce transmission (medium confidence).
6. **A comprehensive package of information and support would likely improve household implementation of self-isolation and quarantine, especially in disadvantaged households and communities.** Maximum effect could be achieved by considering the broad range of barriers to adherence that exist, including financial, practical, informational and emotional factors (high confidence).
7. **The impact of information and support could be maximised by ensuring it is appropriate and easily accessible for people in a range of household circumstances**, and from different cultures and sectors of society (high confidence).
8. In the absence of strong measures to reduce between-household transmission, reduction of within-household transmission may have limited influence, but **when the epidemic is sufficiently controlled by reducing between household mixing, reduction of within-household transmission can potentially make a substantial contribution to further reducing prevalence** (medium confidence).
9. **Successful reductions in household transmission have the potential to contribute to reductions in R, hospitalisations, and mortality, and increase health service capacity** (medium confidence)
10. **We estimate that if all the measures outlined in this paper were followed and an overall 25% reduction in within-household transmission risk were achieved, this could lead to a prevalence of 10-15% lower after three weeks, with associated beneficial impacts for hospitalisation** (medium confidence).

This paper can broadly be split into the following sections:

**1. Reducing within-household transmission**

- A. Pre-emptive infection control measures applicable to all households
- B. Households in which there is a suspected or confirmed COVID-19 case, and there is a requirement for one or more people to self-isolate or quarantine<sup>1</sup>
- C. Households in which one or more people are at increased risk of COVID-19 (clinically vulnerable or clinically extremely vulnerable)
- D. Large or multigenerational households

**2. Reducing between-household transmission**

- A. Support for households and individuals

In addition:

- **Annex A:** Environmental, administrative and personal protection measures to reduce the risk of transmission within households through close-range, airborne and surface contact transmission routes.
- **Annex B:** Support that may improve adherence to self-isolation
- **Annex C:** SPI-M Technical Summary on Modelling Household Transmission

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<sup>1</sup> In this document the terms 'self-isolation' and 'isolation' are used to refer to isolation from others, both of people who have been exposed to a known or suspected case of COVID-19 and to cases. The term quarantine refers to isolation of people who are at risk of infection but are not known to be either a case or a contact of a case. In most cases this document uses 'isolation' or 'self-isolation' to cover quarantine as well in the interests of concision, but in a small number of places both terms are used for clarity.

## Introduction

The new variant of the SARS-CoV-2 virus (VOC-202012/01, variant B.1.1.7) represents a significantly increased transmission risk (high confidence) [1]. Thus, the need to reduce all routes of transmission, including within households, is greatly heightened. These should be in addition to rigorous application of measures outside the household including physical distancing, face coverings, ventilation, hygiene, vaccination, and effective testing, tracing and isolation which are essential for reducing the likelihood that infections enter the household in the first place.

Despite within-household transmission representing a very common mode of SARS-CoV-2 transmission, secondary transmission from a case to others within a household is not inevitable. Measures can be taken to successfully reduce the risk of secondary infection (high confidence) which may in turn have a major impact on population levels of transmission and R number.

### Reducing within-household transmission:

Previously identified mitigations to reduce transmission of SARS-CoV-2 within the household all continue to apply to the new variant but are likely to require a step change in rigour of application.

It is essential to apply a combination of stringent environmental, procedural, and personal control measures to mitigate all transmission routes within the home (via air, via close-range, and via surfaces and objects; see Figure 1). Baseline pre-emptive measures should be applied in all households and enhanced measures should be put into place when a person is confirmed or suspected as infected, or when a household member is vulnerable. When there is a confirmed or suspected case within a household, the most effective action is for the person to self-isolate within a different room as far as possible. More detail on this can be found in [Annex A](#).

It is important to note that even small reductions in transmission at the level of a single household can have a large impact when repeated in many households and scaled up across the population.

### Reducing between-household transmission:

In addition to wider measures such as physical distancing and wearing face coverings, adherence to self-isolation is important for preventing transmission between households. The best available evidence suggests adherence would be increased by targeted support to those asked to self-isolate. The precise form of support that is required is likely to differ from household to household. Ensuring that a broad package is proactively offered and is easily accessible by people (including those who may be distressed or unwell), could help to maximise adherence [2]. This paper synthesises evidence relating to the issues affecting adherence to household isolation and quarantine that need to be overcome, and potential solutions.

Unless barriers to transmission within and between disadvantaged households are successfully overcome, infection rates are likely to remain high in these communities, sustaining the pandemic and maintaining pressure on the NHS. Lockdown alone may not be sufficient to reduce infection rates in these households as they are more likely to continue to be exposed to risks of infection (for example, due to public-facing healthcare or key worker occupations, or residence in houses of multiple occupation [HMOs]).

We estimate that if all the measures outlined in this paper were followed and an overall 25% reduction in within-household transmission risk were achieved, this could lead to a prevalence of 10-15% lower after three weeks, with associated beneficial impacts for hospitalisation (medium confidence). See the SPI-M technical [Annex C](#) for further details.

In addition to the benefits of reducing the prevalence of COVID-19 and its consequences for hospitalisation and mortality, this would help reduce absences from work, either through illness or because of the need to self-isolate as a contact of a case, which would help to maintain the numbers of essential workers available to staff hospitals and primary care, schools, emergency services, and other key sectors.

