PSYCHOLOGY MISCELLANY

No.174 - November 2022

COVID-19 (1st March - 31st October 2022): Out of sight, out of mind, or pandemic what pandemic?

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ISSN: 1754-2200

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1. VACCINES

1.1. EVIDENCE

Vaccines protect the individual, and protect others in terms of reducing the spread of covid-19. For example, in the Netherlands, de Gier et al (2021a) reported that vaccinated individuals infected with the Alpha variant of SARS-CoV-2 were 73% less likely to infect unvaccinated individuals, and 63% less likely with the Delta variant (de Gier et al 2021b). But these benefits will be larger because vaccinated individuals do not become infected in the first place (Le Page 2021).

In a laboratory experiment that tried to infect cells in a petri-dish using samples of SARS-CoV-2 taken from twenty-three infected individuals (including six fully vaccinated), with five of the six vaccinated individuals none of the cells became infected showing that vaccinated people shed less virus (Le Page 2021).

The Pfizer-BioNTech (BNT162b2) vaccine has been shown to be effective in neutralising strains of the virus that appeared in 2020 in India (eg: Delta) and Nigeria. Blood taken from twenty vaccinated volunteers was used in laboratory experiments (Liu et al 2021).

But the Delta strain was not inhibited by one dose of the Pfizer-BioNTech or Oxford-AstraZeneca vaccines (or natural anti-bodies) in another study (Planas et al 2021). Two doses of the vaccines, however, were effective (Planas et al 2021).

Alter et al (2021) found that "neutralising anti-body responses elicited by Ad26.COV2.S [Janssen] were reduced against the B.1.351 [Beta] and P.1 [Gamma] variants, but other functional anti-body responses and T cell responses were largely preserved against these variations" (p271). While Yu et al (2021) reported this vaccine as providing "robust protection" against the Beta variant in macaques. Twenty-four rhesus macaques were

used, of which half received a sham vaccine, before a challenge test (ie: infection with the virus) using the original SARS-CoV-2 (WA1/2020 strain) or the Beta variant.

Using a retrospective cohort study method (covering January to July 2021), Eyre et al (2021) found that vaccination reduced transmission of the Delta variant, "but less than the Alpha variant" (p2). The adult contacts [1] (n = over 146 000) of over 108 00 SARS-CoV-2-infected adults in England were included.

The study only included individuals using the English contact testing system, and with PCR-confirmed cases. It was assumed that if a contact developed covid-19 within ten days of interaction with the infected individual then the infected individual was the cause. The study was dependent on the accuracy of PCR testing, particularly in classifying the variant of SARS-CoV-2.

Based on a study of 56 US volunteers, Arunachalam et al (2021) were able to chart the innate and adaptive immune responses to the Pfizer-BioNTech mRNA vaccine (appendix 1A). Insights allowed physicians to "prime the innate immune system to mount a more potent response after booster immunisation" (Arunachalam et al 2021 p410). While Oberhardt et al (2021) provided longitudinal data on this vaccine for 3-4 months with blood samples every 3-4 days from thirty-two healthcare workers in Germany.

Concentrating on adults over eighty years of age, Collier et al (2021) found that second and booster vaccine doses were beneficial, especially with the Alpha, Beta, and Gamma variants of SARS-CoV-2. The participants were 140 individuals in the UK, and this was reported as the first study of immune response after vaccination specifically in this older population.

1.1.1. Spreading the Virus

Initially, studies found that transmission of SARS-CoV-2 was reduced by vaccinated individuals, but this may not be true with the Delta variant (Subbaraman 2021).

For example, vaccinated individuals have been found to carry as much virus in their nose as unvaccinated ones in a study in Wisconsin in June and July 2021 with 719

[1] A contact was defined as living in the same household or having had face-to-face contact for a certain period of time.

people (311 of which vaccinated) (Riemersma et al 2021). This was confirmed in a study of 469 people in Provincetown, Barnstable County, Massachusetts (Brown et al 2021).

But Delta variant carriers are infectious for a shorter period, according to a study in Singapore (Chia et al 2022).

However, the importance of mask-wearing is underscored whether an individual is vaccinated or not.

1.2. PREGNANCY

There has been concern from the first covid-19 vaccinations about pregnant individuals. Enough evidence is now emerging to allow Prasad et al (2022) to perform a systematic review of published data on (i) the effects of covid-19 vaccination in pregnancy, and (ii) vaccine effectiveness in pregnancy.

Twenty-three relevant studies (published up to early 2022) were found, of which five were randomised trials. The studies together included over 100 000 individuals vaccinated during pregnancy.

a) Vaccination during pregnancy - Three observational studies were found of the mRNA vaccine comparing vaccinated pregnant and unvaccinated pregnant individuals. Overall, the effectiveness of the vaccine against confirmed SARS-CoV-2 infection seven days after the second dose was 90%. Put into everyday language, if all the control group became infected, only 10% of the vaccinated group was infected.

b) Vaccination and pregnancy outcomes - Eighteen observational studies compared vaccinated and unvaccinated pregnant individuals, and overall, "there was no increase in any adverse outcome examined, for the mother or baby. In fact, there was some evidence of benefit" (Prasad et al 2022 p2). Vaccination was associated with less stillbirth, and hypoxic brain injury at birth, while there was no significant impact of vaccination on pre-term birth or miscarriage.

Prasad et al (2022) commented: "The mRNA vaccine causes both anti-body and cellular immune responses; given the importance of T-cell suppression in placental development and foetal well-being, concern has been expressed that the vaccine may increase miscarriage risk. Social media has been full of reports that have fuelled this concern, and many pregnant people have cited this

fear as their primary reason for vaccine hesitancy. Our data do not support such concerns, based on both observational data... and inadvertent exposure in early pregnancy in vaccine trial participants" (p6).

With any review there are differences between the studies included in terms of methodology. Such issues include:

i) Variation in detail given - "Very few studies reported maternal and neo-natal outcomes after each dose of the vaccine and according to trimester at vaccination, and there was variation in the outcomes reported..." (Prasad et al 2022 p5).

ii) All data from high-income countries.

iii) Mostly the mRNA type of vaccine.

iv) The duration of follow-up.

v) The matching of vaccinated and unvaccinated pregnant individuals by demographic and/or clinical characteristics.

vi) Control of and/or adjustment for confounders in analysis (eg: age; diabetes).

vii) Time of studies in terms of pandemic peak.

1.3. SIDE EFFECTS

The risk of heart problems after covid-19 vaccines is tiny, but there is some evidence. For example, Patone et al (2021) found that, in England, there was an additional twelve myocarditis events per one million males aged 13-39 years old in the 28 days after a second Pfizer-BioNTech vaccine, and an additional thirteen after the third dose.

Comparison of data between countries is difficult, and the vaccines' benefits outweigh any risks (Wilson 2022c).

1.4. HESITANCY

Many countries faced the challenge of a weak healthcare system that was overwhelmed by the demands of

covid-19. Added to this, there is also growing vaccine hesitancy and anti-vaccination sentiments. The Philippines is an example of such a country (Amit et al 2020).

Historically, there was high vaccine confidence in this country, but the 2017 controversy over "Dengvaxie" (for dengue fever) knocked this confidence. This vaccine was "introduced as part of a national school-based immunisation programme despite the lack of empirical data on the risks associated with administration of the vaccine among those not previously infected with dengue or sero-negative children. By the time reports were released that the vaccine may cause more severe disease among sero-negatives, the Philippines had already inoculated more than 800,000 Filipino school-age children. This was highly politicised, and damaged trust in vaccines and the health sector. As a result, immunisation rates dropped and the country saw outbreaks of previously controlled vaccine-preventable diseases such as measles and polio" (Amit et al 2022 p2).

An official survey found that just over half of Filipinos would be willing to be vaccinated against covid-19 before a vaccine was developed (Amit et al 2020). Amit et al (2020) explored this further in their online survey of 1599 adults and thirty-five in-depth interviews in June-August 2021.

Concentrating on the latter, nineteen females and sixteen males from around the country were asked about their perceptions and attitudes about science, vaccines, the health system, and the government. Three categories or tiers of barriers to vaccination were found:

1. Individual barriers:

i) Vaccine brand preference - eg: concern about Sinovac-CoronaVac.

ii) Not trusting the health system - eg: "Dengvaxie".

iii) Vaccines viewed as unsafe - Some participants believed that the vaccine was more deadly than covid-19, while others feared a shortened life. For example, one woman said: "I am more afraid of vaccines. Once you inject that into your body, you will not be able to reverse its effects or take it out of your system. With covid, if you are just careful and follow health protocols, and strengthen your immune system, I do not

think you will immediately get sick. Compared to the vaccines – we are not sure how safe they are" (p8).

iv) Vaccines are not necessary - eg: younger participants who had experienced mild symptoms of covid-19. As shown by a women in her 20s who said: "The elderly and those with co-morbidities – they need the vaccine more than I do. In my experience of getting covid, I only had mild disease. I know that my body can survive. But how about them? How will they survive?" (p9).

v) Scepticism about incentives to encourage vaccination - eg: "If the vaccine is really that good, then people should be fighting each other to get it. But how come the government has to give you an incentive to get the vaccine? [...] If it's really that good, why the incentive? If it's really that good. That's why it bothers me. [...] If it is for your protection, if it is for your health, we do not need that [incentive]" (woman in her 70s; p9).

vi) Vaccines not fully tested before general use - eg: "It [the vaccine] needs to under a thorough process or take many years to have enough clinical studies that can validate the results or so we can see the adverse reactions in the human body. I don't think it's [the development process] this easy that in just a matter of months, we can already use it, right? I don't think it's this easy for them to say that the vaccine is effective to combat the virus" (woman in her 50s; p9).

vii) Low health literacy - eg: "They say the vaccines change your DNA. I don't know. Actually, I don't know what to believe in. If
I'm being honest, I don't know what to believe in" (woman in her 60s; p9).

viii) Religious beliefs - eg: one participant described covid-19 vaccines as the "Anti-Christ".

2. Interpersonal barriers:

i) Family influences.

ii) Misinformation spread by social networks - eg: "People in the remote areas, especially the middle-aged and senior citizens, are apprehensive because they heard from other friends that vaccines may cause damage to

their health. [...] They said that when you are vaccinated you are given only two years to live and that vaccines contain metals [...] so a new generation will come out" (woman in her 60s; p11).

iii) Perceived conflicts of interest by health professionals - eg: "In some way, [name of health professional redacted] is funded by some drug companies. Once you are involved in these drug firms, being objective becomes difficult. It is important to be objective, or else you will bias your findings. Although not directly forced [by the drug company], but you have information that you know of but choose to withhold. You will just forget about it, especially if there are unwanted adverse effects [to the treatment or vaccine]" (man in his 70s; p11).

3a. Structural barriers: Health systems and service delivery:

i) Inadequate supply of vaccines - especially outside of urban areas.

ii) Perceived inefficiencies of the vaccination system - eg: long waiting times; administration problems.

iii) Inflexible organisation that excluded vulnerable and marginalised individuals - eg: individuals without access to register online.

iv) Logistical challenges - eg: temperature control of vaccines.

v) Health professionals as amplifiers of misinformation - eg: disagreements among health professionals over "Ivermectin" as a treatment for covid-19.

vi) Poor response to pandemic by health organisations - eg: "They're [institutions] not doing their job they're supposed to do. That's not a political statement, that is the comment of the people on the ground. Us, we in the masses... They are just giving us lies and inciting fear, and misleading [us]" (man in his 50s; p14).

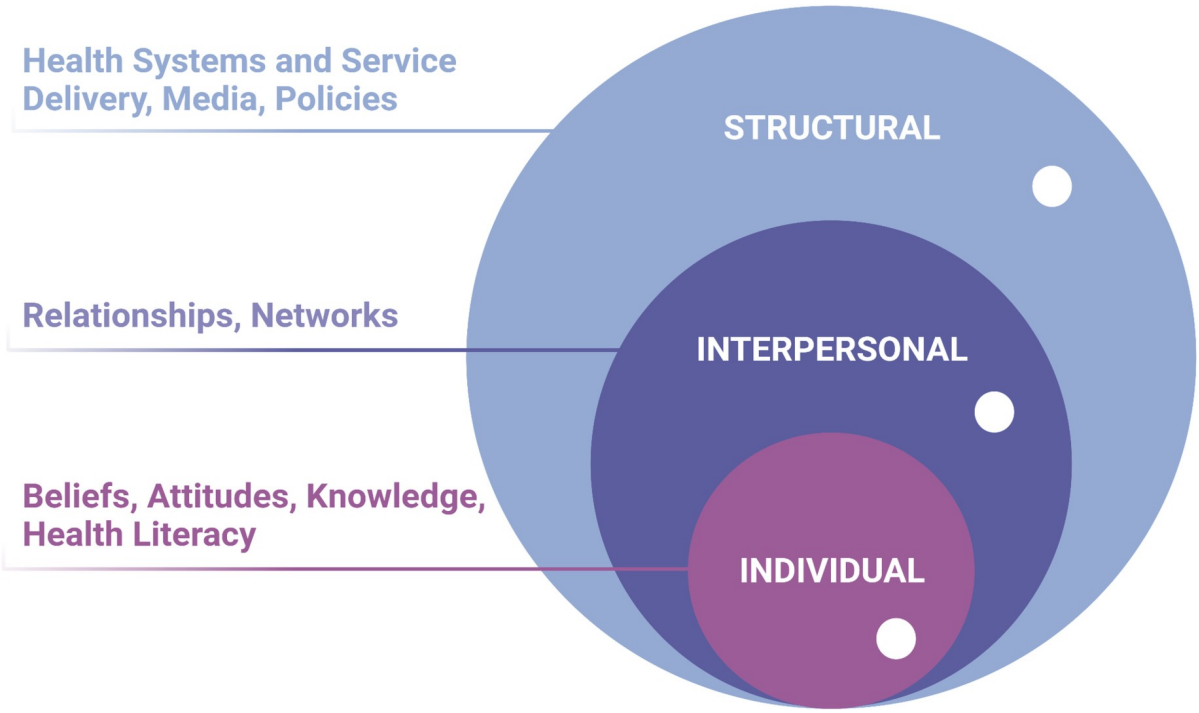
3b. Structural barriers: Media and policies:

i) Media amplified information (accurate or not) - eg: "Have you read about the New World Order? I read that this is a 'plandemic' instead of pandemic. In other words, this virus was made in the laboratory in Wuhan, China with the purpose of depopulating the world. [...] I now believe that we are in the End Times as mentioned in the Bible. It was only now that my eyes have been opened because of YouTube" (woman in her 60s; p16).

ii) Perceived poor government policies - eg: "As I have mentioned before, I tend to decide based on what I know and what I have read. Most of the vaccines that the government ordered are Sinovac, which did not undergo phase 3 and peer review. This is the reason why I don't believe in our government. Also, Sinovac is more expensive but has a lower efficacy rate compared to other vaccines which are cheaper but has higher efficacy rate like AstraZeneca. Now ask yourself why would your government prefer a vaccine that is more expensive but with lower efficacy for its constituents if our government applied for loans in international banks?" (man in his 20s; p16).

iii) Other political issues - eg: attitudes towards China: "My least preferred vaccine brand is Sinovac because of its country of origin. I do not believe in China. Directly, you can put that on record. Because of their products and medicines, and also what they're doing to us with the West Philippine Sea. Those things are also now being considered by people. For me, at least for me. I'm speaking for myself. I don't like what they're doing to us as a country. You can place that on record" (man in his 50s; p16).

Amrit et al (2022) summed up: "Our study supports the findings of other published research that report a host of individual, interpersonal, and structural barriers that work individually or collectively against vaccination uptake and reach" (p17). The researchers linked the categories/tiers to the social ecological model (figure 1.1).



(White dots = impact of misinformation)

(Source: Amit et al 2022 figure 1)

Figure 1.1 - Social ecological model and categories of vaccine hesitancy.

1.5. MISINFORMATION

Policy changes by Facebook around anti-vaccine content had temporary success, according to Broniatowksi et al (2022).

Facebook has attempted to deal with vaccine misinformation on its site, including by reducing the ranking of anti-vaccine posts, banning anti-vaccine advertisements, and promoting authoritative vaccine information (Broniatowksi et al 2022).

Between November 2020 and February 2021 Facebook became more aggressive, for example, in removing the "Stop Mandatory Vaccination" pages. Broniatowksi et al (2022) evaluated this misinformation content removal policy by comparing Facebook data prior to the new policy and afterwards (specifically 33 anti-vaccine and 46 pro-vaccine pages, and 69 anti-vaccine and 70 pro-vaccine groups).

Anti-vaccine pages, but not anti-vaccine groups were significantly more likely to have been removed by the new policy compared to the pro-vaccine pages and groups.

However, "[L]ow-credibility content became more prevalent in anti-vaccine pages and groups, and high-credibility content became less prevalent in pro-vaccine pages" (Broniatowksi et al 2022 p2).

An official response by "Meta" (who own Facebook) stated: "There were many other changes happening during this period which could have played a role in these results, which the research doesn't take into account" (quoted in Stokel-Walker 2022).

1.6. INCREASING UPTAKE

Attempts have been made to increase vaccine uptake using the psychology of persuasion. One approach is to change intentions (ie: increase the intention to vaccinate), but this is not necessarily the same as actual behaviour (Dai et al 2021).

Another approach "involves helping people to follow through on their vaccination intentions and overcome sources of friction, such as forgetfulness, hassle costs and procrastination" (Dai et al 2021 p404). This can be linked to "nudges" (ie: changing "people's behaviour in a predictable way without forbidding any options or significantly changing economic incentives"; Thaler and Sunstein 2008 quoted in Dai et al 2021).

Dai et al (2021) reported two randomised controlled trials using nudges to increase covid-19 vaccination uptake. Starting in January 2021 with over 93 000 patients from UCLA Health in California, participants received text-message reminders or not to get vaccinated. The reminder overcomes the barrier of forgetfulness, and appointment-scheduling link was included to overcome the barrier of inconvenience. There was also a link to a short video to correct common misconceptions in some cases. The wording of the reminder was varied to include a "just been made available for you" version to encourage psychological ownership over the vaccine.

The first trial had five conditions:

- Control - no reminder.
- Basic reminder.
- Ownership reminder.
- Basic reminder and video.
- Ownership reminder and video.

The main outcome measure was the scheduling of a first-dose vaccination appointment within six days of the

reminder text, and the secondary measure was actual vaccination within four weeks of the reminder.

The control group had rates of 7.2% and 13.9% respectively. All the other conditions had higher percentages than these. The basic reminder condition had an appointment of 12.8% and a vaccination rate of 17.1%. The best response was in the ownership reminder condition (14.2% and 18.2% respectively).

The second randomised controlled trial involved sending a second reminder text to individuals who did not schedule an appointment within six days of the original text. This lead to a small improvement in uptake compared to the control group.

