ADVICE FROM THE ADVISORY GROUP 2 JULY 2020

Advice Commissioned by the First Minister and Chief Medical Officer on Superspreading

Superspreading Events

In considering these questions, 'superspreading' should be considered in the context of outbreak management, as a collection of circumstances that come together to produce the right conditions for spread from a proportionately small number of individuals, locations or events. In some diseases typically 20 percent of the host population contributes to at least 80 percent of the net transmission potential, as measured by the basic reproduction number, R. This is an example of the statistical pattern known as the 20/80 rule. The rule applies to a variety of disease systems including vector-born parasites and sexually transmitted pathogens. The rule implies that control programmes that are targeted at the "core" 20 percent group are potentially highly effective and, conversely, that programmes that fail to reach all of this group will be much less effective than expected in reducing levels of infection in the population as a whole[i].

1. What is the most recent evidence on the types of settings and locations that have highest risk of transmission?

Published accounts and those reported in the media reveal some common themes. Typically these are indoor locations with large numbers of people brought into close proximity for a significant period of time. The virus seems to transmit better indoors, particularly in damp, cold places. The latest evidence indicates that large clusters are associated with religious events spanning a number of days, worker dormitories, care homes, hospitals, prisons, ships, bars, conferences and food processing plants. Few clusters were reported in schools[ii].

International data is helpful in understanding this, but should only be taken as indicative of the kinds of environments where COVID-19 transmits, as the published studies are far from systematic and do not provide a basis for quantifying the risk associated with specific settings in Scotland.

The evidence suggests that schools, and in particular children, are not significant drivers of transmission. Most "outbreaks" are very small (index case + 1) and in the larger ones the teachers were more involved that the children.

There have now been a number of very large outbreaks associated with meat processing plants, both in North America and Europe. These are not yet fully understood. Larger numbers of people brought into close proximity indoors seems likely to be the main factor. One theory is that they are noisy and so people come close and shout at each other, which may increase transmission of infection. Other factors may include a low income workforce, often living in dormitories.

In addition to locations, individuals and occupations can be the focus of superspreader events. As well as analysis of superspreader occupations involving

large numbers of interactions with people from different networks (such as supermarket workers, security guards, cleaners and care workers), there is a wealth of social science network analysis which looks at individuals who form the hub of multiple networks. This needs to be taken into account alongside location risks.

2. What environmental and behavioural characteristics are associated with greater likelihood of superspreader events? Is superspreading more likely from symptomatic or pre-symptomatic individuals?

The mechanisms are not certain but these events are predominantly related to indoor settings where people are in close proximity for a period of time, including workers sharing accommodation. Humidity and low temperature are also possible factors. Shouting and singing have both been proposed as potential risk factors in increasing the spread of the virus. Close personal contact, most prominently personal care in healthcare and care home settings, is a high risk factor for spread.

It is always difficult to ascertain who might have been the person from whom a large scale infection event has occurred. Thus, it is difficult to estimate the relative risk of spread from asymptomatic versus symptomatic individuals. However, a number of studies have found that viral loads are very similar in asymptomatic and symptomatic individuals, and that in a pre-symptomatic phase, viral loads are probably at their highest. Absence of cough will limit spread from respiratory particles, but speech alone can generate infectious particles, and spread from asymptomatic individuals in domestic settings has been reported. Thus, it is biologically entirely plausible that large scale transmissions could result from an individual who was asymptomatic at the time of transmission.

3. Are any additional mitigations required or advised in these settings? What is the strength of evidence that these reduce the likelihood of a superspreader event?

Physical distancing commensurate with the community level of infection and the use of face coverings/masks and proper hygiene are potentially important mitigating factors. The reduction in case numbers during lockdown is perhaps the best evidence that limiting social interactions of any sort is highly effective in limiting spread. There is strong evidence that good hygiene is important, while the evidence on distancing is dealt with elsewhere in this paper. Evidence that face coverings/masks are effective in community settings is relatively weak but has strong biological plausibility.

4. How should people be given advice and information to allow them to assess or mitigate their own risk if frequenting these places?

Visible notices reminding of the need to maintain the safe distance are recommended. For individuals at high risk the best solution might be to not frequent such places.

5. What steps should be taken to ensure that a venue associated with any outbreak, such as a hospitality or leisure site, will support test and protect procedures i.e. recording names and addresses of people who attend?

Knowing where an infected individual has been is a key fact to determine if they could have spread infection to larger numbers of individuals. Collation of contact details at such locations would thus significantly facilitate tracing of potentially infected individuals before they develop symptoms and thus help to reduce community transmission.

Technology, such as that used In New Zealand, can enable phones to capture contact details of those visiting a location, by scanning a QR code posted at the venue. This has the advantage of ease of use, although some may be reluctant to leave personal details. One of the New Zealand apps keeps the personal data on the phone but allows private notification if a case is identified at a venue to alert the user to contact the tracing team or to self-isolate[iii].

6. Are superspreading events associated with use of public transport? Can reliable methods to support contact tracing of individuals using public transport be identified from literature?

The closed, crowded environment in most public transport would highly favour transmission of SARS-CoV-2. Studies of the spread of influenza related to usage of the London Underground found a correlation between usage and incidence of influenza-like illness, which is supportive of a role for transport in potentially increasing transmission of SARS-CoV-2[iv].

Identifying passengers on public transport will be challenging, especially when journeys are short (e.g. on a bus), and might involve significant changes in how tickets are issued. Similarly, clusters associated with transport are likely to be very difficult to determine. Identifying spread of infection in a public transport network is extremely challenging as the numbers of individuals are large and their geographical spread extensive.

Technology may provide solutions. In the short term, tracking the use of electronic travel solutions such as smart phone tickets might enable the partial tracking of those on specific bus or train journeys. The use of QR code scanning on some services that provide longer journeys would be potentially useful, but would have to account for different carriage location within a train. Logistical implementation of such a scheme would be challenging. Recording passenger details on air transport is already in place because of the legal requirements to file a flight manifest with passenger details, and these have been used in the past for tracing of viral haemorrhagic fever contacts, amongst others**.**

Endnotes

[i] PNAS January 7, 1997 94 (1) 338-342; https://doi.org/10.1073/pnas.94.1.338
[ii] What settings have been linked to SARS-CoV-2 transmission clusters? https://wellcomeopenresearch.org/articles/5-83
[iii] https://www.paperkite.co.nz/rippl/
[iv] Analysing the link between public transport use and airborne transmission: mobility and contagion in the London underground https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0427-5