## 1. Reducing within-household transmission

For the purpose of this document, a household is defined as a group of people (who may or may not be related) living at the same address and who share cooking facilities, bathrooms, or toilets and/or living areas.

This may include institutional settings such as students in halls of residence where facilities are shared. It is important to consider that in these kinds of environments an infectious case could lead to a large-scale outbreak, and that the responsibility for some actions will lie with the institution rather than individuals.

Awareness in the general population of the necessity, feasibility, and effectiveness of reducing transmission within the home is important for effective responses. Previously identified personal, procedural, environmental, and societal mitigations to reduce transmission of SARS-CoV-2 all continue to apply to the new variant but are likely to require a step change in the rigour of application, given the significantly increased transmission risk that the new variant likely represents (high confidence) [1].

Annex A summarises environmental, procedural and personal measures that could be taken within the home, ranging from pre-emptive background measures to enhanced measures when someone is self-isolating or quarantining due to confirmed or suspected infection.

### A. Pre-emptive infection control measures applicable to all households

It is likely that where households follow good practice to minimise transmission within the home at all times, the overall risk of transmission will be reduced (medium confidence). These are described in previous papers [3, 4, 5], and summarised as “pre-emptive measures” in Annex A. This requires focusing on the three main routes of transmission - close-range, airborne, and surface contact - with routine measures that include: ensuring regular ventilation of common areas; maintaining adequate physical distancing from visitors wherever possible; frequent handwashing using soap and water; limiting the use of sharing surfaces or objects (e.g., towels) where feasible; and frequent cleaning of shared surfaces.

A more extensive programme of communication and support is required to increase motivation, skills and capacity to reduce transmission within households [2, 6]. This should include using the outputs from relevant research programmes, such as Germ Defence [7], that are designed to provide practical advice on reducing transmission risks in the home (high confidence). To date, Germ Defence (which was developed with extensive co-design and input from diverse users) is the only digital intervention worldwide with evidence of reducing transmission of infection in the home [6].

**Figure 1.** Infographic taken from Germ Defence (see [www.germdefence.org](http://www.germdefence.org)).



Community engagement and co-production is required to ensure communications and interventions are developed that address the needs of different communities and types of households. It may be necessary to change existing patterns of household activity and interaction to protect household members (e.g. reallocating cleaning or caring responsibilities) and acceptable and feasible solutions need to be agreed by household members.

**B. Households in which there is a suspected or confirmed case, and there is a requirement for one or more people to self-isolate or quarantine**

When a person within a household is suspected or confirmed to have COVID-19, further measures will be required in addition to those listed above. To ensure that these measures are in place during the period in which the person is most likely to be infectious, it is important to implement additional measures as soon as there is any suspicion that a person may have been infected or exposed to risk of infection, rather than waiting for a positive test result. To improve timely uptake of these measures, information on the importance of self-isolation and infection control measures, and advice on how to achieve them, could be given when requesting a test and / or at the time of the test. Suspicion of exposure or infection might be based on NHS contact tracing, an alert from the NHS App, the development of symptoms, receipt of a positive test, or an informal notification from a

friend, co-worker, or other contact that they have developed symptoms or tested positive. Additional measures become even more important if infection is confirmed.

There is evidence from household studies of COVID-19 [8, 9] and other respiratory pathogens [10] that enhanced hand hygiene and surface cleaning can reduce the risk of transmission within the household. There is also evidence that wearing face masks in homes with an infected case can reduce transmission of SARS-CoV-2 and influenza [9, 10]. Sleeping in the same bedroom and dining together have also been identified as risk factors [11]. High contamination of surfaces in close proximity to an infected person and in the bathrooms that they use has been seen in multiple hospital sampling studies [12, 13] and in a household sampling study [14], and diarrhoea has been identified as a risk factor for transmission [11].

A person who is a suspected case, wherever possible, should stay fully apart from other members of the household, remaining within a dedicated room. Ideally, they should not share a bedroom, bathroom or toilet with others, nor should they eat alongside other members of the household.

However, for many households, this level of isolation within the home may not be possible due to constraints on space and/or facilities. Previous modelling of out of home isolation showed a modest impact on reducing transmission [15], but if cases were to be detected and notified sooner, and provided with alternative accommodation where necessary, before they have passed on the infection to others in the household, there would be potential for greater benefits.

It may not be possible to engage in all possible mitigation measures due to caring responsibilities, if young children are present within the home [16], or if members of the household are not able to self-isolate inside or outside the home. Engaging in as many as possible of the recommended behaviours, even if not all of them, is however still likely to reduce risk – these measures must not be viewed as “all or nothing.” Cases are infectious for about 10 days, and with varying levels of infectiousness during that period. A reduction in per person transmission risk from 20% to 10% to 5% has the potential to reduce the risk of 1 or more secondary infections in a six-person household from 67% to 41% to 23%.

### C. Households in which one or more people are at increased risk of COVID-19 (clinically vulnerable or clinically extremely vulnerable)

Some people are at elevated risk of severe consequences or death from COVID-19 and may be considered as either high risk (‘clinically extremely vulnerable’), or moderate risk (‘clinically vulnerable’) [17]. In households where one or more people sit within one of these categories, it is even more important to take exceptional care to reduce the likelihood of them becoming infected.