Overall, receiving a reminder text (of any type) increased actual vaccinations by around 2%, and a second reminder by another 1%.

Subsequent analysis showed that "approximately 90% of participants who received the first dose at UCLA Health scheduled their second dose. Thus, the biggest barrier to increasing covid-19 vaccinations is getting participants to schedule the first-dose appointment" (Dai et al 2021 p408).

The two trials showed that simple reminders/nudges that make vaccination easy and induce feelings of ownership over the vaccine can be effective in increasing covid-19 vaccine uptake.

1.7. MORAL DIMENSION

The risk of death from covid-19 increases with age, and so vaccination programmes have focused on older adults first. Wrigley-Field et al (2021) offered an alternative view that this approach "ignored evidence that the risk of exposure to and subsequent infection from SARS-CoV-2, the causative agent of covid-19, is substantially higher for Black, Indigenous, and People of Colour (BIPOC). As a result, vaccine prioritisation based solely on age may have exacerbated racial/ethnic inequities in covid-19 burden because BIPOC populations are generally younger than the white population, more likely to be infected at younger ages, and at higher risk of dying from covid-19 at all ages" (p1). The upshot is that vaccination programmes should consider other risk factors than age when prioritising certain individuals.

Talking about the USA, Wrigley-Field et al (2021) admitted that "distributing vaccines based on race and ethnicity may not be legally viable or politically

tenable... Further, a race-based approach may be perceived as discriminatory... Instead, geographic targeting, using indices of health or covid-19 mortality, may be more practical, more resistant to legal challenges, and still more equitable than strategies based on age alone" (p1).

These researchers modelled different vaccination prioritisation strategies using US covid-19 data for 2020 (particularly from California and Minnesota).

Firstly, age-based prioritisation (eg: vaccinating all 75 year-olds and above first and then moving to younger individuals in stages) was predicted to prevent two-thirds of covid-19 deaths of White individuals, but less of BIPOC individuals (around one-third to one-half). This difference is due to the White population being "substantially older" than most BIPOC populations (Wrigley-Field et al 2021).

Another strategy is to target geographical areas with higher covid-19 mortality (ie: vaccinate all ages in these areas). This approach would reduce BIPOC deaths (in comparison to age prioritisation). This was Wrigley-Field et al's (2021) preferred option.

The final strategy modelled was to lower the age threshold. This produced some reduction in BIPOC deaths, but raised the problem that demand exceeds supply of vaccines. Inequity in access to vaccines in this situation could reduce any improvements.

The study had two main limitations common to modelling studies:

i) The data used - eg: official mortality data.

ii) The assumptions made - eg: assuming vaccine take-up if an individual was eligible and ignoring access.

The researchers admitted that "vaccination strategies that are not widely perceived as legitimate can undermine social solidarity and increase efforts to flout the rules, and we did not evaluate whether geographic prioritisation is likely to be widely perceived — or can be made to be widely perceived — as fair" (Wrigley-Field et al 2021 p9). Also there are practicality issues with any strategy.

As individuals in certain countries had received their third dose of vaccine (boosters) in 2021, there has always been the question of the ethics when very low numbers of individuals in low-income countries have only

received one dose (eg: 1.3% in mid-August 2021; Editorial 2021a) [2].

Boosters appear necessary for individuals who need drugs that suppress the immune system after organ transplant, say, and with the Sinovac vaccine, which provides inadequate protection against variants of SARS-CoV-2 like Delta, but the case among the general population is open to dispute (Editorial 2021a).

Editorial (2021a) stated: "If vaccines were not scarce, boosters would be less controversial. But to focus on boosters when more than half the world lacks vaccine doses is short-sighted and will only keep the pandemic burning longer. For wealthy countries, this strategy means they will be indefinitely chasing their tails in terms of new variants. And for the rest of the world, it means prolonging unnecessary suffering" (p317).

1.7. MISCELLANEOUS

(1) "ZyCov-D", developed in India in 2021, was the first "DNA vaccine" for covid-19 to receive approval. It uses strands of DNA to prime the immune system against SARS-CoV-2. DNA vaccines are easy to produce and are more stable than mRNA vaccines (ie: not needing very low temperature storage) (Mallapaty 2021b).

(2) The development of anti-SARS-CoV-2 anti-bodies was found to be better in individuals infected with the virus before mRNA vaccination than individuals not infected prior to vaccination (Lucas et al 2021). Data came from forty healthcare workers at Yale-New Haven Hospital in the USA between November 2020 and January 2021.

Similarly, Andreano et al (2021) compared memory B cells of ten individuals with Alpha and Delta variants. Andreano et al (2021) summed up: "The most important conclusion from this work is that people who are previously exposed to SARS-CoV-2 infection respond to vaccination with more B-cell-producing anti-bodies that are not susceptible to escape variants and that have higher neutralisation potency" (p534).

Anti-bodies after vaccination show some differences to anti-bodies after infection (eg: five months later), Cho et al (2021) found in a study of thirty-two volunteers in early 2021. These authors confirmed the above finding about previously-infected vaccinated

[2] Western pharmaceutical companies have been reluctant to allow the manufacture of the covid-19 vaccines in other parts of the world (Maxmen 2021c).

individuals.

1.8. APPENDIX 1A - mRNA VACCINE

The mRNA covid-19 vaccines emerged quickly, but the science behind them goes back to the 1960s and includes the work of hundreds of researchers (Dolgin 2021) (table 1.1).

1960s	mRNA discovered
1970s	Development of lipid-based delivery system
1980s	mRNA synthesised in laboratory
1995	mRNA tested as cancer vaccine in mice
Around turn of century,	mRNA-focused biotechnology companies founded
2010s	1st clinical trial of mRNA vaccine for infectious disease (rabies)
	1st mRNA vaccines using lipid-based delivery system tested in mice
2015	1st clinical trial of mRNA vaccines for influenza
2020	mRNA-based covid-19 vaccines developed

(Source: Dolgin 2021 p323)

Table 1.1 - Key Events in the History of mRNA Vaccines.

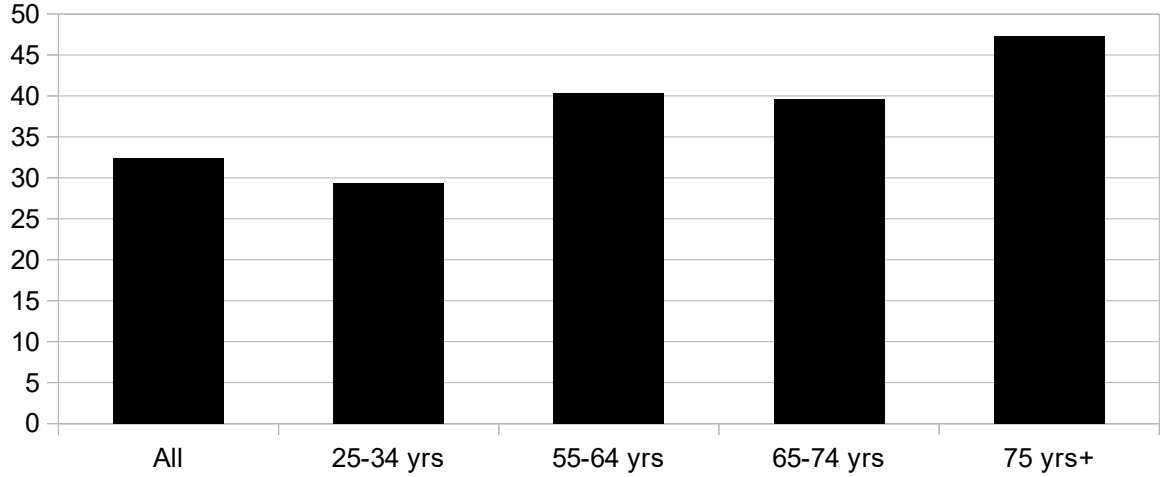
2. COVID-19 TESTING

2.1. TAKING A TEST

Testing for covid-19 can be done en masse (ie: everybody in the population) or selectively (ie: those individuals showing certain symptoms). The latter is more common, but "high uptake requires both an informed and willing population, and sufficient infrastructure to ensure test availability and accessibility" (Graham et al 2022 p2).

Graham et al (2022) investigated the barriers to testing using surveillance data from the UK Zoe Covid Symptom Study (Zoe) (Drew et al 2020), and the University of Maryland Global Covid-19 Trends and Impact Study (UMD-CTIS) (Kreuter et al 2020). Using data from March 2020 to January 2021, 1237 Zoe participants who reported covid-19 symptoms but did not take a test, and 1956 such UK participants of UMD-CTIS were the focus of the analysis.

Compared to the whole study sample, individuals with test-qualifying symptoms (fever, cough, or loss of smell) who did not test had less symptoms, shorter duration of symptoms, and were more likely to be female, and younger (figure 2.1).



(Data from Graham et al 2022 table 4)

Figure 2.1 - Percentage of responses not knowing where to be tested based on selected age groups.

The reasons reported for not testing included in order: "I don't know where to go", "I am unable to travel to a testing location", and "I tried to get a test but was not able to get one" (figure 2.2). Not knowing where to be tested was significantly associated with being older, and less educated.

Figure 2.2 - Percentage of respondents giving reasons for not taking test.

The UK NHS testing programme for covid-19 was free, but its success depends on the knowledge of individuals as to when to use it as well as practical barriers like where to go. Graham et al (2022) recommended targeted messaging about symptoms and test accessing (eg: non-digital formats).

2.2. IDENTIFICATION

Identifying pre-symptomatic or asymptomatic individuals is crucial to control the spread of disease (appendix 2A). Risch et al (2022) reported the use of data from a wearable medical device ("Ava-bracelet"). This device measures five physiological parameters - breaths per minute (respiratory rate; RR), heartbeats per minute (heart rate; HR), heart rate variability (HRV), wrist-skin temperature (WST), and skin perfusion (blood

flow just beneath the skin). Also sleep quantity and quality were recorded via an accelerometer.

The participants came from an ongoing cohort study in Liechtenstein begun in 2010 ("Genetic and Phenotypic Determinants of Blood Pressure and Other Cardiovascular Risk Factors"; GAPP). Between April 2020 and March 2021 over 11 000 individuals participated, and they gave regular blood samples for SARS-CoV-2 determination. Questionnaires were also completed. The data were analysed by a machine learning algorithm.

During the study period there were 127 laboratory-confirmed covid-19 cases. Significant differences were found in four of the physiological measures in these cases between baseline and the illness period:

- RR - Increased RR during the symptomatic period.
- HR - Increased HR during incubation, pre-symptomatic, and symptomatic phases.
- HRV - Some differences noticed.
- WST - Increased from the incubation period onwards.

An algorithm using these differences identified 68% of the laboratory-confirmed cases two days before symptom onset. Risch et al (2022) concluded that "a wearable-informed machine-learning algorithm may serve as a promising tool for pre-symptomatic or asymptomatic detection of covid-19. However, RT-PCR testing remains the most effective method to confirm covid-19 infections" (p10).

2.3. APPENDIX 2A - ZIKA VIRUS

The Zika virus (ZIKV) was first identified by medicine in 1947, but "it had attracted little scientific attention until an outbreak in Brazil's Northeast was associated with an unusual cluster of microcephaly among newborns" (in 2015) (Kameda et al 2021 p684).

The most urgent problem was finding a reliable way of detecting the ZIKV, which is transmitted by a mosquito species. "The vast majority of cases appeared to be asymptomatic, and when symptoms appeared they were generally mild and self-limiting, with patients reporting non-specific aches, skins rashes, low fever and general fatigue. Several of these symptoms resembled those associated with dengue – early reports, in fact, often

described the condition as a 'mild' form of dengue – another virus transmitted by Aedes mosquitoes that is endemic across the region" (Kameda et al 2021 p684).

Kameda et al (2021) stated: "Diagnosis is the cornerstone of modern medicine" (p685). But this is far from straightforward, particularly with new and emerging infections. The apparent objectivity of scientific diagnosis is a product of time, place, and situation, according to Fleck (eg: 1979/1935). "Scientists investigating a new disease and epidemiologists concerned with limiting its spread are likely produce divergent data on the prevalence of a transmissible pathology: Researchers seeking to elucidate the specific biological mechanism of host-pathogen interaction will tend to exclude all borderline cases, while epidemiologists intent on halting an outbreak will be inclined to include them" (Kameda et al 2021 p685).

One upshot was the difference in estimates of the prevalence and spread of the infection in Brazil in 2015-17. A group of Brazilian epidemiologists (Oliveira et al 2017), for instance, presented a picture of a first wave in early 2015 in the Northeast, and a geographically more wider distributed second wave later in the year. While a retrospective, international study (Brady et al 2019) argued that "the circulation of the virus had been largely restricted to the Northeast, with 94% of an estimated 8.5 million total cases between 1 January 2015 and 23 May 2017 occurring there" (Kameda et al 2021 p695). At this point, it is not clear who was correct because, as Kameda et al (2021) observed: "Public health intelligence has been limited to an exercise in epidemiological imagination" (p695).

Accurate and reliable diagnosis of ZKV was also important for pregnant women, and then the diagnosis of microcephaly or congenital Zika syndrome. "If the scarcity of reliable laboratory diagnosis and inconsistencies in the quality of ante-natal care limited diagnostic options for many women, the criminalisation of abortion severely constricted the actions they could take upon any knowledge they were able to obtain" (Kameda et al 2021 p697).

Even if medical diagnosis could offer no "hopeful clinical pathway – it afforded a predicament, rather than a promissory course of action. For many women, this created a space for what Carneiro and Fleischer [2018 quoted in Kameda et al 2021] call 'social diagnosis', a search for 'more comprehensive existential explanations' for the birth of a child with severe neuro-developmental

challenges" [eg: "divinely mandated"] (Kameda et al 2021 698).

The inequalities in society were superimposed on this unfolding situation. "The concentration of cases in the Northeast - where poverty is strongly associated with skin colour – further solidified the view that this was a pathology that affected predominantly poor, non-white people in historically disadvantaged regions of the country... What was originally deemed a 'national' emergency was thus soon disaggregated into socio-economically and racially divergent levels of exposure. On-going cuts to healthcare budgets, and the conservative political turn that began in the summer of 2016, further cemented this trend, making Zika a neglected disease within Brazil itself" (Kameda et al 2021 pp698-699).

The covid-19 pandemic pushed ZKV, along with most everything else, into the background.

3. VIRUSES

3.1. ORIGINS OF SARS-COV2

A US intelligence-community investigation into the origins of SARS-CoV-2 in 2021 was inconclusive as to whether it came from animals or from a laboratory accident, but it was agreed that the virus was not developed as a biological weapon or genetically engineered (Maxmen 2021b).

Cohen (2022) considered three new studies about the origin of SARS-CoV-2, and despite two years passing and the Chinese government's lack of transparency, they "undercut the thought the virus somehow escaped from the Wuhan Institute of Virology".

The studies all examined different aspects of the spread of the virus at the Huanan Seafood Market (HSM) in Wuhan. Two studies (Pekar et al 2022; Worobey et al 2022) suggested a zoonotic leap at the market, "likely twice" [3], in late 2019, and the third (Gao et al 2022) that the virus was imported there.

1. Pekar et al (2022) - Two subtly different lineages of SARS-CoV-2 (dubbed "A" and "B") found in people at the HSM suggesting two separate zoonotic jumps. "B" probably jumped to humans in late November 2019, and "A" a few weeks later.

Critics suggested that the two lineages developed after a single jump to humans (Cohen 2022).

2. Worobey et al (2022) - Connected the virus to specific stalls at the HSM where live animals were sold. A wide range of data types were used to show that the specific stalls sold SARS-CoV-2-susceptible live mammals (eg: Asian raccoon dog; hog badger; red fox).

[3] The earliest genetic sequencing of SARS-CoV-2 in China in late 2019 and early 2020 found two broad lineages - A and B. Did one of the lineages evolve from the other or are the two lineages two separate spillover events? The presence of key nucleotide differences between lineages A and B favour the latter (Mallapaty 2021d).

3. Gao et al (2022) - Used data from the Chinese Centre for Disease Control and Prevention collected at the HSM between 1st January and 2nd March 2020. This included 1380 samples from 188 animals in the HSM and surrounds (eg: sewer wells), of which 73 samples contained SARS-CoV-2.

However, this pre-print took the position of the Chinese government that SARS-CoV-2 was imported from other countries (eg: via frozen food) (Cohen 2022).

3.1.1. 1918 Pandemic

The 1918 influenza A (H1N1) pandemic was recognised in the summer of 1918 globally, peaked in the autumn, and continued into 1919. The global death toll is estimated at 50-100 million. "While young children and the elderly were severely affected, the 1918 pandemic stood out as causing exceptionally high mortality in healthy 20–40 years-old people. Its duration, high death toll and unusual epidemiology all contributed to its profound impact on societies of that time" (Patrano et al 2022 p2).

There was some speculation at the time that a virus was the cause, but only in the 1930s was this fact "finally proven", and from the 1990s molecular analysis was available to study the virus, including the construction of two complete genomes (Patrono et al 2022).

Patrono et al (2022) reported genomic analysis that constructed the flu strains and mutations that adapted in humans during the 1918 pandemic.

This work is over a hundred years later, but with covid-19 we are in a much better position as the first genome of SARS-CoV-2 appeared in a matter of weeks [4]. At the same time, there is a similarity to 1918 in that knowledge about a pandemic comes after the event and by looking back in history. What will researchers in 2119 know and say about covid-19, I wonder?

3.1.2. Zoonosis

Human-to-animal transmission of pathogens is more common than thought. Fagre et al (2022) found ninety-seven cases (including bacteria, viruses, fungi, and

[4] A number of genomic databases of SARS-CoV-2 have been created, including at the Global Initiative on Sharing All Influenza Data (GISAID), and the National Centre for Biotechnology Information (NCBI) (Li et al 2021).

parasites), of which 57 were transmission to primates. The majority of cases involved zoo animals. "There were no confirmed cases of a disease crossing to an animal species and continuing to spread between individuals" (Wilson 2022b p24).

Three out of four emerging infectious diseases are believed to be zoonotic (ie: jumped from non-human animal hosts to humans) (Lopez and Nowakowski 2021). Eight recent examples include (Lopez and Nowakowski 2021):

- Sin Nombre - First appeared in North America in 1993, a pulmonary illness, identified in the deer mouse.

- SARS - East Asia 2003, including over twenty countries worldwide.

- Nipah - First outbreak in 1999 in Malaysia, attributed to bats.

- Hendra - 1994 in Australia and spread by fruit bats to horses to humans.

- Machupo (or Bolivian haemorrhagic fever) - First emerged in 1952 and the large vesper mouse was found to be the reservoir host.

- Crimean-Congo haemorrhagic fever (CCHF) - First appeared in the Crimea in 1944 and then in 1956 in the Belgian Congo, spread by ticks.

- Zika - First discovered in Uganda in 1947 and spread by mosquito.

- Marburg - First identified in Marburg (Germany) in 1967, but has an African origin with the African fruit bat host.

Birds also act as vectors and reservoirs for zoonotic diseases. An example is the avian pathogen Chlamydia psittaci, known to be in over 460 species globally (Kasimov et al 2022). It can "cause diseases in livestock... and most importantly, a zoonotic event can cause severe respiratory disease in humans" (Kasimov et al 2022 p2).

In Australia, Kasimov et al (2022) found Chlamydia species "prevalent in a wider range of avian hosts than previously anticipated, potentially increasing the risk

of spillover to Australian wildlife, livestock and humans" (p1). Samples were analysed from 564 different birds from 107 species admitted to the Australian Zoo Wildlife Hospital in Queensland in 2019-20.

Cousins et al (2022), using the H5N8 avian influenza virus in South Africa in 2017 as a case study, noted the tension between the biosecurity (eg: to cull the birds), and the livelihoods of "global chick suppliers, local egg producers,... and unregulated local poultry economies" (p422).

Zoonotic outbreaks, thus, are "social events" as has become apparent with the covid-19 pandemic. There is social meaning for individuals beyond the biology of the virus itself.

As of the middle of July 2022, over 12 500 monkeypox [5] cases and three deaths in sixty-eight countries had been reported since May 2022. Most of the cases had occurred among men who have sex with men (MSM), and transmission via skin-to-skin and sexual contact (Osterholm and Gellin 2022). Murugesu (2022b) commented: "The current outbreak is unusual in that infections seem to be mostly spreading between people with no recent travel links to affected regions in Africa, suggesting the virus is being transmitted undetected in the community" (p7).

3.2. VIRUS

The life cycle of SARS-CoV-2 can be divided into five stages (Scudellari 2021) [6]:

1. Viral entry - Each SARS-CoV-2 virion (virus particle) has 24-40 flexible spike proteins on its surface which help in fusing with human cells. The receptor binding domain (RBD) of the spike proteins attach to the ACE2 receptor on the outside of human throat and lung cells. The enzyme TMPRSS2 is mostly used by the virus to cut into the host cell and allow the depositing of its genome directly into the cell [7].

[5] The disease is zoonotic and from rodents (despite the name). It was first spotted, however, in monkeys in laboratories in 1958, and the first human case was identified in 1970 in the now named Democratic Republic of Congo (Le Page 2022g).

[6] The International Committee on Taxonomy of Viruses named "SARS-CoV-2" because of a genomic organisation similar to SARS-CoV, and as the seventh coronavirus that can infect humans. But there were two key genetic differences between SARS-CoV and SARS-CoV-2, particularly related to the spike protein (Li et al 2021).

[7] As early as February 2020, Wrapp et al (2020) published the structure of the key protein of SARS-CoV-2 that it used to access human cells (Powell 2021).

2. Inside the cell - Viral RNA is translated into non-structural proteins (NSPs) that favour this RNA over the cell's. The virus also shuts down the cell's alarm system (including the release of interferons) that would signal to the immune system the presence of the virus.

3. Remodelling the cell - The virus transforms the cell's endoplasmic reticulum into double-membrane vesicles, which provide a safe place for viral RNA replication.

Meanwhile spike proteins travel to the surface of the cell and poke out, trying to fuse with neighbouring cells via ACE2 receptors [8].

4. Exit - Once a complete virus particle has been assembled in the cell, it leaves.

5. The last slice - On the way out of the cell, a host enzyme, furin, makes a cut at the site of five amino acids and this makes the virion more efficient in targeting and entering human lung cells.

3.2.1. Variants

The SARS-CoV-2 virus is estimated to accumulate 24 mutations per year, or 0.3 mutations per viral generation. Most of these mutations appear as evolutionarily neutral, but a few confer a transmission advantage (eg: B.1 lineage is 20% more transmissible than the original A lineage in Wuhan) (Vohringer et al 2021).

In terms of transmissibility, the original SARS-CoV-2 virus infected 2-3 others on average, while the Delta variant 6-7, and Omicron "seems to be even more contagious" (Le Page 2022a) [9].

In South Africa, for instance, a comparison was made between Delta and Omicron using nasal and saliva swabs. With Delta, all nasal swabs were positive and only around three-quarters of the saliva swabs, but with Omicron all saliva swabs were positive and around 80% of the nasal swabs (Diana Hardie in Le Page 2022b). In terms of detection, lateral flow tests that "only involve swabbing the nose may be more likely to give false negative

[8] That SARS-CoV-2 attaches to cells via the ACE2 receptor was known quite soon, but Lempp et al (2021) reported the use of other means as well (the C-type lectin receptor).

[9] Technically, Omicron describes a family of variants that appeared in November 2021. BA.1 was initially most common, and it shares 32 mutations with BA.2, but this variant has 28 different mutations (Le Page 2022c). Other sub-variants include BA.2.12.1, BA.4, BA.5, and most recently, BA.2.75 (nicknamed "Centaurus") (Kupferschmidt 2022).

results for Omicron, because this variant may be more likely to reach high levels in saliva before it does in nasal mucus" (Wilson 2022a p9).

Yuan et al (2022) compared the Omicron (B.1.1.529) variant and the Delta (B.1.617.2) variant in Syrian hamsters. The "Syrian hamster model" "closely simulates non-lethal human disease and has been widely used to study various aspects of SARS-CoV-2 infection biology" (Yuan et al 2022 p428).

Three key patterns were observed in the study:

i) "Omicron-infected hamsters lost significantly less body weight and exhibited reduced clinical scores, respiratory tract viral burdens, cytokine and chemokine dysregulation, and lung damage than Delta-infected hamsters" (Yuan et al 2022 p428). Put simply, Omicron was less severe.

ii) Transmission via contact was similar for both variants, but Omicron was more transmissible via non-contact. Contact transmission was studied by placing an infected and a naive hamster in a cage together for four hours. Non-contact transmission involved one infected individual in an adjacent cage with air flow to six naive hamsters.

iii) Delta outcompeted Omicron when there was no selection pressure, but the opposite with selection pressure (ie: within vaccinated hamsters).

Evidence quite soon emerged that Omicron was causing less hospitalisations than previous variants of the virus, partly due to the virus itself, and partly to the protection from vaccines and/or previous SARS-CoV-2 infections (Le Page 2022b). But "there is no guarantee that future variants will remain less severe. The 2006 SARS virus infected cells in the same way as Omicron, yet oddly was far more deadly" (Le Page 2022b p8).

Writing at the start of 2022, Le Page (2022a) stated: "We have been watching evolution in action as one coronavirus variant after another emerges and triggers further waves of infections around the world. There is every reason to think this will continue during 2022 - and there is no guarantee that future variants will be any less dangerous" (p16).

Le Page (2022a) continued: "It is often claimed that new viruses will evolve to cause milder symptoms. But

because SARS-CoV-2 is most infectious just before symptoms appear, there is little selective pressure for it to do this" (p16).

Also commenting on the future, Wilkins and Wong (2022) stated: "While Omicron may have shifted expectations for how nations can cope with covid-19 in the mid-to-long term, the prospect of further variants means that there are no certainties. 'A variant with any property could emerge at any time, and it could be totally different in terms of disease. It could be worse, could be better, could be the same, and that will happen at random' [academic Lance Tuttle]" (p7).

A new variant different to the past ones could appear in immuno-compromised individuals who cannot clear the virus from the body and so have a long-running infection. For example, a surveillance programme at the Yale New Haven Hospital in the USA found a patient in the summer of 2021 with a supposedly extinct lineage (B.1.517) (Chaguza et al 2022). This individual in their 60s was undergoing treatment for a lymphoma (which meant immuno-compromise), and was originally infected with SARS-CoV-2 in November 2020 and still continued to carry the virus in 2022 (ie: 471 days after first covid positive test). It was found that the virus evolved at twice the normal speed in this individual (Kupferschmidt 2022) [10].

This patient supported the "chronic infection hypothesis" for explaining the emergence of genetic variants of SARS-CoV-2. The other two theories are prolonged human to human transmission, and a zoonotic reservoir (or human to animal and then back transmission) (Chaguza et al 2022).

Using a cohort of over seven hundred London healthcare workers who were tripled vaccinated, Reynolds et al (2022) investigated the response of the immune system to Omicron. This cohort was followed from March 2020 to January 2022, and information was available on which versions/variants of SARS-CoV-2 had infected individuals - ancestral Wuhan Hu-1 (original virus), Alpha (B.1.1.7), Delta (B.1.617.2), and Omicron (B.1.1.529).

The immune system response to Omicron depended on the prior infection experience. For example, infection-naive individuals who became infected with Omicron had enhanced immunity against other variants, but not against Omicron. This could explain why individuals can become

[10] Four early studies (in late 2021) with Omicron suggested that it "blunts the potency of neutralising anti-bodies more extensively than any other circulating SARS-CoV-2 variant" (Callway 2021 p368).

reinfected with Omicron (Reynolds et al 2022).

3.2.2. Omicron

Omicron was reported in Hong Kong in early 2022, but with a high number of severe cases of covid-19, unlike other places. "Part of the reason is that too few of the older people in Hong Kong are vaccinated. The failure to vaccinate the most vulnerable seems to be a result of trying to please China. Hong Kong continues to pursue a 'dynamic zero-covid' strategy that focuses on testing" (Le Page 2022d p7).

Around one-third of over 80s were vaccinated at the time (March 2022), and most with Sinovac Biotech's "CoronaVac" vaccine, which is less effective with Omicron (Le Page 2022d).

Elsewhere, the lower severity of Omicron was seen in March 2022 in the UK with less than one-tenth of individuals needing ventilation in intensive care compared to January 2021 (Wilson 2022f). At one level, this is less impact upon hospital services, however, mild infections in hospital are still a problem. "It causes disruption when someone on a cold ward tests positive: everyone else has to be tested, those who are positive are moved to hot wards, and there needs to be deep cleaning. In the meantime, new people cannot be admitted to that ward, and care home residents who are positive cannot be discharged, meaning a loss of available beds" (Wilson 2022f p14).

A recombinant coronavirus of Omicron and Delta genetic material (called "XD") was initially reported (Le Page 2022e). Then many versions of the recombinant "Deltacron" were discovered - ie: specifically Delta-BA.1 recombinants (also called "XD" and "XF"). Seven recombinants of BA.1 and BA.2 have been found (named "XE", "XG", "XH", "XJ", "XK", "XL" and "XN") (Le Page 2022f).

A disease like measles is caught once (and very rarely a second time). There is a "sterilising immunity" here, but not with coronavirus (Wilson 2022e).

So the question is how much does the first covid-19 infection reduce an individual's risk of a second infection? For example, according to US data, an unvaccinated person has 85% less risk of a a second infection, and so does an individual after two doses of the mRNA vaccine (Wilson 2022e).

These data were collected when the Delta variant was dominant, but Omicron causes more reinfections. So, how long between infections, is the next question? Data are limited, but from the UK, a range of 90 to 650 days (with an average of 343 days). While Danish data from a small study found intervals of 20 to sixty days (Wilson 2022e).

3.3. IN RETROSPECT

Surveying the spread of SARS-CoV-2 from the vantage point of the end of 2021, Li et al (2021) noted "our currently limited understanding of coronavirus diversity in nature, the rapid spread of the virus and its variants in such an increasingly connected world, the reduced protection of vaccines, and the urgent need for co-ordinated global surveillance using genomic techniques" (p408).

Sen et al (2021) reflected back on covid-19 in 2020 in the USA. The first case was identified on 20th January 2020 in Washington state, and three pandemic waves followed in that year:

i) A spring outbreak (March-May), mostly in selected urban areas.

ii) A summer wave (June-August), mostly in the southern half of the country.

iii) An autumn-winter wave into 2021.

While covering the period 1st September 2020 to 26th June 2021 in England, Vohringer et al's (2021) analysis of over 280 000 viral genomes presented a picture of "a series of sub-epidemics". Officially, this period covered second, third and fourth waves of the epidemic (with the first wave in early 2020) (Vohringer et al 2021).

Assessing the situation in March 2022, The leader (2022a) commented that "we cannot expect to deal with the pandemic in one corner of the globe and not see repercussions elsewhere; and that, ultimately, the only way to prevent new variants is to prevent the spread of the virus" (p5). This was at a time when fear of another Omicron wave was prominent. The sub-variant BA.1 in late 2021 was being "replaced" by the BA.2 sub-variant (Le Page 2022e).

4. MENTAL HEALTH

4.1. HEALTHCARE WORKERS

NHS clinical and non-clinical healthcare workers (HCWs) have experienced "extraordinary pressures" and "significant stressors" (p802) during the covid-19 pandemic (Lamb et al 2021).

Self-reported mental health of the general population in the UK has deteriorated during the pandemic, but is the impact for HCWs worse? The early studies produced conflicting answers to this question. But these were cross-sectional studies with convenience samples recruited via social media (Lamb et al 2021).

The NHS CHECK study overcame these limitations by studying a cohort (ie: all staff working at three NHS hospital trusts in South-East London who agreed to participate; n = 4378).

Lamb et al (2021) reported the findings from the first lockdown in April-June 2020. The General Health Questionnaire (GHQ-12) was the main measure used. Around half the respondents (n = 2166) agreed to complete a longer questionnaire covering aspects of mental health.

From the GHQ-12 it was found that 59% of the total sample had probable common mental disorders (CMDs). The word "probable" was used because official diagnosis did not take place and the questionnaires were self-reported.

Among the sub-sample completing the longer questionnaire, the following prevalences of "probably" disorders were found:

- Anxiety - 23%
- Depression - 27%
- Alcohol misuse - 11%
- Post-Traumatic Stress Disorder (PTSD) - 30%
- Suicidal thoughts - 9%
- Attempted suicide - 2%
- Deliberate self-harm - 3%

In terms of demographic variables, younger staff, and females were more likely to have probable CMDs, and those exposed to "morally injurious events", while doctors were less than other staff.

In summary, "a high prevalence of adverse mental health outcomes" was found (Lamb et al 2021 p804).

Table 4.1 summarises the main strengths and weaknesses of the NHS CHECK study.

STRENGTHS	WEAKNESSES
1. Larger sample than previous studies. 2. Demographics typical of overall NHS, but more ethnic minority staff as is common in London. 3. All staff included (HCWs, non-clinical ancillary, administration and temporary).	1. The response rate was only 12%, and "therefore, it is inevitable that findings are open to selection bias, with those for whom the survey had greatest salience (ie: those who were distressed) probably being most likely to participate" (Lamb et al 2021 p805). 2. Three-quarters of the sample were female. 3. The data were cross-sectional, though the aim is to produce longitudinal data subsequently.

Table 4.1 - Main strengths and weaknesses of the NHS CHECK study.

Lamb et al (2021) made comparisons of their findings with the limited number of studies available:

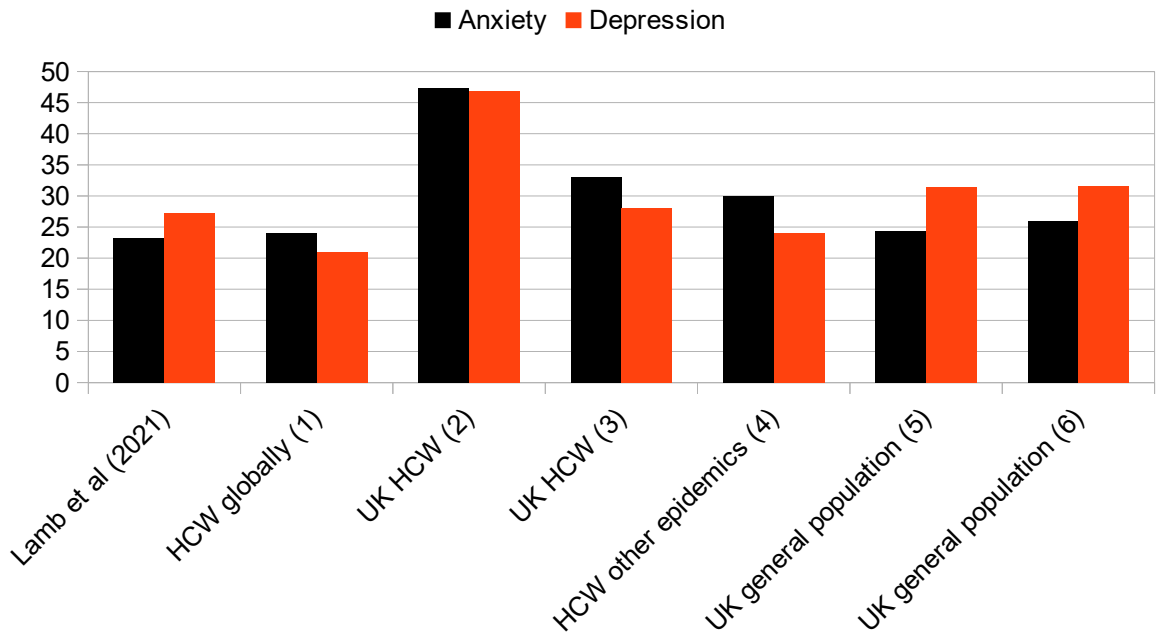
i) HCWs globally - Lamb et al (2021) found a higher prevalence of CMDs, but admitted: "Direct comparison of our findings with other covid-19 HCW studies is challenging owing to varied methodological quality and heterogeneity of healthcare systems in different countries..." (p805).

ii) HCWs in UK - Lower levels of depression and anxiety, but higher levels of PTSD here compared to cross-sectional, volunteer studies. Different measures and cut-off points, however, were used in the studies.

iii) HCWs in previous epidemics - Comparable rates to a review of 117 international studies by Serrano-Ripoll et al (2020).

iv) UK general population - Pierce et al (2020a and b), using the GHQ, found prevalence of probable CMDs of 37% and 27% respectively.

Figure 4.1 shows a comparison of the prevalence of anxiety and depression in different studies.



(1) Muller et al (2020) review of 59 HCW international studies.
(2) Greene et al (2021) UK HCWs.
(3) Gilleen et al (2020) UK HCWs.
(4) Serrano-Ripoll et al (2020) review of 117 international studies of HCWs in previous epidemics.
(5) Covid-19 Social Study (Fancourt et al 2020).
(6) Mental Health in the UK and Covid-19 Study (Jia et al 2020).

Figure 4.1 - Prevalence (%) of anxiety and depression in different studies.

4.1.1. Pakistan

Haroon et al (2021) surveyed over 100 healthcare workers at one hospital in Pakistan in May 2020. The 25-item questionnaire covered sources of stress (eg: availability of personal protective equipment), and anxiety symptoms. The latter used the "Generalised Anxiety Scale-7" (GAD-7) (Spitzer et al 2006), which covers seven symptoms for the past two weeks (eg: "feeling nervous, anxious or on edge"; "feeling afraid, as if something awful might happen"), each scored 0 to 3 in terms of severity. This gives a total score out of 21, with the cut-off points of 5 for mild anxiety, 10 for moderate, and 15 for severe.