All the measures described above should be followed rigorously. If it is not possible for a case or contact to self-isolate fully within the home, they should, wherever possible, stay in a safe environment outside of the home for the period during which they are infectious, or until they have received confirmation from repeated tests that they are not an infection hazard to others. This may require the kinds of support described elsewhere in this paper, including provision of out of home accommodation.

#### D. Reducing transmission in large or multigenerational households

Larger occupancy households (number of people in the household) and multigenerational households (households with at least one person aged 65 or over and one person 20 years younger) are linked to increased risk of infection and/or mortality [18]. The pathways explaining the role of household composition and increased risk of household transmission are not well understood but likely to be multiple and interrelated, with complex interactions of internal and external drivers such as occupation, housing quality and crowding, age composition, and social relationships.

Larger households can take different forms including multiple adults who are not related (e.g., HMOs) or one or two adults with multiple children. The risk of transmission increases as the number of people in a household increases [19]. Shared spaces, surfaces, and objects, such as kitchen and bathroom areas, have high potential for fomite transmission and this risk increases with the number of people and frequency of use.

Deprivation and economic constraints are associated with household overcrowding and reduced availability of space such as a spare room. Overcrowded or dense living conditions increase the risk of droplet and aerosol transmission. There is a triple burden of risk imposed by deprivation and poverty. People living in these situations are more likely to be in public-facing occupations that generate increased exposure to risk of infection, with an increased likelihood that they will be in low-paid, precarious employment which increases the disincentives for them to engage in testing or isolation because of risks to their income over the short and long term. At the same time, they are less likely to be able to isolate from others within the home than more affluent people if there is a lack of space. These problems may be exacerbated in certain ethnic groups that have a higher preponderance of large and/or multigenerational families living in the same home where space is limited [11].

Multigenerational households are more likely to have at least one family member with another disease that puts them at greater risk of COVID-19 when compared to single generational households [20] and are more likely to include individuals who find it difficult to avoid exposure through occupation such as key worker roles. Caring responsibilities within the home increases risk of transmission from younger to older family members and from older family members that are being cared for to younger family members [21]. Domestic and kin care has intensified during the COVID-19 pandemic in the UK due to a reduction in formal services and greater reliance on informal patterns of care [22].

Households are not only physical structures containing numbers or types of people, they are part of a network of support structures of kin and care work, which carry risks of transmission, but which are also crucial to weathering economic and social shocks [23]. Supportive measures are required to make these networks safer, particularly for disadvantaged and minority groups, without undermining the importance of family values, culture, social support and care work.

In addition to the support requirements outlined in Section 3 and [Annex B](#), a combination of additional measures, including practical and specific guidance relevant to larger and multi generation household include:

Co-designed, socio-culturally tailored public health communications that reflect a wide range of different family and household types, including larger occupancy and multigenerational households are more likely to be effective [24]. Communications should raise awareness of how to make domestic and care work safer within the household. This includes guidance on how to reduce

transmission both between carers and those who are cared for, and from younger to older members of the household. Risk factors are also high for people who carry out household work of cleaning and care work, paid and unpaid. Clear instructions on how to do this safely are required to minimise this risk.

Mitigations and self-isolation may be difficult to enforce where shared responsibility for maintaining the health of the household may not be present, such as houses of multiple occupation (HMOs) or institutional settings, or where there are gendered expectations of domestic and care work [25]. Support to enable within-household communication such as developing an agreed social contract (in HMOs) or a household action plan may promote safer practices within large and/or multigenerational households.

For communities which prioritise wide kin networks, communications should include language that emphasises protecting the family. This could potentially reduce difficult conversations and decisions, particularly for larger households with extended family networks, to implement safe measures within the household.

Community champions can support communities and local authorities to co-create interventions and increase awareness of support and trust towards public health campaigns to promote behaviours that reduce transmission in the home.

Practical Support to improve housing conditions and enable implementation of mitigations.

Overcrowded households in deprived areas are linked to poorer housing quality. Funds to support short-term emergency improvements to housing quality or enhance winter fuel payments could help increase or enable good ventilation for those who are most vulnerable while maintaining thermally comfortable conditions and reduce damp and mould [4], minimising the risk of poorer COVID-19-related health outcomes in disadvantaged groups. When the national lockdown is lifted, community spaces and improved access to green infrastructure such as gardens and parks may promote safe meetings of people from different households, reducing the risk of transmission within crowded dwellings.

## 2. Reducing transmission between -households

In addition to wider measures such as physical distancing and mask wearing, adherence to self-isolation is important for preventing transmission between households. Current estimates of adherence differ depending on sample and how one defines “adherence” (see [Annex B](#)) but suggest there is substantial room for improvement.

The best available evidence suggests adherence would be increased by targeted support to those asked to self-isolate [2]. The precise form of support that is required is likely to differ from household to household. Ensuring that a broad package of support is proactively offered and is easily accessible by people (including those who may be distressed or unwell), should help to maximise adherence [2].