Overall, 31% of respondents were categorised as mild, 14% as moderate, and 6% as severe anxiety. The last

group included nurses and frontline workers only.

The overall mean GAD-7 score for nurses was significantly higher than for physicians, while younger staff (21-30 years old) had a statistically significant higher mean score than older staff. Frontline workers' mean score was significantly higher than other staff. Altogether, younger age, and being a frontline worker predicted anxiety.

The most important sources of stress were fear of carrying infection home, lack of social support when staff unwell, and feelings of inadequate performance at work.

In summary, mild and moderate anxiety symptoms were common among the staff. Studies of similar staff groups around the world have confirmed this (eg: Iran and India), while the higher anxiety among younger workers and frontline workers has also been noted (eg: China) (Haroon et al 2021).

In terms of sources of stress, compared to other studies, Haroon et al (2021) admitted: "Surprisingly, lack of personal protective equipment was not a significant source of anxiety in our cohort" (p6).

Table 4.2 summarises the key limitations with Haroon et al's (2021) study.

- Only anxiety symptoms measured.
- Anxiety based on self-reports (though with a standardised measure), but it was not clinical diagnosis.
- Only limited number of sources of stress covered.
- Cross-sectional study (ie: no long-term measure or ability to follow symptom progression over time).
- Volunteer sample in the emergency department in one hospital in Islamabad.

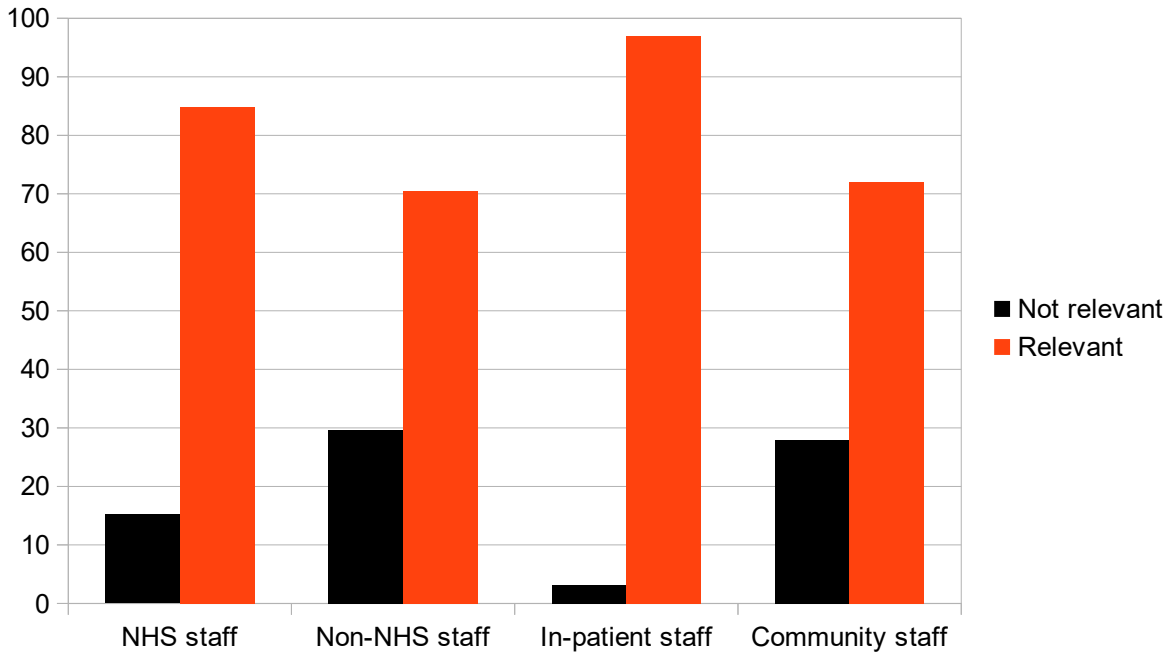
Table 4.2 - Key limitations with Haroon et al's (2021) study.

4.1.2. Specialist Staff

Adults with learning disabilities and/or autism have been at higher risk during the pandemic because of co-occurring physical health conditions, and shared living. Front-line staff working with these service users have had to adapt their practices.

Sheehan et al (2022) investigated the experiences of such staff (n = 648) in the UK with a survey, which included three areas - the challenges of working during the pandemic, the staff perspective on problems faced by service users and family carers, and the sources of help. The length of the survey ranged from 97 to 277 questions depending on answers and branching questions. The data were collected in April-May 2020.

Sheehan et al (2022) concentrated on the challenges faced at work by staff. Being infected with covid-19 at work was important (figure 4.2), along with problems and issues related to transmission and infection control policies (eg: lack of personal protective equipment).



(Data from Sheehan et al 2022 table 1 p203 and table 2 p205)

Figure 4.2 - Responses to the item: "The risk I or my colleagues could be infected with covid-19 at work" (%).

Three key themes emerged from the qualitative responses - remote operating, flexibility, and organisational improvement. The first theme can be seen in this quote: "Telephone and online counselling for some clients has been beneficial as they struggle to access the building... my DNA [did not attend] rate has decreased as a result" (p204).

Sheehan et al (2022) noted some differences depending on where the staff worked, for example: "Staff

working in the community reported greater difficulty in adapting to using new technologies in their work and in engaging patients with neurodevelopmental disorders in remote appointments... They also expressed more difficulty in managing their work-life balance" (p204).

While NHS [National Health Service] staff, for example, were "more likely than those in other sectors to express problems with having to adapt too quickly to new ways of working, having insufficient support to use new technologies, and lacking necessary tools and equipment to make remote working a reality" (Sheehan et al 2022 p205).

The sample was opportunity (ie: those who responded to online advertisements. Sheehan et al (2022) explained: "Staff in the present sample worked with people with intellectual disability and/or autism but could also work with other patient groups, and it was not possible to disentangle which opinions are informed by work with specific groups; however, their experiences are overarching, as many 'mainstream' mental health services are accessed by people with neurodevelopmental disorders" (p206).

The survey captured a snapshot of the experiences of staff in the early days of the pandemic (during the first national lockdown in the UK).

A similar study in Ireland (McMahon et al 2020) found moderate levels of burnout, and mild levels of anxiety and depression among 285 staff.

4.2. ADOLESCENTS

Prior to covid-19 there was already concerns that rates of mental distress among adolescents had increased in the 21st century. "Explanations for this have centred on increased pressures related to exams, the rise of social media, and the impacts of rising inequality and poverty" (Knowles et al 2022 p1). So, what has been impact of covid-19 on this group including with school closures and social restrictions?

Early (in the pandemic) online surveys with convenience samples reported inconsistent findings - worsening, improving, or unchanged mental health. But these surveys lacked pre-covid-19 comparison data, and were cross-sectional (Knowles et al 2022).

Studies with comparison data subsequently appeared, but the findings were "again mixed, methods varied, and samples relatively homogenous, with minority ethnic

groups and those from low-income households – that is, those most likely to be impacted by social restrictions and school closures – under-represented. Further, a primary focus on overall trends neglects variations by social and ethnic group and by direct impacts of the pandemic, be these negative or positive" (Knowles et all 2022 p2).

The Resilience, Ethnicity, and AdolesCent Mental Health (REACH) study can overcome many of the aforementioned problems. It involved 4353 11-14 year-olds in south London who were surveyed annually for three years (2016-19) pre-pandemic (T1-T3) (Knowles et al 2021). Knowles et al (2022) reported a fourth wave (T4) in mid-2020 with 1074 of the participants.

Four hypotheses were proposed:

1 - An increase in mental distress between pre-pandemic (T1-T3) and mid-pandemic (T4).

2 - The increase will be greater in certain groups - (a) those with prior mental health problems, (b) females, (c) those living in low-income households, and (d) minority ethnic individuals.

3 - The increase will be greater among individuals reporting worse mid-pandemic circumstances.

4 - Changes in mental distress will be linked to perceptions of the impact of the pandemic.

The questionnaires used were the same in T1 to T3, but included extras in T4 relevant to the pandemic. Mental distress in all cases was measured by the Strengths and Difficulties Questionnaire (SDQ) (Goodman et al 1998), which covered emotional and behavioural problems in the last six months. Total scores ranged from 0-40, and ≥18 indicates "probable mental health problems".

Hypothesis 1 was not supported by the data. The prevalence of "probable mental health problems" overall was 16% at T4 compared to 17-18% previously. "However, there was considerable variation around the average of 0 change in SDQ scores, with many reporting marked changes in distress – increases and decreases" (Knowles et al 2022 p4).

Concerning Hypothesis 2, females showed a small increase in mental distress between pre- and mid-pandemic, while the other groups showed no change or a small reduction. It is possible to say that "pre-Covid-19

disparities in distress linked to household discord, income, and isolation largely persisted or decreased – but did not widen – in the early phase of the pandemic" (Knowles et al 2022 p4).

Hypotheses 3 and 4 had the strongest support from the data. Mental distress increased among individuals with worse covid-19 circumstances (eg: deteriorating family relationships; household financial problems). The researchers found that experiencing multiple negative impacts amplified the increase in mental distress.

In summary, two broad trends were noted:

i) Pre-pandemic disparities in mental distress linked to disadvantage persisted, but did not widen mid-pandemic.

ii) Individuals impacted negatively by covid-19 showed an increase in mental distress.

Knowles et al (2022) stated: "This is among the most comprehensive studies of the impacts of covid-19 on the mental health of adolescents from diverse ethnic and social backgrounds in a densely populated inner-city UK sample during the initial period of the pandemic" (p7). But, saying that, the sample size of T4 was around 40% of T1-T3. T4 was performed online which introduced bias in terms of home internet access. Knowles et al (2022) explained: "At T1–T3, all questionnaires were administered in class, on study tablets, with trained researchers present to answer questions. At T4, data were collected remotely. In using a remotely completed self-report questionnaire, the potential for measurement error and misclassification (eg: in mental health status) is high. This limitation is offset, to some extent, by our use of validated measures that have been used extensively in previous epidemiological studies of adolescent mental health (eg: the SDQ). This limitation characterises all covid-19 research, given the restrictions on face-to-face interviews" (p8).

In terms of other studies, Hafstad and Augusti (2021), for example, suggested an increase in depressive symptoms among 13-16 years during the pandemic "beyond what might be expected based on existing time trends of adolescent mental health" (Mansfield et al 2022 p2) (table 4.3).

Mansfield et al (2022) made use of data from two large, ongoing multi-phase intervention trials in the UK (Interventions in Schools for Promoting Well-Being

STUDY	TYPE	MAIN FINDING
Aknin et al (2022)	Review	Increased psychological distress during early stages of pandemic
Thorisdottir et al (2021)	Longitudinal population-based study in Iceland	Increased depressive symptoms before and during the pandemic
Wright et al (2021)	Wirral Child Health and Development Study - UK cohort	Increased depression, post-traumatic stress disorder, and externalising behaviours (eg: conduct disorders)

Table 4.3 - Three studies on adolescent mental health and the pandemic.

Research in Education (INSPIRE) and Approaches for Well-Being and Mental Health Literacy: Research in Education (AWARE)). The upshot was longitudinal data on 11-15 year-olds prior to the pandemic (September-October 2018, September-October 2019, and January-March 2020), and during/after (February-April 2021). In total, 11 450 pupils from 178 schools.

Depressive symptoms increased and life satisfaction decreased after the pandemic when compared to the pre-pandemic period. It was estimated that if the pandemic had not happened, the prevalence of depressive symptoms would be 1.6% lower, and 6% fewer adolescents with high depressive symptoms. "The pandemic has therefore led to a deterioration of mental health in this population beyond what would have been expected based on existing trends. However, there was no main effect of the covid-19 pandemic on adolescent externalising difficulties. Exploratory analyses suggest that the impact of the pandemic may have been greater in females, with females exposed to the pandemic showing greater depressive symptoms, externalising difficulties and lower well-being. Adolescents of higher socio-economic position showed a greater difference in life satisfaction between the control and covid-19 group" (Mansfield et al 2022 p13).

In terms of methodology the study was a quasi-experiment (or natural experiment). There was a "control" group, who were measured at two points prior to the pandemic (2018 and early 2020), and an "exposed" group measured in 2019 and 2021. The two groups were similar in school- and pupil-level characteristics, but there was greater drop-out in the exposed group. "Greater drop-out could have resulted in a biased sample at follow-up, with

schools and individuals with certain characteristics more likely to participate" (Mansfield et al 2022 p17).

4.3. MISCELLANEOUS

4.3.1. Singing

The covid-19 pandemic led to a cessation of in-person group singing, but "virtual singing" via communications technology emerged (Morgan-Ellis 2022).

Controlled laboratory studies showed that singing expelled droplets containing the virus to a wider field than speaking, and so group-singing was "an exceptionally high-risk activity during the pandemic" (Morgan-Ellis 2022 p29).

Seeking to understand the adaptation to virtual singing, Morgan-Ellis (2022) interviewed twenty-two singers involved in online singing. Technical problems, in many cases, limited all participants singing together, so one solution was for the host to share an audio recording and everybody sang along on mute. Individuals were able to see each other, and to talk together between songs. Morgan-Ellis (2022) explained: "Although many singers regretted not being able to hear the voices of those 'present', I learned that they found meaning in the ability to gather and sing in a virtual setting" (pp32-33).

Other research has confirmed the well-being benefits of virtual singing, even if it is far from the same as in-person group singing (eg: Draper and Dingle 2021; Daffern et al 2021). However, the lack of privacy was an issue for many during lockdowns, however good the technology was (Morgan-Ellis 2022).

4.3.2. Pastors

Lockdowns "disrupted one of the most fundamental activities of religious congregations – bringing people together for corporate worship... As a result, often in the span of a few days, clergy were forced to adapt the practices of their religious communities to public-health restrictions... and denominational guidelines" (Johnston et al 2022 p376). Johnston et al (2022) interviewed 26 United Methodist ministers in North Carolina in June-August 2020 about the impact.

The researchers applied Swidler's (1986) concept of an "unsettled cultural period" (ie: "a moment in which

cultural ideas and practices are in flux"; Johnston et al 2022 p376). In settled periods "culture is intimately integrated with action" (Swidler 1986), so "people rarely think consciously about their actions. However, unsettled moments raise previously unconsidered practices to the level of conscious thought and prompt actors to reconsider the status quo, and, if necessary, develop new strategies for action" (Johnston et al 2022 p377). The upshot for pastors is a rethinking of "congregational culture" (Johnston et al 2022).

The interviews showed how the pastors were "'re-doing' ministry" in terms of worship, pastoral care, and pastoral identity. This process was "easier and more effective in some areas (worship) than others (pastoral care)" (Johnston et al 2022 p379).

"Unsettling" was a key theme from the interviews, as "Beverly" stated: "[Ministry] is radically changed. It is absolutely radically changed" (p380), while "Luke" felt, "We're unlearning ministry and starting from scratch" (p380). Again quoting "Beverly", "It's like you've been thrown into the deep end and you better learn how to swim really quickly" (p380). "Rebecca" used the analogy of "trying to build a plane while we fly it" (p380). "Many pastors found this overwhelming. As one later-career elder, Alice, told us, 'Everything I learned about how to be a pastor, I've virtually had to re-figure out... I was at a point where I felt completely competent in how to be a pastor and now I no longer feel competent'" (Johnston et al 2022 p380).

The response to this change was the next theme, namely "redoing". "If pastoral ministry is, as Luke described it, primarily 'the ministry of presence', pastors like Luke were left asking, 'How do you remain present when you are not physically present?'" (Johnston et al 2022 p381). Worship services were tried via "Facebook Live", for example, with technical hitches (eg: "Steven" said: "I thought all you did was hit the start button. But, no"; p382). But singing was a problem with this medium, and with groups that met outdoors. In the latter case, "Arthur" said: "I told folks a couple of weeks ago, if you can sing softly, then do so. If you're like me and you can't sing softly, you have to belt it out, then put a mask on so it doesn't spray everywhere" (p383).

Communion was also difficult to perform via social media. "Rebecca" felt that "the existing substitutes – using 'little pre-sealed packs' or 'telling people to bring their own elements to an online service' – were not sufficient. For her, 'there's something about physically

offering the bread and cup' that defined the practice. Rebecca planned a different work-around: her congregants were going to 'meet in small groups every now and then on a porch, socially distanced, for 15 min so that we can have communion'" (Johnston et al 2022 p383).

Pastoral care was totally disrupted. "Danny" explained: "We've had two elderly members of our church actually die of covid. And they were alone in the hospital. And that's just really hard when you're used to providing care in a certain way in a certain level and the best you can do now is a phone call or a card, which is good, but it's not what it was" (p385). Johnston et al (2022) explained: "Generally speaking, pastors found pastoral care during the covid-19 pandemic overwhelming and exhausting. Unable to rely on pre-existing methods and practices for connecting with congregants (namely during worship and through in-person visits), pastors were forced to find new ways to do so — most commonly by phone, email, or text. Despite considerable time and effort, however, many still felt that they were not doing enough. As Rebecca told us: 'It doesn't feel good enough. It doesn't feel like what we think we need church to feel like'" (pp386-387).

The changing role of the pastor was seen in having to answer questions about the virus, as "Arthur" described: "My people are, 'Pastor, what do we do?' Okay, and it now falls on me to try to come up with the best answer. They talk about, 'Well, the virus lives on surfaces for days. No, wait, it doesn't live on surfaces for very long, but then again it might, so you probably shouldn't touch anything'. It's been that all along with covid... I'm getting a lot of people looking to me... They're looking to me for leadership and wisdom, and I'm having to do a whole lot of studying to try to figure it out for them" (p387).

A third theme was the possibility of "new traditions". "By unsettling ministry-as-usual, the pandemic allowed pastors to reimagine and creatively re-work different aspects of ministry. Some pastors even described this period as energising and exciting" (Johnston et al 2022 p388). For example, "Luke" hoped to continue online worship. "Carolyn" observed: "Pandora's box has been opened... We're going to have to think about church differently" (p390).

Most of the focus was upon the practical changes (the "hows of ministry") rather than "the 'theoretical, big picture' implications of the pandemic (ie: the whys of ministry)...It is possible that more ideological shifts will begin to emerge as the long tail of the

pandemic starts to disrupt taken-for-granted meanings and priorities" (Johnston et al 2022 p392).

The response of the pastors varied with age, and with congregation size and location (eg: rural). "Early career pastors were more likely to speak of the opportunities to be creative and innovative, while later career pastors,... more often reported being overwhelmed and exhausted by having to rethink and redo ministry in this new context" (Johnston et al 2022 p394).

5. ILLNESS AND DEATH

5.1. DEATHS

Rural regions around the world were "largely spared in earlier waves of the pandemic" (Mallapaty 2021a p325), but the fear was that the spread of the Delta variant would challenge this situation. Rural areas tend to have less access to healthcare, and to vaccines (Mallapaty 2021a).