### A. Support for households and individuals

Four forms of support are important to consider when developing a comprehensive support package:

1. Financial support which ensures that people would not experience financial hardship when self-isolating is likely to enable more people to adhere. Financial hardship, lower socioeconomic position and inability to work from home are currently associated with lower self-reported adherence [26]. The roll-out of paid sick leave policies has previously been associated with reduced sickness absence in the USA and lower spread of influenza [27, 28].
2. Practical, non-financial support may be required by many people. Leaving home to shop for food or groceries is a common self-reported reason given for non-adherence [29, 30, 31]. This could be mitigated if food retailers were to reserve a number of slots for same-day delivery for households that need to isolate. Caring for others, including vulnerable friends and family who live outside the home, is also a barrier to adherence [29]. Receiving support from outside the household is associated with a greater likelihood of adherence [32]. The type of support needed is likely to differ between households. Proactive outreach should identify the specific needs of each household and the best way to help. Particularly for large or multigenerational households, support to ease the burden of domestic and care work within households such as provision of PPE, cleaning supplies, pre-packed meals (to minimise time in the kitchen), and paid care workers if household members become unwell could minimise transmission risks between household members.
3. Information about the principles underlying self-isolation should help people understand why and how to adhere. Multiple studies in the current pandemic and in previous outbreaks have shown that low levels of knowledge, not believing the illness to pose a serious risk, and not perceiving a benefit to self-isolation are associated with lower adherence [29, 30, 33]. The importance of making information clear and shared by trusted sources should not be underestimated. A campaign similar to the current #HandsFaceSpace campaign may be helpful, in addition to messages targeted at those who are self-isolating.
4. Support for psychological wellbeing will be important for many people. Distress amongst those self-isolating is associated with financial stressors, inadequate access to essential supplies including food and medicines, insufficient or unclear guidance and confusion as to the purpose of self-isolation [34]. Resolving these issues may improve wellbeing. Social and emotional support may also be required by some and can be provided following an initial assessment by local schemes in addition to more formal mental health services (including those delivered remotely). Reducing emotional distress is likely to bolster adherence further [29].

Annex B provides further details of what a broad package of support might look like in the UK context.

Annex A: Environmental, administrative and personal protection measures to reduce the risk of transmission within households through close-range, airborne and surface contact transmission routes.

It is likely that people will be able to adhere more effectively with these recommended measures if guidance is provided through easily accessible formats, including online tools (e.g. the Germ Defence website [35]).

It is essential that measures are taken to mitigate all transmission routes (via air, via close-range and via surfaces and objects). When there is a confirmed or suspected case within a household, the most effective action is for them to self-isolate within a different room as far as possible.

	The physical environment	Procedural actions	Personal actions
<b>Baseline:</b> Pre-emptive infection control measures applicable to all households			
<p>These are measures that could be taken on a daily basis with relatively small impacts on daily lives.</p> <p>Greater rigour may be needed in houses of multiple occupation and households where people have more interaction with those outside (e.g. through work/education) and hence there is a greater risk that infection will be brought into the household.</p> <p>It is important to pay more attention when there are visitors to the home (e.g. tradespeople/support bubble).</p>	<p>While maintaining physical distancing with close household members is unlikely to be desirable or feasible, it is a good idea to maintain distance as far as possible from any visitors to the home. Consider physical arrangements and keep visits to as short a duration as practical.</p> <p>Regular airing of rooms is beneficial for health and wellbeing as well as reducing COVID-19 risks through build up of aerosols. Ventilation is most important when there are visitors to the home who may be a source of infection – open windows and/or use extract fans before,</p>	<p>Ensuring that the house, especially high touch surfaces, is kept clean, will reduce risks of surface and fomite transmission. Cleaning bathrooms is particularly important as studies have shown these can be more contaminated. It is also important to clean after any visitors have come into the home.</p> <p>Where it is feasible to do so, avoid sharing towels and other surfaces that are hard to clean, especially in houses of multiple occupation.</p> <p>Closing toilet seat lids before flushing can minimise any contamination of the environment by faecal aerosols.</p>	<p>Washing hands regularly is shown to be effective at reducing the risks of infection. Washing hands immediately when returning home is good practice.</p> <p>Practicing good respiratory hygiene through using and safely disposing of tissues and immediately washing hands can reduce contamination of the air and surfaces.</p> <p>Face coverings are unlikely to be practical or feasible on a routine basis, but it is likely to be beneficial for visitors such as tradespeople and occupants of the home to wear face coverings during a visit.</p>

	<p>during and for a short while after their visit.<sup>2</sup></p> <p>As far as possible maintain comfortable temperatures and indoor humidity. As well as impacting on virus survival this is beneficial for the wider health of occupants.</p> <p>Shared bedrooms have been shown to pose a risk, so keeping a window open slightly at night where practical may be beneficial.</p> <p>It is possible that some people may shed the virus through faeces. Ensure plumbing systems are in good order.</p> <p>Restrict visitors to the home to only those who are essential</p>	<p>Excessive cleaning, however, could cause other health issues due to exposure to chemicals, so it is important to maintain good ventilation during cleaning activities.</p> <p>Ensuring good ventilation during activities such as high energy exercise in shared indoor spaces can minimise aerosol exposure from someone who is asymptomatic</p> <p>Pay particular attention to good hygiene during food preparation and ensuring cutlery and crockery are washed thoroughly.</p> <p>Advice on appropriate risk mitigation for people (both paid and unpaid) carrying out domestic and caring work in the home such as cleaning, laundry etc.</p>	
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<sup>2</sup> Household ventilation is an area that is often overlooked or perceived as difficult due to concerns that additional heating costs will be incurred as a result. There may be other barriers for example, noise or security. Use of ventilation is commonly associated with control of thermal comfort. Opening windows is the simplest method of increasing ventilation for most people. Wider openings provide more air flow, but this does not mean that a window must be wide open all the time, even opening the window a small amount can be effective, even more so if windows can be opened on both sides of a dwelling. Opening windows intermittently to refresh the air may still be effective if windows cannot be left open the whole time. However, simple actions such as leaving open background trickle vents, and not closing or blocking vents, can ensure there is constant background ventilation. Ventilation can also be increased by leaving extractor fans running in bathrooms, toilets, and kitchen areas for longer than usual, with the door closed, after someone has used the room. If someone is isolating in a room, keeping the door closed and having the vents and the window open slightly may help to keep this room separate from the rest of the home. More guidance on ventilation has been provided previously by EMG [51].