Accurate measurement of the number of covid-19-related deaths is important, but difficult around the world. One problem is that "health-care reporting systems generally do not list covid-19 as the cause of death without a positive SARS-CoV-2 test, and thus deaths due to covid-19 will be missed in official counts in locations with low testing capacity. For example, early in the pandemic, before tests were widely available, many deaths due to covid-19 among older individuals in high-income countries, particularly in long-term care facilities, are unlikely to have been attributed to covid-19" (Covid-19 Excess Mortality Collaborators 2022 p2).

Furthermore, there is "no universal agreement as to when a death of someone infected with SARS-CoV-2 should be reported as a death due to covid-19" (Covid-19 Excess Mortality Collaborators 2022 p3). Add to that "political considerations" (eg: the desire of governments to hide the number of deaths from the public), and covid-19-related deaths have almost definitely been under-reported and under-estimated.

Overall excess mortality has become a means of measurement to overcome these problems. This is "the net difference between the number of deaths during the pandemic (measured by observed or estimated all-cause mortality) and the number of deaths that would be expected on the basis of past trends in all-cause mortality" (Covid-19 Excess Mortality Collaborators 2022

p2).

Covid-19 Excess Mortality Collaborators (2022) used this method for 191 countries and territories using official data, like the "World Mortality Database", and the "Human Mortality Database".

By the end of 2021, global reported deaths due to covid-19 was 5.94 million, but Covid-19 Excess Mortality Collaborators (2022) estimated the number to be over three times greater (18.2 million).

Excess mortality studies in India (eg: Deshmukh et al 2021) suggested a death toll of nearer to five million compared to the official figure of 431 000 covid-19 deaths by mid-2021 (Mallapaty 2021a).

5.1.1. Exacerbation by Air Pollution

Zhou et al (2021) provided evidence that the 2020 wildfires in the USA amplified the number of covid-19 deaths through high levels of fine particulate matter ($PM_{2.5}$). Wu et al (2020) had calculated an eleven percent increase in covid-19 mortality for one unit increases in average air pollution levels.

The US Centers for Disease Control and Prevention (CDC) stated that "wildfire smoke can irritate your lungs, cause inflammation, affect your immune system, and make you more prone to lung infections, including covid-19" (quoted in Zhou et al 2021).

Zhou et al (2021) analysed publicly available data for ninety-two counties in California, Washington, and Oregon states that experienced wildfires in 2020. The average daily covid-19 death rate for these counties was 1.12 per 1 000 000 population for a focused 61-day period (15th August - 15th October 2020). This rate varied between 1.00 on non-wildfire days and 1.23 on wildfire days. A wildfire day was defined using satellite images showing smoke cover (and confirmed with airport data).

The analysis, however, could not control for confounders (eg: wearing of masks; social distancing), nor distinguish the smoke pollution from other air pollution.

5.1.2. Indonesia

Retrospective data allows researchers to look for characteristics common to different groups after it is known about the severity of the illness. Surendra et al

(2021), for example, did this in Indonesia.

Between 2nd March and 31st July 2020 21 397 PCR-confirmed covid-19 cases were reported in Jakarta. These were treated as a cohort and the outcomes were analysed - 21% were hospitalised. Of these, 94% (n = 4265) reached a definitive outcome by the end of the study period: deceased (12%; n = 497) or discharged (88%; n = 3768).

Firstly, the hospitalised group; the median age was 46 years old, 52% were male, and 31% had pre-existing co-morbidities (eg: hypertension, diabetes). Then focusing on the deceased patients, they were older (median age 58 years), more likely to be male (14% of hospitalised men vs 10% of hospitalised women died), a history of co-morbidities (62%), and more severe illness on admission to hospital. The over-riding risk factor for death was multiple co-morbidities. For example, more than one co-morbidity increased the risk of death by sevenfold compared to no co-morbidities. There was a lack of complete data about obesity as a risk factor, however.

This study covered the first few months of the pandemic, and involved "the largest patient series hospitalised with covid-19 in South-east Asia" (Surendra et al 2021 p6). The data conformed that multiple severe symptoms on hospital admission, and underlying health problems were key.

The in-hospital death rate was 12% in Jakarta, which was lower than reported in high-income countries (eg: USA 21% and UK 26%), but "those populations were substantially older, with more co-morbidities and more frequent presentation with severe disease" (Surendra et al 2021 p7). Under-reporting or under-diagnosis may have been an issue in this study.

Djaafara et al (2021) used confirmed covid-19 cases and deaths, and funerals data in Java (including Jakarta) up to early December 2020 to estimate a death toll from covid-19 approximately 3.3 times higher than official reported. The funerals data involved individuals exhibiting covid-19-like symptoms who died before receiving an official diagnosis and so were buried under strict covid-19 protocols. Such data involved assumptions. Djaafara et al (2021) stated: "Without confirmed diagnoses, the proportion of these individuals who were infected will always be unknown and liable to vary spatio-temporally, as will the extent to which measures of suspected deaths represent all deaths of individuals displaying covid-19 symptoms" (p8).

5.1.3. Orphanhood

The loss of one or both parents due to covid-19 in the USA parallels the experience of orphanhood due to HIV/AIDS in Sub-Saharan Africa (eg: 15 million individuals) (Kidman 2021).

Kidman et al (2021) estimated that around 40 000 children in the USA had been orphaned between February 2020 and February 2021. Hillis et al (2021) proposed a figure of more than one million globally by mid-2021.

Kidman (2021) summarised some of the findings from research with HIV/AIDS orphans in Sub-Saharan Africa, including:

i) Multiple negative consequences of being orphaned, including mental health problems, and risk of sexual abuse, and school drop-out. The loss of parent(s) increases the frequency of other and cumulative adversities.

ii) Supporting the family is crucial (eg: "cash plus care"; Laumann 2019). For example, in Tanzania, orphans randomly selected to receive cash transfers were significantly more likely to complete primary school (Evans et al 2021).

iii) A stable, supportive carer helps develop resilience.

5.2. SEVERITY

Some individuals develop severe symptoms of covid-19, while others show no signs at all. The interest has been in finding the factors involved. Severity is linked to age and underlying medical conditions, as well as socio-economic factors, it has become clear (Asgari and Pousaz 2021).

Covid-19 Host Genetics Initiative (2021) also found thirteen locations on the human genome that predicted susceptibility to and severity of covid-19 (eg: a gene known to increase the risk of lung disease). This study involved groups working around the world (ie: around 3000 researchers) and more than 49 000 covid-19 sufferers (and two million controls).

However, the majority of participants were of European ancestry, and the study did not control for all socio-demographic factors. Also a question that could not

be addressed related to "the combined effect of specific variants in the SARS-CoV-2 genome and variants in the human genome on disease outcome" (Asgari and Pousaz 2021 p391).

"Auto-anti-bodies", which turn against the immune system, are key to severe illness and death from covid-19 (Bastard et al 2021). Auto-anti-bodies were found in 14% of 3595 individuals with severe covid-19 studied in thirty-eight countries (compared to 0.4% of healthy individuals) (Kwon 2021).

5.2.1. Children

Viruses tend to hit the most vulnerable hardest - young children and older adults - producing a U-shaped curve of severe illness and death, but covid-19 has not impacted children particularly (eg: 2% of hospitalisations for covid-19 in the USA between March 2020 and August 2021 under 18s) (Mallapaty 2021c).

The hypotheses for the differences in hospitalisation between children and adults include:

a) Children are not getting infected in large numbers - Studies of anti-bodies (ie: signs of SARS-CoV-2 having been present) show that this is not the case (Mallapaty 2021c).

b) Children have fewer ACE2 receptors (the means by which the virus enters cells) - Conflicting evidence here (Mallapaty 2021c).

c) "Viral load" (ie: concentration of viral particles) in upper airways less in children - eg: Yonker et al (2021) found that among 110 two week to 21 year-olds viral load was high in both symptomatic and asymptomatic individuals.

d) Children vulnerable to other coronaviruses and so develop "cross-reactive" anti-bodies - No differences between children and adults (Mallapaty 2021c).

Another possibility is that the novelty of SARS-CoV-2 has meant that adult immune systems have no advantage from previous viruses, and so has created an equal starting point to compare immune systems. The innate immune response of children appears to be "revved up and ready to go" (Betsy Herold of Pierce, C.A et al 2020

quoted in Mallapaty 2021c).

Pierce, C.A et al (2020) compared sixty-five individuals under 24 years old and sixty older adults, and found differences in the innate immune system (better in younger individuals) and the adaptive immune response (poorer in younger individuals). The researchers "suspected that the children mounted a less robust adaptive immune response because their innate response was more efficient at eliminating the threat. An overactive adaptive response in adults... could be causing some of the complications in covid-19" (Mallapaty 2021c p167).

5.3. LONG COVID

"Long covid" or "post-acute sequelae of covid-19" (PASC) is increasingly being reported, and by non-severe covid-19 sufferers. For example, one-third of individuals reporting symptoms two months after SARS-CoV-2 testing had been asymptomatic at the time of testing (Huang et al 2021), while the prolongation of at least one symptom was reported by nearly 90% of 143 patients in Italy (Tabacof et al 2020).

Pretorius et al (2021) found that individuals with long covid had large anomalous (amyloid) deposits (micro-clots) in their blood. The samples from South Africa, however, were small - thirteen individuals with acute covid-19, eleven with long covid, thirteen healthy controls, and ten individuals with type 2 diabetes.

Long covid appears more likely for individuals with type 2 diabetes, with "auto-anti-bodies", or who were previously infected with glandular fever, for example (Marshall 2022b).

"Given the variety of long covid symptoms, finding one mechanism behind it or a single treatment is unlikely. 'I would caution anybody who tells you they have one answer to long covid', says Mark Toshner at the University of Cambridge. He says we probably aren't dealing with a single disease pathway. Instead, we are getting a number of overlapping answers, some of which describe mechanisms we already knew about from other viruses, some of which may be heightened in covid-19 and some of which may be specific to it" (Marshall 2022b p40).

Antonelli et al (2022) compared the risk of long

covid following Omicron and Delta variants of SARS-CoV-2 using data from the Covid Symptom Study app. Nearly 100 000 adults in the UK were identified between June 2021 and March 2022 using the following criteria:

- SARS-CoV-2 confirmed by PCR or lateral flow antigen test.
- Individuals used the app at least once per week during 28 days after testing positive.
- Prior vaccination and no SARS-CoV-2 infection before that vaccination.
- Long covid defined as ongoing symptoms four weeks or more after onset.

Long covid was categorised in 4.5% of Omicron cases and 10.8% of Delta cases. Omicron cases were less likely to experience long covid, even controlling for age, and time between vaccination and infection.

The study assumed the SARS-CoV-2 variant based on official data of the dominant variant in the UK - ie: December 2021-March 2022 Omicron and June-November 2021 Delta. Illness duration was self-reported as with symptoms.

The Cambridge University Teaching Hospital in England set up a long covid (LC) clinic in May 2020, with referral based on symptom duration of five months or more, among other criteria (Krishna et al 2022).

Krishna et al (2022) noted a 79% drop in referrals from August 2021 to June 2022 as compared with August 2020 to July 2021. "This change is notable as the decrease begins in August 2021, 5 months after the British population started receiving second doses of covid-19 vaccines in March 2021. Taken in context, this observation points toward vaccination in the UK playing a role in reducing the rates of the most severe LC cases" (Krishna et al 2022 p1). However, "[V]accination has not changed the symptoms of LC, but has likely reduced symptom severity" (Krishna et al 2022 p2).

In a cohort of US Army veterans (Al-Aly et al 2022), vaccination was found to reduce LC symptoms by 15% at six months (Krishna et al 2022).

5.4. MISCELLANEOUS

(1) During covid-19 the number of influenza cases and deaths have dropped drastically because of public health measures. In the USA, for example, there were seven hundred deaths from influenza in the 2020-21 flu season compared to over 20 000 in the pre-covid-19 flu season (Peek 2021).

(2) Anti-viral pill, molnupiravir, in an early trial reduced the risk of hospitalisation from covid-19 by 50%, but subsequently in another trial by only 30% (and compared to up to 85% for monoclonal anti-body treatments) (News in brief 2021).

(3) "Ivermectin" (a drug used to treat parasites) became popular as a lay treatment for covid-19 despite the lack of scientific evidence to support its use. In the USA, poison control centres had reported a surge of ivermectin-related cases (Stokel-Wlaker 2021).

In the UK, a campaign called the "Ivermectin Approval Club" had tried to get the drug officially approved for use with covid-19, while a group on the social media site "Telegram" called "Ivermectin Buyers Club" has tried to source the drug unofficially (Stokel-Walker 2021).

(4) There is evidence of an increased risk of diabetes after covid-19 infection (Wilson 2022d).

The possible explanations include previously undiagnosed cases being noticed after infection, a temporary form of diabetes (as in pregnancy), or that SARS-CoV-2 in some ways damages the pancreas (Wilson 2022d). "Confusing matters further, there have been some reports of people with signs of both type 1 and type 2 diabetes after a covid-19 infection" (Wilson 2022d p14).

(5) Larger declines in the grey matter volume thickness in the frontal and temporal lobes have been observed in individuals previously infected with covid-19 than not. There appears to be no difference between mild and severe forms of covid-19 (Bernard 2022).

6. OFFICIAL RESPONSES

6.1. RESPONSES TO PANDEMIC

6.1.1. China

The Chinese government has employed a "zero-covid policy" with only two deaths between 15th May 2020 and 15th February 2022 (out of 24 249 confirmed covid-19 cases) (Chen and Chen 2022). The policy has involved regular, strict and prolonged lockdowns.

Chen and Chen (2022) argued for an ending of this policy, but the greatest challenge will be a rapid surge in cases which could overwhelm the healthcare system.

Chen and Chen (2022) outlined the advantages of ending the policy: "The change should better balance the control of covid-19 versus other socio-economic issues. The change should also better balance the control of covid-19 versus other diseases, as the zero-covid approach has occupied vast public health resources. Moreover, living with the virus in a highly vaccinated population can lead to robust herd immunity against various SARS-CoV-2 variants through repeated natural mild infections" (p1).

6.1.2. New Zealand

New Zealand's elimination strategy, which severely limited international visitors and introduced rapid lockdowns, seemed to be effective as five months (April-

August 2021) passed without a locally acquired case of covid-19. But then the Delta variant was detected in mid-August 2021 in Auckland (Klein 2021).

6.1.3. Border Control

The spread of covid-19 can be reduced by stopping travellers enter an area, but such restrictions may impact tourism.

Four main strategies have been used internationally by different countries (Bastani et al 2021):

i) Allow individuals from "white-list" countries unrestricted access.

ii) Require travellers from "grey-list" countries to provide a negative PCR test result before arrival.

iii) Require travellers from "red-list" countries to quarantine on arrival.

iv) Refuse access to travellers from "black-list" countries.

The decision on which countries to place in each list varies.

Bastani et al (2021) reported the use of a machine learning algorithm with real-time reinforcement learning (called "Eva") to help in decision-making at forty points of entry to Greece (from August-November 2020). Passengers had to complete a form detailing their point of origin 24 hours before arrival, and this was used in decision-making. Eva identified more asymptomatic, infected travellers than random testing.

The UK Government refused in mid-2021 to recognise individuals as vaccinated on arrival (ie: exempt from quarantine) if the vaccine had been received in most of Latin America, Africa, and south Asia (Hodges et al 2021). "Many commentators have rightly called out this discriminatory policy, which unfairly targets people from low-income countries" (Hodges et al 2021 p1565).

Hodges et al (2021) argued that the "consequences of suspicion, and not evidence, driving policy are serious. This UK policy is irrational because many of these low-income and middle-income countries administered the same vaccines that the UK Government distributed to its own

population. In some instances, the UK Government donated these vaccines" (p1565). Furthermore, it gives ammunition to vaccine hesitancy and scepticism.

6.1.4. The End

When does a pandemic end? Simply, when the World Health Organisation officially pronounces so, as with the official beginning on 11th March 2020. "That won't mean that the SARS-CoV-2 virus has been eliminated, however. Instead, the end will come when new infections occur at a fairly constant rate, as opposed to the big, unpredictable waves we have experienced so far" (Marshall 2022a p12). This is what is called "endemic" (Marshall 2022a).

The timing of this depends on four factors (Marshall 2022a):

i) Global vaccination rates (including the number of doses needed per person).

ii) The evolution of the virus.

iii) Medical advances in treatments for covid-19.

iv) Preventative measures (eg: mask wearing).

6.2. EXPERT KNOWLEDGE

Camporesi et al (2022) assessed the use of expert advice by policymakers in Italy in early 2020, including via interviews with members of official advisory committees, and analyses of relevant documents. Italy was at the forefront of the pandemic with China, and "had to deal with the highest degree of uncertainty, regarding the new pathogen" (Camporesi et al 2022 p12).

The technical experts who advised the government were required to sign non-disclosure agreements and prohibited from contact with the media. "These strict non-disclosure clauses imposed on the technical experts may have led to a proliferation of unofficial or non-appointed experts becoming regular guests in news channels and TV shows. Italian citizens felt a desperate need for information in the midst of a highly uncertain and frightening crisis, and the media grappled to satisfy it. Throughout 2020, a plethora of virologists, immunologists and epidemiologists regularly appeared on

TV as consultants on different pandemic-related topics. The opinions shared by these independent experts were often divergent and contradictory, leading to heated live arguments and discussions, as well as questionable declarations, such as famously that the covid-19 virus was 'clinically dead' in the summer of 2020... This proliferation of independent experts talking to the media likely contributed to generate a situation of general confusion and misinformation in the public opinion, which undermined the ownership of, and trust in, expert advice in the pandemic" (Camporesi et al 2022 pp7-8).

Subsequently, the minutes of government meetings were made available after a "cooling off" period. "This cooling off period was the agreed compromise between the request to publish the minutes, and the need to get things done in the midst of a health emergency without having to discuss every single decision. 'Democracy and management of health emergency' do not always go hand in hand, as one of our key stakeholders put it", explained Camporesi et al (2022 p8).

Camporesi et al (2022) felt that overall the government closely followed the expert advice of their committees, and there was "an active effort spearheaded by the politicians themselves to take the 'politics' out of the management of the pandemic through the use of expert knowledge" (p10).

But there was a risk of politicians passing too much responsibility to experts for key decisions. One member of the expert committee said: "We have become legislators. The problem is we don't want to be legislators, we only want to be a consultative tool. We are trying hard to keep our function of consultative group however it's not our own strength but others' weaknesses which transforms us into something else" (p7). Camporesi et al (2022) explained: "Expert-based politics can only be a temporary solution for politicians. The continued resorting to expert-based advice beyond the strict limits of the emergency can lead to diminished trust in experts with longstanding consequences for science" (p12) (appendix 6A).

Health advice was given more prominence than economic and social expertise (Camporesi et al 2022) [11].