<b>Enhanced 1: With a person in the household who is likely to be vulnerable to severe consequences of infection</b>			
<p>Where someone is vulnerable, it is beneficial to undertake a review of the environment to maximise ways of reducing their likelihood of being exposed to the virus from a household member, a visitor, or objects brought into a home. This should be done with care to ensure that vulnerable members are not socially isolated or stigmatised.</p> <p>Alongside measures in the home, use of regular asymptomatic testing by those who attend education or work outside the home in public facing roles may reduce the risk of exposure to a vulnerable household member.</p>	<p>In addition to the measures above:</p> <p>Maintain more focus on ventilation to ensure that areas where a vulnerable person has to interact with anyone else are kept well ventilated.</p> <p>Identify strategies to maintain greater distance between the vulnerable member and others. This could include them sleeping in a separate room if this is possible, and rearranging furniture to make distancing easier.</p>	<p>In addition to the measures above:</p> <p>Pay greater attention to cleaning, especially high touch surfaces, identify strategies to limit the use of shared objects such as towels, cutlery and crockery.</p>	<p>In addition to the measures above:</p> <p>Pay greater attention to maintaining good respiratory and hand hygiene</p> <p>Strongly encouraging any visitors to the home to wear face coverings may minimise the risk that they inadvertently bring the virus into the home.</p>
<b>Enhanced 2: When a member of the household is a suspected contact and is quarantining</b>			
<p>When someone has been identified as a contact of an infected case they should behave as if they may be infected and adapt the environment and their interactions with others in the home accordingly.</p> <p>If this person is a carer for others in the household, then they should not stop these activities (unless there is an alternative within the home), but</p>	<p>In addition to the measures above:</p> <p>Consider whether further adaptations can be made to the environment, including restricting the contact to a different room as far as possible.</p> <p>Ensure rooms where the contact spends time are well ventilated, especially if they have to be shared with others.</p>	<p>In addition to the measures above:</p> <p>Avoiding activities that may generate aerosols, such as singing or high energy exercise within shared rooms in the home during the self-isolation or quarantine period is likely to reduce the chance that any virus is shed.</p>	<p>In addition to the measures above:</p> <p>Evidence suggests that wearing face coverings where there is a case in a household can reduce transmission. If the contact has to interact with others it would be beneficial for them to wear a face covering. These should be washed regularly/disposed properly</p>

<p>should take additional care especially if they are caring for a vulnerable person.</p> <p>Even if others in the household are not required to self-isolate or quarantine they should take extra care as there is a higher chance that they too may be infected.</p>	<p>Do not allow any visitors to the home unless they are critical for health/care or emergency reasons.</p>	<p>Pay more attention to limiting the use of shared surfaces and objects.</p> <p>Where possible, contacts should use a different bathroom to avoid contaminating surfaces. Where this is not possible, they should always clean the bathroom after use.</p> <p>Contacts should avoid preparing food themselves as far as possible, and where this is unavoidable, they should use kitchen facilities at a different time and clean afterwards.</p> <p>Where possible the contact should eat separately from the rest of the household, ideally within the room where they are quarantining</p> <p>Wash clothes, towels and bedding more regularly, especially those used by the potential case.</p> <p>Provide advice for people carrying out domestic and caring work on how to minimise their risks of infection.</p> <p>Ensure enhanced hand hygiene for all household members</p>	
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Enhanced 3: When a member of the household is a confirmed case and they (and the rest of the household) are isolating			
<p>When someone has tested positive, they should assume that they can transmit the infection through the air, through close-range interactions, and through contamination of surfaces.</p> <p>Actions to minimise interactions with all other household members can potentially reduce the risk that they spread their infection.</p> <p>It should be assumed that one or more others in the household could also be infected and hence all should behave as if they were infected.</p>	<p>In addition to the measures above:</p> <p>Confine the infected person to a different room as far as possible, with their window open and door closed.</p> <p>Maintain greater distancing between all other household members in case others are infected.</p> <p>Maintain good ventilation in all rooms where people spend time.</p> <p>Do not allow any visitors to the home unless they are critical for health/care or emergency reasons.</p>	<p>In addition to the measures above:</p> <p>Restrict all use of shared objects as far as possible between all household members.</p> <p>Maintaining an enhanced standard of cleaning throughout the whole house is likely to be beneficial, assuming that any member could be infected. Always use PPE and other protections for people carrying out domestic and caring work.</p> <p>If providing care to the infected person, ensure high touch surfaces such as door handles and the items they used (e.g. cutlery/crockery) are cleaned thoroughly. Evidence suggests surfaces close to the person are likely to get contaminated. Hot water and soap, bleach based and alcohol cleaners are all effective.</p> <p>Ensure enhanced hand hygiene for all household members</p> <p>Wash clothes, towels and bedding for all household members more regularly, with those from the infected person on a hot wash.</p>	<p>In addition to the measures above:</p> <p>There may be benefits to all adult household members wearing face coverings if they have to interact with the infected person or in close proximity to each other. These should be washed regularly / disposed properly.</p> <p>Where care needs to be provided to an infected person, additional PPE such as gloves and eye protection may be beneficial. If, however, this is used, it needs to be taken off with care and disposed of/cleaned correctly.</p> <p>Good hand hygiene following any care of an infected person is essential.</p>

## Annex B: Support that may improve adherence to self-isolation

### *Testing in England is currently detecting most cases of COVID-19*

The last incidence estimate produced by the ONS was for the week ending 28 November. That week, ONS estimated that there were 179,900 new cases of COVID-19 [36]. Over 19 to 25 November, NHS TT tested 1,663,130 people for COVID-19 and identified 110,620 cases [37]. This suggests NHS TT successfully identified 61% of new cases. Note that around a third of people with COVID-19 do not experience any symptoms and hence are technically ineligible for a test in many regions.

### *Current rates of adherence to self-isolation remain unclear, but are likely suboptimal*

Current levels of adherence to self-isolation are difficult to state with any certainty. In September, SPI-B reviewed three studies in the UK and highlighted their methodological limitations [2]. Since then, several more estimates have been produced.

Self-reported full adherence to self-isolation among respondents in a recent cross-sectional population survey who had cough, fever or loss of taste or smell was 29% [26]. Full adherence may be hard to achieve and among those who are not fully adherent there may be many people whose minor transgressions pose only a low or negligible risk, although these may nevertheless represent important contributions to transmission at a population level.

Among people who are in contact with NHS Test and Trace, a cross-sectional survey has found that 59% of people report not having left their home (other than to go for a Covid test or a medical emergency) [30]. This survey had a 16% response rate. Given that adherence is probably correlated with likelihood of responding to the survey, this rate of adherence is very likely an over-estimate. This measure is limited to those people who are already 'in the system' – people who have not sought a test after developing symptoms or who are not named as contacts are not included.

Among international arrivals who had entered the UK and were required to self-isolate, a cross-sectional survey of 1,191 travellers by the ONS identified 67% whose self-reports categorised them as compliant and 12% who appeared to be non-compliant (the remainder had uncertain compliance) [31]. The response rate for this survey is not clear, and the use of self-report to measure a behaviour that is legally enforceable is a major limitation.

### *There are many factors affecting adherence*

There are multiple factors that are likely associated with low adherence to self-isolation. These have been discussed previously by SPI-B [2] and can be broadly divided into financial, practical, informational and emotional factors. Table 1 lists factors that have been identified in research with UK samples as associated with lower adherence. Note that the table is not a fully comprehensive summary and that categorisations made in the table are purely illustrative. For example, issues such as having a dependent child at home are likely associated with financial, practical, informational and emotional challenges. The key message from Table 1 is the range of challenges that exist. There is no single 'magic bullet' solution to low adherence. As previously discussed by SPI-B, financial support is necessary. However, it may not always be sufficient. Note also that, aside from one randomised controlled trial of SMS and or telephone contact with people in self-isolation, all factors within the table were identified in cross-sectional surveys or qualitative studies. We do not have direct evidence that interventions that target these factors improve adherence.

**Table 1:** Example factors affecting full self-isolation, as identified by research in UK participants

<b>Category</b>	<b>Factor</b>
<i>Demographic factors</i>	Male gender [32]
	Younger age [31]
<i>Financial issues</i>	Lower socioeconomic grade [29], greater financial hardship [29] [although one study reported little difference in adherence between those who did and did not receive sick pay from their employer] [30]
	Leaving home to go to work [29]
	Key worker status [29]
<i>Knowledge or perceptions</i>	Belief that you have previously had COVID-19 [29]
	Lower knowledge about symptoms of COVID-19 or guidelines on how to self-isolate [29] [30]
	Delayed self-isolation after symptom onset [38]
	Symptoms improve [29] / Symptoms are mild [29]
	Lower perception of risk from coronavirus outside the home [32] / Lower perceived personal risk of COVID-19 [30] / Lower perceived risk to society of the pandemic [30]
	Low perceived effectiveness of self-isolation [30] / Low perceived importance of following advice [30]
	Low perceived risk of COVID-19 to friends and family [30]
	Low confidence in ability to self-isolate [30]
	Higher perceived credibility of government [29]
<i>Practical issues</i>	Need to shop for groceries / other supplies [16] [29] [32]
	Performing “one last trip” before beginning self-isolation [30]
	Need to help or provide care for a vulnerable person [29]
	Not receiving help from outside the home [32]
	Not receiving supportive calls from NHS Test and Trace [30] / Being informed of need to self-isolate by means other than phone [30]
	Lower sense of community with others in the neighbourhood [32]
	Cramped accommodation [16]
	Having a dependent child [29] in the household
	Leaving home for a walk / other exercise [29]
	Loneliness / to meet friends and family [29] [31]
<i>Emotional issues</i>	Boredom [29]
	Greater perceived impact on mental health [32]



### ***What would a broad support package look like?***

Based on the factors identified in Table 1, a broad package of support to improve adherence by tackling as many issues as possible should include several components. Community champions could provide support to enable each of these components making them accessible to a wider range of communities. Examples of these components are provided below, building on the evidence that is referenced in Table 1.