[11] A survey by "Nature" of 321 scientists, who had been interviewed in the media, advised policymakers, and/or wrote social-media posts about covid-19, found that a number had received negative consequences, like, at the extreme, death threats (n = 47), and threats of physical or sexual violence (n = 72) (Editorial 2021b). But 85% said that engaging with the media was a positive experience (Nogrady 2021).

6.2.1. USA and the Administrative State

Tushnet (2021) presented a picture of the USA in the late 19th century: "Technological change, again symbolised by the railroad but encompassing what we now refer to as information technology (the telegraph and the telephone), generated new problems: exploitation of workers and farmers, for example, and new political possibilities enabled by 'yellow journalism'. So did rapid urbanization and immigration; the modern city was overcrowded, rife with environmental dangers and crime" (p6).

The solution proposed was "new administrative agencies guided by professionals deploying the findings of contemporary science" (Tushnet 2021 p6). This is the "administrative state".

The size of the administrative state has grown over time, but so has criticisms of it. Many of the agencies have become caught up in the party politics that they were meant to transcend, and "the idea of disinterested scientific expertise has come under sustained assault from all sides" (Tushnet 2021 p10).

Tushnet (2021) felt that the problems were evident with the policy responses to the covid-19 pandemic. Medical experts gave estimates of health risks associated with various policy options, and economists calculated the economic costs. "Neither epidemiologists nor economists, though, could tell us which policy we should adopt, in part because their estimates were inevitably fuzzy and, under the circumstances, should have changed as information accumulated and in part because, notwithstanding the economists' best efforts, only devoted technocrats believe that costs to the economy and costs to human life and health can be measured by a single metric. Technocratic-driven policy choices, which of course have to be implemented through politics, proved to be unstable in the face of public scepticism about how much the experts really could tell us. 'Following the science' can bring policy-makers to the point where they could make reasonably well-informed choices, but “the science” could not and did not tell them what choice to make" (Tushnet 2021 pp10-11).

6.2.2. Preparedness

Covid-19 could be described as a "black swan" occurrence - ie: "a very low-probability but very high-risk event" (Taleb 2010 quoted in Schwarcz et al 2021).

Covid-19 is not the last pandemic, and spillovers, like Ebola viruses which has occurred around twenty-five times in the last fifty years, are inevitable (Maxmen 2021a) (appendix 6B). So, prevention may be limited in success, which makes preparedness important.

Preparedness tends to cover general areas like (Maxmen 2021a):

i) Surveillance for spillovers - "Insufficient detection worries researchers because outbreaks get exponentially harder to contain once they've expanded beyond a limited area" (Maxmen 2021a p333). Surveillance may be limited by simple shortages in poorer countries, like sample tubes to collect blood or basic anti-viral drugs (Maxmen 2021a).

ii) Data collection and modelling to understand the spread of pathogens.

iii) Improved public health systems and messaging.

iv) Development of treatments and vaccines.

6.3. MISCELLANEOUS

6.3.1. Ventilation

Ventilation of public buildings is an important strategy as covid-19 is an "air-borne disease", but establishing standards for ventilation are not easy (Lawton 2021).

One way is to measure the carbon dioxide (CO^2) in the air, which is exhaled by people. Outdoor air had 410 parts per million (ppm) of CO^2, whereas in a crowded Tube train in London it was over 1000 ppm, according to measurements by the "New Scientist" in summer 2021 (table 6.1) (Lawton 2021).

• Outside	413
• Full bus	724
• Full Tube train	1076
• Overground train (windows closed)	720
• Private car (two people, windows closed)	1740
• Busy small supermarket	1100
• Half full office	477

(After Lawton 2021 p13)

Table 6.1 - Selected highest readings in London of CO^2 (ppm).

6.3.2. Predicting The Future

Predicting the future global population trends has traditionally been the province of the United Nations (eg: plateauing at 10.9 billion by 2100). But a forecast by the International Institute for Applied Systems Analysis in Vienna suggested a peak of 9.7 billion in 2070 and then a decline (Adam 2021).

"The difference poses a conundrum for governments, companies and others trying to plan for everything from investment in infra-structure and future tax income, to setting goals for international development and greenhouse-gas reductions" (Adam 2021 p463).

Any future number is a prediction based on the number of people alive today, which is established by population censuses. Covid-19 has impacted both the collection of set data, and predictions of future numbers (Adam 2021).

The size of the future population relies heavily on the fertility rate (ie: the average number of children borne by a woman). Fertility rates are lower in higher income countries and as women become more educated. But what about the impact of covid-19 here?

The following trends are expected (Adam 2021):

- A decline in the fertility rate in richer countries because of economic uncertainty (eg: 5-8% less births in November 2020 - January 2021 in the USA compared to one year before; Sobotka et al 2021).

- An increase in poorer countries as contraception supplies are disrupted.

- A "post-pandemic boom" in births.

6.3.3. Fear of Mass Panic

Governments are fearful of mass panic in response to crises like the pandemic, but Petersen (2021) argued that this tends not to happen, using Denmark as an example. The Prime Minister (Matte Frederiksen) announcing a lockdown on 11th March 2020 "created a sense of urgency and crisis, but not panic" (Petersen 2021 p237) (appendix 6C).

Petersen (2021) continued: "The idea that the public is incapable of dealing effectively with the unpleasant truth stymies pandemic management. It leads authorities to communicate in self-defeating ways" (p237). Research

has shown that clearly communicating with self-efficacy is effective (Jorgensen et al 2021) [12]: "people who feel that they know what to do, and how, are likely to comply" (Petersen 2021 p237).

Honesty encourages trust (eg: discussion of side effects of vaccines) (Sonderskov et al 2021; table 6.2).

- Data from a Danish panel survey in 2021 before and after reported cases of thrombo-embolic events with the Oxford-AstraZeneca vaccine were analysed (n = 1654 respondents). Key questions related to the willingness to be vaccinated, and the perceived safety of the vaccine.
- The willingness to be vaccinated was reported by 89.3% of respondents during 4th-21st February 2022 (ie: before) and by 89.2% during 15th-25th March 2022 (ie: after the media reports of the side effects).
- The perceived safety of the Oxford-AstraZeneca vaccine was lower in March 2021 than the PfizerBioNTech one (mean 5.35 vs 8.26 out of 10). The perceived safety was lower among vaccine-hesitant individuals.
- There was no baseline measure of perceived safety of the vaccines prior to the side effects being reported (early March 2021). The study also measured stated willingness to be vaccinated, not actual behaviour (Sonderskov et al 2021).

Table 6.2 - Details of Sonderskov et al (2021).

The opposite approach of downplaying negative or complicated facts, and vague reassurances can reduce trust in authorities (Petersen et al 2021) (table 6.3).

- This research compared vague and transparent communications featuring positive or negative information in two online experiments with over 13 000 American and Danish adults.
- Study 1: Participants were given information about a new fictional vaccine. The clarity of communication, and the additional information were varied. The communication was either "transparent" (clear information about effectiveness, side effects, and clinical trials), "neutral/transparent" (clear with some information not known), or "negative/vague"

[12] Jorgensen et al (2021) analysed data from over 26 000 responses to public opinion surveys in eight Western democracies in March-May 2020. Self-efficacy was key, being "both necessary and sufficient for protective behaviour during the first wave of the covid-19 pandemic and constitutes a pathway to compliance with pandemic health advice not driven by personal fear" (Jorgensen et al 2021 p692). This fits with Protection Motivation Theory (Rogers 1975), which suggests that individuals respond to risk based on the perceived threat to themselves, and their ability to comply with advice to combat the risk (ie: self-efficacy).

(negative side effects described in vague language - eg: "adequate"). The additional information was either "conspiracy) (suggests that the authorities were lying about information), "certainty" (authorities working hard on safety), or "control" (no additional information). Compared to vague communication, transparent communication significantly increased vaccine support.

- Study 2: This replication added two more communication conditions - "transparent/positive", and a "control" with no information about the vaccine. The previous findings were confirmed.

- Overall, vague communication was less effective in eliciting support for the vaccine. Transparent communication was better, though "transparent negative communication may indeed harm vaccine acceptance here and now but that it increases trust in health authorities" (Petersen et al 2021 p1).

- Petersen et al (2021) ended that "the present findings provide a clear warning for health authorities and politicians against succumbing to the use of vague communication to satisfy myopic goals of increasing vaccine acceptance here and now" (p7).

Table 6.3 - Petersen et al (2021).

6.3.4. Willingness To Share Data

Individuals need to be willing to share data (privacy) in order to aid "digital epidemiology". In the case of covid-19, human mobility data can be important as collected via the geospatial global positioning system (GPS) on smartphones.

Hswen et al (2022) investigated the willingness to share such data with over 1000 participants from forty-one countries recruited online via Amazon Mechanical Turk. After completing a questionnaire about themselves, and their covid-19 history, the participants were randomly divided into one of three conditions about sharing their GPS data to help authorities understand the pandemic. The messages emphasised self-interest, pro-social, or monetary motivations for sharing, and each condition had a positive and negative version (table 6.4).

Overall, 56% of participants agreed to provide their GPS data. More participants in the monetary conditions were willing to share their data than in the other conditions, while the positive or negative framing of the messages had no impact overall.

Willingness to share data was greater for Android (vs IOS) smartphone users, those living in India or Brazil (compared to the USA), and individuals who had

- 1. Self-interest (positive): "We will provide you feedback on how to navigate your daily schedule in a safe way with covid-19".
- 2. Self-interest (negative): "We will provide you feedback on if you have been in contact with someone who has tested positive for covid-19".
- 3. Pro-social (positive): "It will help us identify how to re-open your community safely".
- 4. Pro-social (negative): "It will help us identify hotspots that need to be sheltered in place in your community".
- 5. Monetary (positive): "You will receive a $5 bonus payment if you give your GPS data".
- 6. Monetary (negative): "You will not receive a $5 bonus payment if you renounce giving your GPS data".

Table 6.4 - Messages used by Hswen et al (2022).

been tested for covid-19 (and particularly, found positive).

Hswen et al (2022) accepted that the sample may have been "biased by the profile of the Amazon-Turk users, who may be more likely to accept data transfers (in other words, the sample members of this platform are self-selected and might be in general more willing to let access to their data than the general population)" (p7).

6.4. APPENDIX 6A - PSEUDO-SCIENCE

The leader (2022b) observed, cynically: "If you have a tricky bit of policy you need to sell, try reaching for some scientific words - whether or not research actually backs up your claim" (p5). The example of the use of the term "behavioural fatigue", "a science-sounding concept supposedly based on research in psychology, but which scientists advising the government later-disowned" (The leader 2022b p5). The UK Government used this term as the basis for not introducing covid-19 social distancing measures in early 2020.

Fox (2022) argued generally for "clearer separation between science communication and government communication, so the public can hear science directly from those doing it" (p27). She continued that the "loss of control might be painful for government, but the benefits in terms of public trust in science would be worth it. As the pandemic has shown, that really can be a

matter of life and death" (Fox 2022 p27).

Murugesu (2022a) noted the use of apparent science ("pseudo-science") in the policy of the UK Government around confirming child from adult asylum seekers. The policy involves sending adults to Rwanda. Without documentation (or with fake documents), the Government has the problem of establishing the age of individuals in their teens and early 20s. Markers like facial hair and pronounced Adam's apple have been used, according to anecdotes, but the Government has proposed three "scientific" ways to establish age (Murugesu 2022a):

i) Dental x-rays to assess wisdom teeth maturity.

ii) Wrist bone x-rays compared to averages for the age group.

iii) Biomarkers in the blood.

All three techniques have been criticised for accuracy in establishing age by scientific bodies (eg: British Medical Association; British Dental Association) (Murugesu 2022a).

6.5. APPENDIX 6B - EBOLA VIRUS DISEASE

Ebola virus disease (EVD) is known is known to remain dormant in individuals and later clinically reawaken (Garry 2021). Keita et al (2021) found evidence that the outbreak of EVD in Guinea in 2021 was triggered by reactivation of a dormant infection from the 2013-2016 West African EVD outbreak. This conclusion was based on analysis of the genome of the virus which had fewer mutations than would have been expected if it had continued to replicate and move from host to host since the earlier outbreak (Garry 2021).

An outbreak of EVD in 2021 in the Democratic Republic of the Congo (DRC) has also been suggested as a reawakening from the 2018-20 outbreak in that country (Kinganda-Lusamaki et al 2021).

Both Guinea and the DRC have large pools of survivors of EVD from previous outbreaks. "Humans can now be added to the list of intermediate hosts that can serve as long-term Ebola virus 'reservoirs' and trigger new outbreaks" (Garry 2021 p479). Bats could also be a reservoir.

"Ultimately, it might be found that the virus does

not have a single reservoir. It can infect any of a large number of species, with few - if any - genetic changes required. Viruses that can readily infect cells in different tissues and hosts, such as Ebola, rabies viruses and several coronaviruses (including SARS-CoV-2), possess highly efficient molecular mechanisms that allow them to move between species naturally" (Garry 2021 p479).

Garry (2021) advised vaccination, and continued support and surveillance of survivors. "The resurgence of Zaire ebolavirus from humans five years after the end of the previous outbreak of Ebola virus disease reinforces the need for long-term medical and social care for patients who survive the disease, to reduce the risk of re-emergence and to prevent further stigmatisation" (Keita et al 2021 p539).

6.6. APPENDIX 6C - FALSE COLLECTIVE FLIGHT RESPONSE

Crowd flight responses are often presented as a "stampede" or "mass panic" in response to a perceived hostile threat, like a terrorist attack (Barr et al 2022). But terms like "mass panic" "suggest that people primarily engage in uncontrolled selfish behaviours. Yet the disasters and emergencies research literature note a diversity of public behaviour during emergencies, much of it co-operative" (Barr et al 2022 p827).

Barr et al (2022) focused on understanding "collective flight responses to misperceived hostile threats", specifically in Great Britain between 2010 and 2019, by analysing news reports and videos. Twenty-six relevant "false alarm" events were (of which twenty occurred in London) (table 6.5). In fact, 126 incidents were found, but 26 were classed as "urgent crowd flight responses", and the remainder as "non-urgent" (eg: no running).

The findings were presented with the following key points:

i) Reported injuries from the crowd flights were rare (19 in total, of which 16 occurred at one event).

ii) A variety of behaviours were noted. "While some people did run from misperceived threats, not everyone did. Many walked away without much urgency, others stopped and filmed, others investigated the reason for the commotion. In some cases, people intervened in the apparent sources of threat, such as a fight or a fire"

Location	Date	Apparent cause
Oxford Circus, London	29th November 2019	Fight
Arndale Shopping Centre, Manchester	27th November 2019	Fireworks
Euston Station, London	29th August 2017	E-cig exploded
Liverpool Street Station, London	8th December 2015	False fire alarm
National Express Station, Liverpool	8th October 2014	African woman collapsed, thought to have Ebola

(Source: Barr et al 2022 table 1 p832)

Table 6.5 - Selected examples of "urgent crowd flight responses.

(Barr et al 2022 p831). Furthermore, "less than half the incidents featured competitive behaviours like pushing and trampling. Incidents where people engaged in intense evasive actions such as vaulting escalators were also rare" (Barr et al 2022 p831).

iii) A relationship to actual terrorist attacks - ie: more false alarms after an actual event - and when the national threat level was higher. Risk perception was higher after a "marauding terrorist attack" (MTA), where perpetrators randomly attack passersby. The false alarms were also in large city centres where there was a potential risk of MTAs.

iv) Mass panic - No evidence. Barr et al (2022) stated that "in a challenge to 'mass panic' explanations of irrational, impulsive, 'stampedes', the pattern of false alarm crowd flight incidents suggest public perceptions of the risk of terrorist attack are calibrated to the frequency and location of actual attacks" (p839) (ie: peak false alarms and terrorist attacks between 2015-2019).

7. MISCELLANEOUS BEHAVIOURS

7.1. VIEWING PORNOGRAPHY DURING LOCKDOWN

"Pornhub" ("the second largest pornographic website in the world"; Martinez et al 2021 p258) offered its "Premium services" for free during the covid-19 pandemic. The website used slogans like "Touch yourself, not others", and appropriated "Flatten the curve" in its advertising (Martinez et al 2021).

Martinez et al (2021) investigated the use of Pornhub during the pandemic. Data from Pornhub themselves ("Pornhub Insights" [13]) and Google Trends. The period of 1st March to 30th April 2020 (during pandemic/lockdowns) was compared to in 2019 (pre-pandemic).

There was a peak of 24% more searches for pornographic audio-visual material in 2020 internationally compared to 2019, with the increase being highest in Italy, Spain, the UK, and the USA.

Google searches for four comparable pornography websites declined during the same period. Martinez et al (2021) attributed the difference to the advertisement campaign by Pornhub - "the Pornhub campaign 'Flatten the curve' would be related to a type of advertising that trivialises public health issues and even emergencies, such as a pandemic. While hundreds of people died every day, Pornhub used a medical slogan to promote pornography. In fact, the link between institutional communication and the increase in traffic is clear in the case of Italy. On 11 March, Italian Prime Minister G. Conte announced the beginning of lockdown. On the same day, Pornhub began offering free access to Premium Service, using the slogan 'Flatten the curve' as part of a wider campaign to increase viewers and to convey the image of a brand devoted to promoting socially responsible behaviours" (p265).

The study has two key limitations:

i) The source of the data, which did not include

[13] Martinez et al (2021) noted that "Pornhub is a private company that just offers their statistics on their site and there is no public way to verify the Insights page data" (p261).

other search engines like "Bing", nor independent figures on Pornhub (if such data exist).

ii) No information about the reasons for the increased consumption, if that is the same as the increased searches for pornographic material.

Martinez et al (2021) commented: "Several studies agree that during the early months of the pandemic, certain groups reported decreased sexual intercourse... Also, it has been noticed that the confinement and reduction of the number of social contacts has created stress and anxiety patterns in a significant percentage of people... This study may serve as a basis for analysing the extent to which pornography consumption serves to alleviate these feelings among the population" (p265).

7.2. DRUG-TAKING

The lockdown restrictions imposed during covid-19 limited the production and trafficking of illicit drugs, including increased cost and decreased purity. This led to a switch to legally available substances. For example, in certain states in the USA, arrests for possession of cocaine decreased in mid-2020, but opioid overdoses increased in a similar period (Montgomery et al 2021). These patterns were based on cases that came to official notice (eg: police; hospitals).

Montgomery et al (2021) analysed wastewater to gain a more general picture of licit and illicit drug use. Samples were taken on forty days between March and July 2020 from sewerage treatment plants in two rural communities in the USA (Kentucky and Tennessee). Metabolites of drugs are execrated from the body.

The following patterns were observed over the study period:

a) Stimulants - A decrease in consumption of methamphetamine and cocaine.

b) Opioids - Increased use.

c) Anti-depressants - Increased consumption.

d) Sedatives (eg: benzodiazepines) - Increased use.