#### ***1. Information distributed to the wider public***

Given that transmissibility is highest in the early stages of infection, ensuring that people appreciate the need to enter self-isolation immediately after developing symptoms is important. This would require a public information campaign. This should focus on factors likely to prevent people from beginning self-isolation, including:

- Explanation as to the exact symptoms that necessitate self-isolation [38].
- Explanation as to the need to self-isolate for even mild symptoms [38].
- Emphasis that self-isolation is important for protecting other, vulnerable people and an illustration of the effectiveness of adhering to self-isolation in achieving this.
- Explanation that self-isolation is most effective if begun immediately.
- Uncertainty as to the necessity of self-isolation among people who believe they have already previously had COVID-19 [29]. Currently, around 15% of survey respondents in the UK believe they have already had COVID-19 [39].

#### ***2. Communication with people who are asked to self-isolate***

- Telephone contact with a case worker from NHS TT is associated with greater adherence and should continue.
- A positive, supportive interaction between a case worker and patient should allow the case worker to get a better understanding of the needs of the patient, and is more likely to encourage adherence [40]. Interactions with NHS TT that people find frustrating should therefore be minimised. Possible examples worth consideration include:
  - Case workers should have authority to prevent repetitious calls or texts to a household, and to manually correct the 'countdown' timers given in texts, emails and the NHS App where these would otherwise be inconsistent;
  - The impact of messages relating to legal enforcement in messages should be reviewed;
  - Allocating one case worker to act for an entire household and conduct all contact tracing and needs assessments might reduce the time required in dealing with a household and any perceived inconvenience for household members.
- Messaging should recognise that self-isolation can be distressing. Demonstrating concern for the patient and thanking them for adhering may help promote a good relationship and reinforce the core rationale for adhering: the protection of other people [40, 33].
- Information to those in self-isolation should cover:
  - The basic guidelines on how to self-isolate, including the need to self-isolate from other household members as far as possible;
  - The need to continue self-isolation even if symptoms improve;
  - The importance and effectiveness of self-isolation in protecting vulnerable people.
- Given that inability to socially distance within the home has been highlighted several times as a challenge for people [16, 41, 42, 43], this adds weight to the need for advice on strategies

to improve hygiene practices within the household. Evidence-based [7] packages that achieve this already exist [35].

### *3. Financial support*

Provision of financial support would resolve many, though not all, of the issues identified in Table 1. Adequate financial resources are necessary, but not always sufficient, for adherence. The roll-out of paid sick leave policies has previously been associated with reduced sickness absence in the USA and lower spread of influenza [27, 28].

- A flat-rate provision of financial support could remove many practical barriers that people may experience (e.g. ability to buy groceries, pay for essential bills).
- Additionally, reimbursing people for all financial losses arising from self-isolation would remove a disincentive to self-isolation among people who are not in receipt of sick pay. Intentions to self-isolate in a general population sample in Israel increased from 57% to 94% when lost wages were to be compensated [44].
- Even where money is paid to cover time away from work, concerns about job security will also be important for some – a guarantee that work will still be available after self-isolation is important.
- Ensuring that financial support is well communicated, easy to obtain and provided rapidly may improve uptake [45], particularly given that some people may need to access it when ill or distressed.

### *4. Practical, non-financial support*

- Accessing groceries, medication or other essential shopping is a common reason given for leaving self-isolation. An offer of a free, prioritised delivery slot via a local food retailer or one of the major supermarkets made at a very early stage in the self-isolation period may remove this barrier for many people. For other people, including those who require medication, more direct in-person support will be needed.
- The need to provide care, broadly conceptualised, also appears to be a barrier to adherence. This includes, among other things:
  - care for vulnerable family members or friends who live outside the home;
  - care for children, for example arranging transport to school or outside activities where only the parent is required to self-isolate;
  - care for animals, for example walking a dog or looking after livestock;
- Arranging support to deal with many practical barriers is likely to require links to local councils, charities or mutual aid groups. Many routes to support already exist. NHS TT case workers, messages and websites should provide links to the wide range of support that is on offer, and ensure people feel comfortable accessing it – an assessment of any barriers to access would be worthwhile.

### *5. Emotional support*

Self-isolation can be distressing [34]. Given that boredom, loneliness and perceived impact on mental health are associated with lower adherence, strategies to reduce these effects should be explored. These could include, as examples:

- Vouchers for entertainment (e.g. online video or games providers);
- Continued use of NHS volunteers for “Check in and Chat” services;

- Follow-up by the case worker beyond the self-isolation period, to identify ongoing and unmet physical or mental health needs.

### ***Involving mutual aid groups, charities and the private sector***

There are thousands of COVID mutual aid and similar community support groups across the country. While these were most active in the early days of the pandemic, many are still active now. They are spread across the country, but some studies suggest they are more active in areas with high social capital [46], which suggests that some areas may not be actively served by them.

Delivery of essentials such as food and prescriptions dominated early efforts in COVID-19 volunteering. A second type of activity which became increasingly common as the first 'lockdown' wore on was combating social isolation through forms of emotional support such as arts and crafts packs, telephone support, and online social activities [47]. Mutual aid groups also walk dogs, provide information and offer other support [48].

Needs / requests for support are often identified through social media sites. Many groups have links with the local authority/ local resilience forum, which enables them to get information on who is in need of support. Collaborative relationships with local councils are important for effective provision of support, and may help mutual aid groups obtain resources such as storage space and other facilities [49, 50].