Overall, illicit drug use decreased because of supply problems, while licit drug consumption increased

(as access through tele-prescription-approved refills continued during lockdown).

The study had no pre-covid-19 data to use as a baseline.

7.3. COUPLES AND WORK

Chung et al (2021) asked: "Has covid-19 proved to be a great leveller in terms of unequal division of unpaid work among heterosexual couples?" (p219). Theoretically, flexible working during the pandemic should allow both partners to share the domestic work. Chung et al (2021) surveyed working parents in the UK in May-June 2020 (during lockdown) to see if this was the case.

The online survey "Working from Home during the Covid-19 Lockdown" was completed by 692 couples with children under eighteen years old and where both partners were working before the pandemic.

Over half of all respondents agreed that mothers carried out "more" or "all" of the tasks in the household (cooking, cleaning/laundry) and child care (routine/non-routine, education/home schooling). However, fathers working from home did report more involvement in these tasks.

But education/home schooling was an extra burden on households, particularly taken up by women.

Chung et al (2021) commented on the post-pandemic situation: "The large expansion of flexible working we expect to happen may help reduce some of the gender inequalities that have exacerbated during the pandemic, but only if we reflect on and change our existing work cultures and gender norms" (p218).

Prior to covid-19, less than 5% of US employees were working full-time from home (WFH) compared to around one-third in April 2020 (Yang et al 2022).

Yang et al (2022) investigated the impact of WFH on over 60 000 US Microsoft employees in December 2019 to June 2020 (WFH was introduced fully in March 2020). The data included emails, calendars, instant messages, and video/audio calls.

Overall, "the shift to firm-wide remote work caused business groups within Microsoft to become less interconnected. It also reduced the number of ties bridging structural holes in the company's informal collaboration network, and caused individuals to spend less time collaborating with the bridging ties that remained. Furthermore, the shift to firm-wide remote work

caused employees to spend a greater share of their collaboration time with their stronger ties, which are better suited to information transfer, and a smaller share of their time with weak ties, which are more likely to provide access to new information" (Yang et al 2022 p43). Put simply, wider collaborative working was negatively impacted by WFH.

One issue was that the lack of face-to-face physical contact was not replaced by video or audio equivalents (synchronous communication), but rather with asynchronous communication (eg: email).

7.4. USE OF RIDE-HAILING SERVICES

"Ride-hailing services" involve customers using a smartphone app to contact a potential driver, along the lines of a taxi service. Covid-19 impacted such services, though some travellers continued to use them. Did such users perform self-protective behaviours?

The theoretical models of self-protective health behaviours include key variables like subjective knowledge about the topic, perceived risk, perceived effectiveness of preventive/protective measures, and self-efficacy.

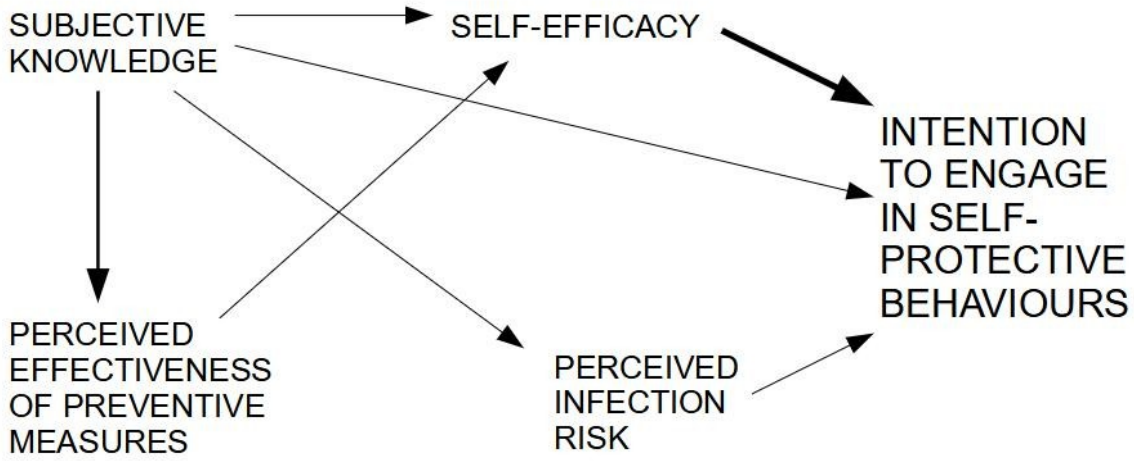
Nguyen-Phuoc et al (2023) tested such models with data from Vietnam. Over five hundred adults in the Ho Chi Minh City completed a survey in July 2020. Questions were asked about knowledge of covid-19, confidence in dealing with it, perceived effectiveness of preventive measures, and perceived infection risk (table 7.1).

VARIABLE	QUESTION
Subjective knowledge	"I think I have a good knowledge of covid-19 transmission routes"
Self-efficacy	"I am certain that I can control myself to reduce the chances of getting covid-19"
Perceived effectiveness of preventive measures	"I think drivers deploy necessary precautionary measures to tackle the spread of covid-19 (eg: clean the cars frequently, wear masks, or limit themselves from talking with you)
Perceived infection risk	"I might be exposed to risk of covid-19 when I use ride-hailing services"

(Source: Table 1 Nguyen-Phuoc et al 2023)

Table 7.1 - Examples of questions used by Nguyen-Phuoc et al (2023).

Self-efficacy (ie: confidence in being able to use preventive measures) was the strongest variable in terms of intention to use self-protective behaviours (eg: wear mask in the car; travel in the back seat alone). Perceived risk was next in importance, followed by subjective knowledge (figure 7.1).



(Based on figures 1 and 2 Nguyen-Phuoc et al 2023)

Figure 7.1 - Significant relationships found between the variables.

The data were collected from ride-hailing services users in the capital city early in the pandemic using opportunity sampling at shopping centres, for example. Nearly half of the sample had a university degree. So, it was not representative of the whole population of the country.

Little data were collected on demographic characteristics (only age, gender, and educational qualifications), nor wider variables (eg: social media; government policy), and potential confounders (eg: scepticism about covid-19). The questionnaire items measured intention to perform self-protective behaviours rather than actual behaviours.

8. MISCELLANY

8.1. ETHICAL QUESTIONS

New ethical questions have arisen during the covid-19 pandemic, like who should receive priority for a vaccine, or should mask-wearing be compulsory in public buildings? Responses to such questions involve explicit moral deliberation, and implicit normative reasoning. The latter involves "'unstated or taken-for-granted assumptions about what is good or bad, right or wrong, required or not required' (Carter 2018). For example, an explicit debate on who should receive covid-19 vaccines first may carry with it a set of unacknowledged normative assumptions around who we see as most valuable in society (eg: healthcare workers) or most worthy of protection (eg: the elderly)" (Johnson et al 2022 p67).

Johnson et al (2022) explored everyday ethical reasoning as part of the nine-country "Solidarity in times of a pandemic: What do people do and why? A comparative and longitudinal study" (SolPan) project. In particular, 177 semi-structured interviews in five countries (Germany, Ireland, Italy, Switzerland, and the UK) in mid-2020 were analysed. Four themes were highlighted:

i) "Deliberating and dealing with ethical contention in the context of normative uncertainty" - In the early days of the pandemic it was not clear how people "should" act, and interviewees were trying to make sense of this. For example, one interviewee said: "In the train it did seem nice to stay away from people... I did try to avoid [close contact], but if a person sat near me I did not change place..." (ITFL06; p70).

ii) "Patterns of reasoning when contemplating restrictions and measures to reduce viral transmission" - Interviewees provided explicit reasons for their behaviour, including "avoiding harm", "doing the right thing", and "instrumental reasoning" (ie: "compliance to restrictions or advice were aimed at achieving a goal,

without a clear reference to the underlining values"; Johnson et al 2022 p71).

iii) "Moral judgments regarding 'good' and 'bad' people - Comments from the interviewees showed a division of the world into two, and a blaming of others, including the "younger generation" for "not taking things seriously", the elderly for "exposing themselves to viral transmission", and other countries (eg: blaming China for the pandemic).

iv) "Using existing standards of meaning for moral reasoning and ethical judgment" - With the "new normative uncertainty", interviewees used existing "frameworks" to make ethical judgments. These included "facts" about transmission (eg: "So sometimes I get totally annoyed when I see people sitting around in the park. More than five people or not far apart"; CHBZ04; p73), and vulnerability (eg: elderly, but not obese, smokers, or ethnic minorities). Also "cultural identities" (eg: negative comments about other countries), and life experiences (eg: "But I think it'll be a bit of World War Two nostalgic feeling. Rolling your sleeves up and come on we can do better than this"; UKSH03; p74).

Johnson et al (2022) concluded: "Our participants reasoned through their experiences, actions and the action of others based on their values, their worries about others, the role that they see themselves playing, the meaning and importance they gave to different normative concepts, such as responsibility. They displayed recognisable patterns of moral judgements and ethical reasoning" (p74). But, at the same time, "people do not reason in the straight lines of ethical theory" (Johnson et al 2022 p75). Blame and responsibility were important concepts in people's judgments (a "blaming dynamic"; Johnson et al 2022).

The interviewees were volunteers recruited via email or social media mainly, and the interviews were conducted online or via telephone. The sample was "skewed toward white, educated middle-aged adults" (Johnson et al 2022 p76).

8.2. DISCRIMINATION

"An increase in racially motivated attacks targeting Asian American and Pacific Islander individuals has been reported across the United States; this may be related to

the ethnically biased misrepresentations of the origins of covid-19 across social media platforms" (Lee et al 2022 p899). For example, in March 2020 President Trump had referred to covid-19 as the "Chinese virus". Discrimination against other ethnic groups has also been a problem (eg: as highlighted by the death of George Floyd) (Lee et al 2022).

Experiencing discrimination has been linked to mental health problems. Lee et al (2022) investigated the relationship between depressive symptoms and everyday discrimination during the covid-19 pandemic using data from the "Covid-19 Participant Experience" (COPE) survey. The COPE survey is a brief online questionnaire administered to a sub-set of participants on the "All of Us Research Programme" (ie: over 62 000 of 315 000 participants) in mid-2020.

There were nine items on everyday discrimination in the previous week (eg: being treated with less courtesy or respect; being considered as dishonest or threatening), each scored as "never" (0) to "almost every day" (3). Nine symptoms of depression were similarly scored for the past two weeks.

A mean item score for discrimination was calculated, and the total depressive symptoms scores were categorised (0-4 = none; 5-10 = mild; 11-15 = moderate; 16-20 = moderately severe; 20-27 = severe).

There was a significant association between reports of discrimination (frequency) and depressive symptoms score. If the report of no discrimination was classed as a risk of 1.00, then individuals reporting discrimination more than once a week were nearly twenty times more likely to report moderate depressive symptoms or above. The relationship was stronger for individuals self-identifying as Hispanic or Latino, and non-Hispanic Asian.

The main limitations of Lee et al's (2022) study included:

i) No pre-pandemic (baseline) scores for discrimination and depression, so it was not possible to say if either had changed with the onset of the pandemic.

ii) The survey was administered online in English or Spanish, and so under-represented individuals without digital access and/or other language-speakers.

iii) The measure of discrimination was self-reported with no independent verification, so it technically

measured "perception of discrimination".

iv) The measure of depressive symptoms was also self-reported, and was not a formal diagnosis by a mental health professional.

On the positive side, as Lee et al (2022) explained: "To our knowledge, this is the largest and most diverse study conducted in the United States examining the mental health effect of everyday discrimination during the covid-19 pandemic" (p904).

Table 8.1 summarises two similar studies in the USA.

STUDY	DETAILS
Lee & Waters (2020)	410 Asian adults reported an increase in racial discrimination, and anxiety and depressive symptoms in the first few months of the pandemic in 2020
Wu et al (2021)	Over 7000 Asian and White adults completed thirteen waves of an internet survey between March and September 2020. The Asian group (both individuals born in the USA and immigrants) reported discrimination, and were more likely to have depressive symptoms compared to the White group

Table 8.1 - Two studies on discrimination and depression in the USA during the pandemic.

8.2.1. Depression and Vaccine Acceptance

Individuals with depression have an increased risk of covid-19 infection, and of severe symptoms/health outcomes. Cai et al (2022) offered these explanations: "First, depression is associated with altered immune function involving a pro-inflammatory state and maladaptive T-cell functioning. Second, depressed patients often suffer from sleep disturbances, which are associated, in turn, with dysregulated immune system functioning and increased risk of infection. Third, some depressed patients do not have healthcare insurance coverage and cannot receive timely treatment when necessary. Finally, due to impairments in cognitive and social functioning, some depressed patients may have difficulty complying strictly with preventive measures against covid-19" (p1).

Also such individuals may be less likely to seek medical help, including vaccination, partly due to concerns around the stigma associated with mental

illness. Cai et al (2022) investigated this issue in China. A "We-Chat"-based questionnaire was distributed to over 1100 depressed patients at six major psychiatric hospitals in late 2020 to 2021. All participants had a ICD-10 diagnosis of recurrent depressive disorder. Future covid-19 vaccination intention was the outcome measure.

Overall, 54% stated an intention to accept the covid-19 vaccine, 8.5% stated a definite refusal, and the remainder were classed as "temporary refusals". Among the Chinese general population, figures over 80% have been found for acceptance, while studies in other countries with non-clinical samples have found acceptance rates of 70-80% (Cai et al 2022). Cai et al (2022) offered these explanations for the "comparatively low rate" of acceptance: "Patients with major psychiatric disorders including depression may have inadequate access to accurate information about covid-19 vaccinations due, in part, to symptoms of their disorder and impaired cognitive abilities. In addition, some patients may be concerned about potential side-effects of covid-19 vaccines on their symptoms and medications, a concern that is somewhat founded because there have been no specific vaccine guidelines for people with severe mental illnesses including depression" (p5).

Looking at the characteristics of the accepting group, they were significantly less likely to report suicidality and depressive symptoms in the last year, and less perceived stigma about depression, but were more likely to have been an in-patient.

There was a significantly inverse relationship between perceived stigma about depression and covid-19 vaccine acceptance after controlling for other variables. Cai et al (2022) explained: "Because stigma reflects disapproval of 'outgroups' that have particular attributes, people with a history of depression or other mental illnesses may feel judged, devalued, or dehumanised by others in their social environments, including health professionals with whom they come into contact. Consequently, psychiatric patients who have had frequent encounters with being stigmatised are more prone to viewing contact with the health care system as a threat to their self-worth and experience general reluctance in seeking healthcare, even when interventions such as vaccinations have no direct bearing on their disorders" (pp5-6).

The researchers were able to identify three specific items on the measure of stigma (Social Impact Scale; SIS; Fife and Wright 2000) which predicted reluctance to accept covid-19 vaccine - "feel others avoid me because

of my illness", "feel useless", and "feel less competent than I did before".

8.3. SOCIAL INFLUENCE

"As vaccination programmes proceed, they can stall because the remaining unvaccinated mainly consist of those who strongly hesitate or refuse to get the vaccine" (Salali et al 2022 p1). One way to increase uptake is the use of social influence (eg: "revealing how many people in the population have received the vaccine and encouraging others to follow"; Salali et al 2022 p1). For example, beginning in late September 2021 in Turkey, the Health Minister announced daily the percentage of double vaccinated individuals in each city, and praised those reaching 75% coverage (Salali et al 2022).

In another form of social influence, Salali and Uysal (2021a) found that the vaccination of friends and family was effective in increasing the vaccination intention of covid-19 vaccine hesitants in a number of countries.

Salali et al (2022) predicted an "inverted U-shape" for the effect of social influence on vaccine uptake - ie: "at lower percentages of vaccinations in a population, there will not be enough consensus for conformity to kick off. At intermediate levels of vaccination coverage, conformist social influence will amplify vaccine uptake... [But] we expect the line to drop down at higher percentages, where the unvaccinated will become disincentivised from vaccinating as they benefit from the growing herd immunity" (p3).

However, individual differences also play a role, like the susceptibility to be influenced by the majority. "For example, individuals who are highly in need of uniqueness are found to resist majority influence... Likewise, psychological reactance refers to the defensive response to and intolerance of others telling one how to think... and is negatively correlated with the tendency to conform... Someone high in reactance perceives advice from others and compliance to social norms as an intrusion on one's freedom and autonomy" (Salali et al 2022 p3). Collectivism (ie: "the extent to which an individual considers group welfare and loyalty over individual success"; Salali et al 2022 p4) is another factor (compared to individualism).

Salali et al (2022) performed an online experiment in Turkey in October 2021 with over 1000 non-vaccinated

participants. Firstly, a questionnaire was completed, including demographic information, and measures of psychological reactance (table 8.2), and collectivism.

- I become angry when my freedom of choice is restricted.
- I find contradicting others stimulating.
- It disappoints me to see others submitting to society's standards and rules.

Table 8.2 - Example of items for measuring psychological reactance.

Then the participants were randomly divided into one of four conditions involving a short statement about the covid-19 vaccination in Turkey:

a) Low social influence condition - "As you know, there has been an ongoing vaccine rollout against the covid-19 pandemic in our country. As part of this rollout, 30% of the people in the district that you are living in have gotten their two doses of the covid-19 vaccine" (p5).

b) Intermediate condition - The same statement, but with 60%.

c) High condition - With 90% instead.

d) Control condition - "As you know, there has been an ongoing vaccine rollout against the covid-19 pandemic in our country" (p5).

The independent variable was the stated percentage of the population who had been vaccinated. The dependent variable (or outcome measure) was the rating of probability of being vaccinated in the future (out of 100).

There was no significant difference in vaccination intention scores between the control and social influence conditions, which was contrary to expectations, but the mean vaccination intention score was highest in the intermediate social influence condition (which fits with the "inverted U-shape" model).

Higher collectivism scores were associated with higher vaccination intention scores, while higher psychological reactance scores were the opposite. This

was expected.

Table 8.3 lists the key limitations of the study.

This study showed that social influence, in the form of a simple statement about the percentage of the population already vaccinated, did not impact stated vaccination intention scores. Salali et al (2022) felt that "information on the percentage of double-vaccinated people in one's district is not as influential as observing people within one's immediate social network getting vaccinated" (p11). The study also showed that individual differences in terms of psychological reactance and collectivism mediated social influence.

Salali and Uysal (2021b), in a study in March 2021, found that psychological reactance was more important in vaccine hesitancy in Turkish than UK and US samples. This study "also found that reactance, belief in health conspiracies, having a general conspiracy mentality and vaccine hesitancy were all positively correlated (unpublished results. One aspect of conspiracy beliefs is that they offer alternative explanations to the majority opinion and attract people with high need for uniqueness who agree less with majorities... The positive links between conspiracy beliefs and the pursuit of uniqueness and conspiracy beliefs and reactance suggest that highly reactant people may refuse to get vaccinated (especially when there is a large vaccine campaign) as a statement of their non-conformity" (Salali et al 2022 p12).

- Volunteer online sample who were more highly educated than the general population, and mostly lived in the three biggest cities in Turkey.
- Over-representation of women (around two-thirds) in the sample.
- The participants were recruited by a commercial survey administration company from a panel, and were willing to undertake a survey about the covid-19 vaccine.
- Intention to vaccinate in the future is not the same as actual behaviour.
- Deception was used, in terms of the percentage of the population vaccinated figures. Salali et al (2022) defended its use as necessary. At the end of the study, as part of the debriefing, there was a link to the official covid-19 vaccination figures.

Table 8.3 - Key limitations of Salali et al's (2022) study.

8.3.1. Influences on Behaviour

Some individuals follow preventative advice, and others do not. What are the factors that determine an individual's response to preventative health advice?

Abbas and Eltayeb (2022) sought to answer this question with particular reference to Arab countries. The authors performed a non-systematic scoping review of the literature, and a multi-round Delphi survey of experts. The Delphi technique asks experts in a field to come to a consensus from a number of choices, and in each round the outlier choices are removed. In this study, 27 experts in human behaviour from nine Arab countries began with twelve social and twelve psychological factors that influence health behaviour, according to the literature review. After three rounds of the Delphi technique, consensus was reached on five social and four psychological factors:

a) Social factors:

- Belief system and Faith (2 factors) - "Many Arab societies did not take preventive measures seriously because their members believed that the disease is the wrath of God that will only affect 'infidel' societies or those that had been dominated by vice, injustice, and deviation from God's rule. This belief continued even after the pandemic had spread throughout the world, including most of the Middle-East countries. Again, the belief of what God decreed is acceptable led to most people failing to take precautionary measures" (Abbas and Eltayeb 2022 p4).

- Income status - eg: the ability to pay for masks, medical supplies, and health insurance.

- Family commitment - eg: willingness to social distance from family members, and not attend family social events.

- Kinship system - eg: patriarchy and the limited options for women, particularly in rural areas.

b) Psychological factors:

- Self-efficacy - Common to many health behaviour

models, this is an individual's confidence that they can perform the preventative behaviour.

- Perception of hazard/risk - Another key factor in health models, the risk or threat perception of covid-19.

- Motivation - eg: individuals with long-term health conditions would be more motivated to follow preventative advice.

- Stigma - eg: perceived stigma of the disease vs perceived stigma of following preventative measures.

The Delphi technique is based on the using the opinions of experts, and gaining a consensus between them. It is classed as a more subjective form of evidence compared to randomised controlled trials, say. But it is a cost-effective way to gain insight into a topic. Its success is dependent on the recruitment of the panel of experts.

8.4. MISCELLANEOUS

(1) The fight against three major infectious diseases has been impacted by the covid-19 pandemic - HIV, TB, and malaria. For example, globally in 2020, the programmes that supply condoms or clean needles and syringes fell by 11% and HIV testing by 22% (Roberts 2021). "Disease experts worry about the impact that waves of SARS-CoV-2 infections and the mergence of new variants will continue to have on efforts to combat these three diseases" (Roberts 2021 p314).

(2) Economic inequality seen in the financial system was particularly evident during the covid-19 pandemic, and there is thus a need for "financial inclusion", "access to credit", and "sustainable finance". These can be opaque terms, or like business jargon using "sheer weight of euphemism, grammatical infelicity, disingenuity and downright ugliness", according to Kellaway (2017 quoted in Schwarcz et al 2021). This is also with "buzzwords", which need to be "rooted pragmatically, taking into account how, functionally, the concept is used in the real world" (Schwarcz 2013 quoted in Schwarcz et al 2021).

In terms of concrete definitions, the International

Monetary Fund (IMF) in 2020 defined "financial inclusion" as "a multi-faceted concept, encompassing various dimensions, including access to and use of financial services as well as other aspects such as affordability, usefulness, quality, and awareness of financial services and products" (quoted in Schwarcz et al 2021). Schwarcz et al (2021) themselves talked of "expanding account ownership to provide basic banking services, namely deposit accounts and funds transfers" (p5).

Technology could prove helpful here (eg: "mobile money" apps for smartphones in Sub-Saharan Africa; cryptocurrencies). Such technologies "could enhance financial inclusion and financial consumerism, but also risk replicating the current system's financialisation" (Schwarcz et al 2021 p6).

"Access to credit" means "access to loan funding on reasonable terms, especially for underserved demographics of potential entrepreneurs" (Schwarcz et al 2021 p4), while "sustainable finance" covers both financial inclusion and access to credit (Schwarcz et al 2021).

(3) One way to collect data on vaccine side effects is via wearable devices, like smartwatches. These can monitor physiological measures like heart rate, and oxygen saturation, and physical activity. "Recent research has shown that smartwatches may identify physiological changes undetected by the individual. For example, wearable devices have been recently shown to be useful in detecting early signs of covid-19 symptoms as well as long-term effects of covid-19 infections" (Guan et al 2022 p1).

Guan et al (2022) compared smartwatches to self-reported questionnaires in two cohorts of individuals in Israel who received second and third covid-19 vaccine doses (n = 355 and 1179 respectively). From the daily questionnaires completed via smartphones, the prevalence of side effects was calculated as around 45%.

Among individuals reporting a severe side effect (eg: chest pain, fever, shortness of breath), the smartwatches showed changes in heart rate and stress reaction which lasted longer than the self reports of the side effects, and this suggested that the wearable devices were more sensitive than the self reports.

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10. ADDENDUM

(1) During the pandemic "dysfunction within... centralised institutions meant that individual American states had to develop their own science advisory process for covid-19 pandemic response" (Weinkle 2022 p2). The US Centers for Disease Control and Prevention (CDC), for example, was criticised publicly by President Trump, and there was tension between the President and public health authorities. "During an interview on public television [in 2020], Dr. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, emphasised the importance of wearing a face mask to limit the spread of the disease. The next day, President Trump simultaneously announced and dismissed CDC recommendations to wear face masks, 'I won't be doing it, personally. It's a recommendation'" (Weinkle 2022 p3).

Amidst this situation, Weinkle (2022) studied North Carolina state as a case study. In March 2020 the Governor set up an emergency task force on covid-19 to take scientific advice and make policy decisions. Three areas of advice were important:

i) Epidemiological modelling - eg: on the spread of infection, which was used in executive orders to limit social gatherings; how or when to lift restrictions.

ii) Collection of data to present to the public.

iii) Ethics of vaccine distribution.

A key recommendation from the study, for Weinkle (2022), was the creation of a standing scientific advisory committee for the Governor. "Deep partisanship in the United States and distrust between leaders of opposing parties underscores the need for states to develop strong institutions for science advise to policymakers in an emergency" (Weinkle 2022 p1).

Weinkle, J (2022) An evaluation of North Carolina science advice on covid-19 pandemic response Humanities and Social Sciences Communications 9: 352

(2) "Babies born during the early stages of the pandemic missed the opportunity of meeting a normal social circle of people outside the family home, including other babies

and grandparents" (Byrne et al 2022 p1). What was the impact of this situation upon the development of these babies?

A study in China (Huang et al 2021), for example, of 546 six month-olds and 285 twelve month-olds in March-May 2020 found deficits in communication and fine motor skills at one year old.

More recently, there has been a study in Ireland (Byrne et al 2022). This study analysed data from the BASELINE Study and the CORAL Study [14]. The former included a birth cohort recruited between 2008 and 2011 (n = 1629 in this study, used as a pre-pandemic comparison group), while the CORAL Study involved infants born in March-May 2020 (n = 309). Ten parent-reported skills at one year-old were measured (eg: crawling; known their own name; point at objects).

There were three significant differences found at 12 months old, in terms of number of children achieving the milestone - point at objects (84% of the CORAL cohort vs 93% of the BASELINE cohort), wave "bye-bye" (88% vs 94% respectively), and has "one definite and meaningful word" (77% vs 89% respectively). The suggestion was, in the CORAL cohort, "some deficits in early life social communication" (Byrne et al 2022 p3).

The data were parent-reported with the risk of recall bias.

Byrne et al (2022) ended: "Babies are resilient and inquisitive by nature, and it is very likely that with societal re-emergence and increase in social circles that their social communication skills will improve. However, this cohort and others will need to be followed up to school age to ensure that this is the case" (p4).

Byrne, S et al (2022) Social communication skill attainment in babies born during the covid-19 pandemic: A birth cohort study Archives of Disease in Childhood (https://adc.bmj.com/content/early/2022/09/19/archdischild-2021-323441)

Huang, P et al (2021) Association between the covid-19 pandemic and infant neuro-development: A comparison before and during covid-19 Frontiers in Pediatrics 9, 662165

(3) Many health data studies "pseudo-anonymise" data,

[14] BASELINE = Babies After SCOPE: Evaluating the Longitudinal Impact using Neurological and Nutritional Impact). CORAL = Impact of Corona Virus Pandemic on Allergic and Autoimmune Dysregulation in Infants Born During Lockdown.

where the name is replaced by a unique identifier number. But Phil Booth (of "medConfidential" [15]) noted that "simply removing people's names from a data set doesn't truly anonymise them, because medical information is so personal that it can easily be linked to your real identity" (Sparkes 2022).

One problem is the "curse of dimensionality", where "the more data points are associated with a person, the harder it is to anonymise their data" (Bennett Cyphers of the "Electronic Frontier Foundation" [16] quoted in Sparkes 2022).

Sparkes, M (2022) NHS health data plan mothballed New Scientist 21st May, p12

(4) Graber (2010) has talked of "the problem of constitutional evil", while Meierhenrich (2021) has developed the ideas of "constitutional dictatorship" and "constitutional violence". All these terms describe a situation where governments enshrine laws to increase their powers in response to an emergency and do not repeal them subsequently.

Scheppele (2010) stated: "Though each crisis has elements specific to time and place, there are common features that emergencies tend to share when one examines them empirically. Regardless of whether an emergency is declared by a right-wing dictator or a left-wing insurgent or whether an emergency is brought about by a war, coup, pandemic, or earthquake, emergency government tends to have a predictable 'emergency script' that unites these different causes in a common set of tactics. The emergency script generally starts slowly with a hollowing out of governmental institutions apart from the executive branch, and the signature abuses that signal a real crisis are generally late in arriving. By the time an emergency is arguably over, these abusive practices have found new rationales for their continued maintenance, and so it is difficult to repeal them" (quoted in Meierhenrich 2021).

Meierhenrich (2021) was particularly aware of this situation as governments gave themselves emergency powers during the covid-19 pandemic.

Meierhenrich (2021) described constitutional dictatorship as the "regime of exception", and quoting

[15] See https://medconfidential.org/.

[16] See https://www.eff.org/.

Zimmerman (2006): "Exceptions can be required by any, or typically all, of the features of an emergency: the emergency may not have been anticipated by general rules, it may require forms of action explicitly forbidden by general rules, or it may require a swifter response than ordinary procedures allow for".

Meierhenrich (2021) distinguished two forms of constitutional dictatorship:

i) "Emergency constitutionalism" - The acquisition of emergency powers by the government to save the country.

ii) "Extremist constitutionalism" - The use of emergency powers to "steal the State". For example, in many countries "the coronavirus crisis accelerated trends toward further concentrated power at the national instead of the local level. Sometimes, this was because presidents and prime ministers used the crisis to consolidate power. In Hungary, the parliament handed Prime Minister Viktor Orbán sweeping new emergency powers. In China, President Xi Jinping used the crisis to expand his power over Hong Kong" (Meierhenrich 2021 p427).

Graber, M.A (2010) Dred Scott and the Problem of Constitutional Evil Cambridge: Cambridge University Press

Meierhenrich, J (2021) Constitutional dictatorships, from colonialism to covid-19 Annual Review of Law and Social Sciences 17, 411-439

Scheppele, K.L (2010) Exceptions that prove the rule: Embedding emergency government in everyday constitutional life. In Tulis, J.K & Macedo, S (eds) The Limits of Constitutional Democracy Princeton, NJ: Princeton University Press

Zuckerman, I (2006) One law for war and peace? Judicial review and emergency powers between the norm and the exception Constellations 13, 522-545

(5) The influenza virus (and other respiratory infections) increase the risk of pneumonia, for example, which can trigger cardiovascular events. So, does the influenza vaccine reduce the cardiovascular event risk?

A meta-analysis by Udell et al (2013) found a reduced risk over the one year after vaccination. Behrouzi et al (2022) updated this study.

Randomised controlled trials comparing the influenza

vaccine with a placebo or control, and with measures of cardiovascular outcomes, published between 2000 and 2021, were included (n = 6).

By one-year follow-up, 3.6% of the vaccination groups had a major adverse cardiovascular event compared to 5.4% of the controls. This converts into a reduced risk of 34% for the vaccination group. Individuals with heart problems prior to vaccination gained an even greater benefit (a 45% lower risk of a cardiovascular event post-vaccination).

Half the trials only were classed as high methodological quality (eg: with double blinding).

Behrouzi, B et al (2022) Association of influenza vaccination with cardiovascular risk: A meta-analysis JAMA Network Open 5, 4, e228873

Udell, J.A et al (2013) Association between influenza vaccination and cardiovascular outcomes in high-risk patients: A meta-analysis JAMA 310, 1711-1720

(6) "Rather than jumping to humans from animals recently, the monkeypox virus variant currently cropping up around the world may have been undetected in people for years, DNA sequencing appears to show" (Le Page 2022 p7).

The latest viruses have up to 47 DNA letter changes, which is unexpectedly high as the money pox virus is assumed to evolve by one mutation per year on average (Le Page 2022).

Le Page, M (2022) Monkeypox unnoticed? New Scientist 11th June, p7

(7) The impact of covid-19 on the brain has been studied in vitro (ie: cells in a petri-dish). For example, Borsini et al (2022) took blood samples from 36 London covid-19 patients, half with delirium symptoms, and added them to human hippocampal cells (grown in cell cultures). The hippocampus is the area of the brain associated with memory.

Cell growth was inhibited and cell death increased by the blood from patients with delirium symptoms. The blood of these individuals contained higher levels of specific cytokines, which are released by the immune system, and this is the "molecular mechanism" to explain

the impact of covid-19 on the brain.

Borsini, A et al (2022) Neurogenesis is disrupted in human hippocampal progenitor cells upon exposure to serum samples from hospitalised covid-19 patients with neurological symptoms Molecular Psychiatry (https://www.nature.com/articles/s41380-022-01741-1)

(8) "Brain fog" (or "sluggish cognition") is an umbrella term to describe symptoms like lack of mental clarity, memory problems, and an inability to focus. It has been associated with covid-19 recently, but other conditions have reported such symptoms (eg: ADHD; allergies) (Sukel 2022).

It is the long-term persistence of the problem that distinguishes it from the passing feeling experienced by many (eg: the night after heavy drinking) (Sukel 2022).

Explanations include the heightened immune response to an infection, the SARS-CoV-2 virus crossing the blood-brain barrier, and the exacerbation of pre-existing (possibly unnoticed) conditions by an infection (Sukel 2022).

Anna Nordvig, a neurologist in New York, noted: "People have been using brain fog to describe a host of cognitive symptoms that come with a wide variety of different medical issues for a very long time", and "In our clinic, we see a lot of co-morbidities...These conditions, as much as covid itself, may be contributing to that overall cognitive dysfunction" (quoted in Sukel 2022).

Sukel, K (2022) Lifting the fog New Scientist 11th June, 38-41

(9) Romano et al (2022) recruited eighteen interviewees in April-June 2020 in Italy to explore the experiences of lockdown. The findings were divided into three groups - daily life during lockdown, public health, and information and media.

The first theme was sub-divided into:

a) Impact - "When asked about the impact of lockdown and public health measures on their daily routine, most respondents described a process including a phase of understanding and acceptance of what was going on followed by progressive development of and adjustment to

a new routine. This was generally associated with a coping strategy that was useful not only in practical terms to keep things going but also in managing stress and anxiety" (Romano et al 2022 p3).

This is described by "Int (interviewee) 17": "Right after the lockdown, everything went upside down because I went from work, work, work to home, home, home. In the beginning, I was frightened by this but, set aside the economic worries… I enjoyed it a lot because being used to organising and planning, to be very systematic, I created a new routine for myself. Because not having a routine was a bit frightening for me I kept setting my alarm at the same time as always, I have a dog and I kept walking it at the same time, I exercised regularly, as far as possible" (p3).

b) Relationships - Relationships polarised around "us" and "them" (ie: people who followed the rules and those who did not). For example, "Int 7" said: "Look, I always respect rules, I get very annoyed when people don't respect them, and I'm even more in this phase. Because if it's compulsory to wear a mask, then it's compulsory to wear a mask, if visiting relatives is not allowed, then you can't visit relatives, while what you see is people going from one house to another, exchanging kids from one house to the other to do homework together and they tell you, it's ok because we don't have Coronavirus! Right! And how would you know?!" (pp3-4).

"Although less frequently perceived than the negative aspects, some respondents also talked about the positive consequences of the situation, such as a heightened sense of humanity and solidarity visible through tangible acts, offering an occasion for people to show strength and resilience. The use of a face mask was positively referred to as an act of respect for others and not perceived as a mere limitation" (Romano et al 2022 p4).

The second theme of "public health" was seen in "opinions on the public health measures", and "ICU criteria". The former was expressed in relation to economic interests (or "Almighty Money"; "Int 7"; p4). "Respondents often mentioned lobbying mechanisms of various kinds that promoted either postponing the lockdown measure or speeding up the re-opening of economic activities" (Romano et al 2022 p4).

Concerning the second sub-theme, Romano et al (2022) explained: "It was admittedly difficult for respondents to express themselves about what criteria should be used

to select which patients would be included in/excluded from intensive care units (ICUs). Whether they properly answered the question or tried to dodge it, one common mechanism was to distance themselves from determining in advance something that was not their decision to make" (p4).

The last theme of "information and media" can be summed up by "Int 8": "My trust in the communication and information system is decreasing... That's because you don't know where to turn and can't be certain you are turning to someone who can tell you something reasonable, correct, or useful... You hear one person and then another who says exactly the contrary, you read one thing and then something else that again says the opposite. This has been difficult to accept and, moreover, it makes the search for correct information difficult" (p5).

Romano et al (2022) drew out a number of issues from their in-depth interviews:

i) Individuals' lives were reshaped and how to cope with that. "One of the most striking social effects of covid-19 was the polarisation between 'us' against 'them', characterised by the need to identify categories one can blame" (Romano et al 2022 p5).

ii) Making sense of the public health complexities.

iii) Navigating information about the pandemic.

In-depth interviews allow the researchers to understand how the interviewees understand the world. Romano et al (2022) argued that their work provided "a privileged look at people's experience" (p7).

Romano, V et al (2022) Italians locked down: People's responses to early covid-19 pandemic public health measures Humanities and Social Sciences Communications 9: 342