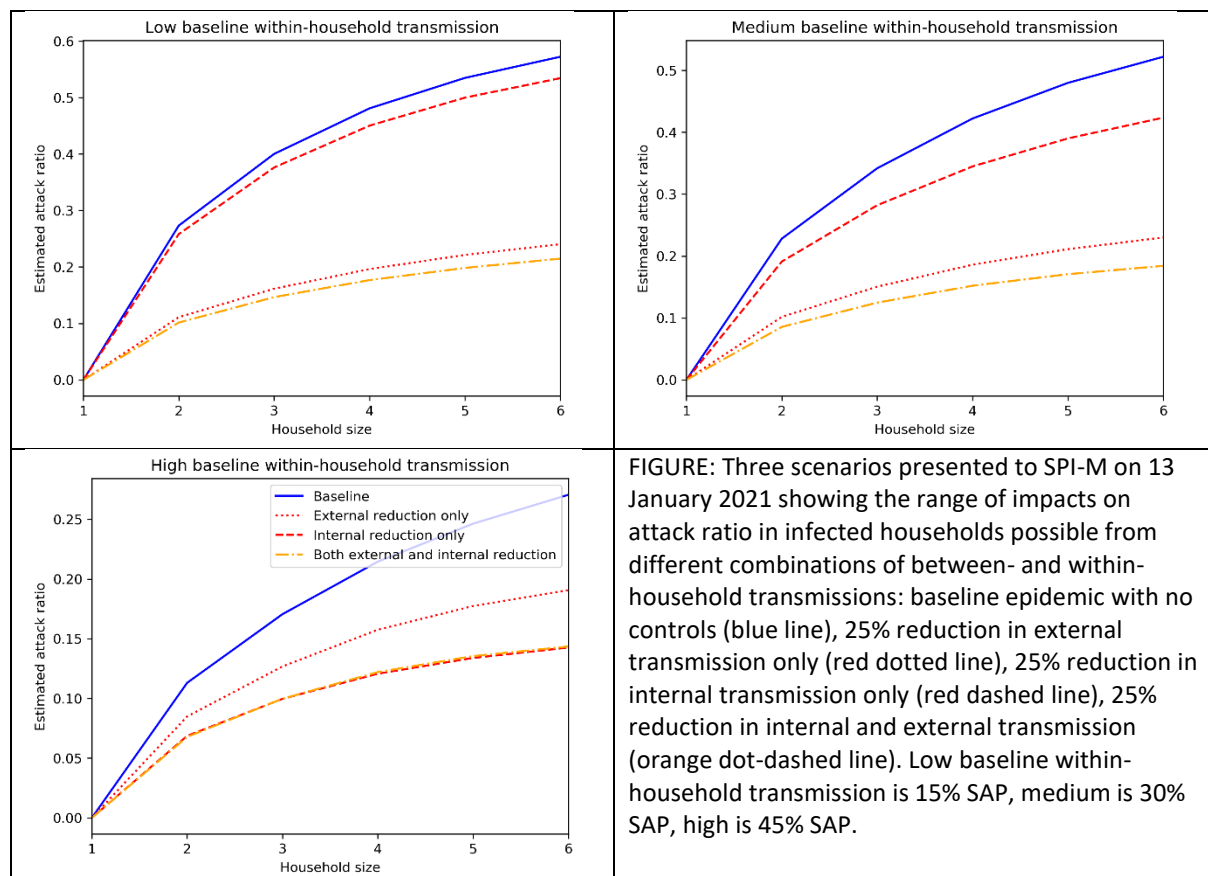
Partnerships with the private sector may also help reduce the challenges inherent in self-isolation. For example, local retailers and supermarkets could provide support with deliveries, the entertainment industry could provide access to programming and games, and the fitness and wellbeing sector could provide remote access to workouts or mindfulness routines.

## Annex C: SPI-M Technical Summary on Modelling Household Transmission

The model is based on a set of self-consistent differential equations (see <https://doi.org/10.1016/j.idm.2020.06.008>, section 3.3.1) with open-source code under continual development at <https://github.com/JBHilton/covid-19-in-households-public>. In this approach, we represent the epidemic dynamics with SEPIR compartmental structure, age-structure and observed household sizes and compositions from England and Wales demographic data.

The figures below demonstrate the impact of reduction of between and within household transmission. Between household transmission is reduced by reducing the rate of contacts between members of different households (e.g. closing schools, restricting mixing), and reducing the risk of transmission when contact occurs (e.g. COVID security). Within household mixing is reduced by measures discussed in the text. The outcomes considered are prevalence of symptomatic infection, and estimated attack ratio, the proportion of household members who are infected in those households which see at least one introduction during the 90-day projection period. We exclude any contribution from the index case from this proportion, so that the estimated attack ratio for households of size one is zero because after the index case there are no other household members to infect.

Four scenarios are considered for three different levels of within household transmission measured by the secondary attack probability (SAP), the probability that a susceptible individual is infected by the first infectious case in their household. The solid blue line is the no control situation. The impact of reducing within household transmission only (red dashed line) and the marginal benefit of reducing within household transmission with between household transmission (compare the red dotted line to the orange dash-dot line) are small unless within household transmission is high, as is the case in HMO and high deprivation.



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