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Covid-19: More Knowledge and
Controversy (1st April -
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A complete listing of his writings at <http://psychologywritings.synthasite.com/>.

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1. OVERVIEW OF CONCERNS

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1.1. INTRODUCTION

A quarter of the way through 2021, and three issues, not new, were prominent in the "New Scientist" magazine:

- i) Side effects of the vaccine.
- ii) The number of doses of vaccine and the time between multiple doses.
- iii) Covid-19 variants.

1.2. SIDE EFFECTS OF THE VACCINE

Side effects of the vaccines, particularly Oxford/AstraZeneca's vaccine and blood clots was a prominent issue ^{1 2}.

No link had been established (as of 2nd April 2021), but with fifteen cases of deep-vein thrombosis (DVT) (as of 8th March 2021) among seventeen million people who had received the vaccine in Europe, and seven cases of cerebral venous sinus thrombosis (CSVT) out of 1.6 million vaccinations in Germany (as of 15th March 2021), a number of European governments had suspended use of the vaccine (Liverpool 2021) (table 1.1).

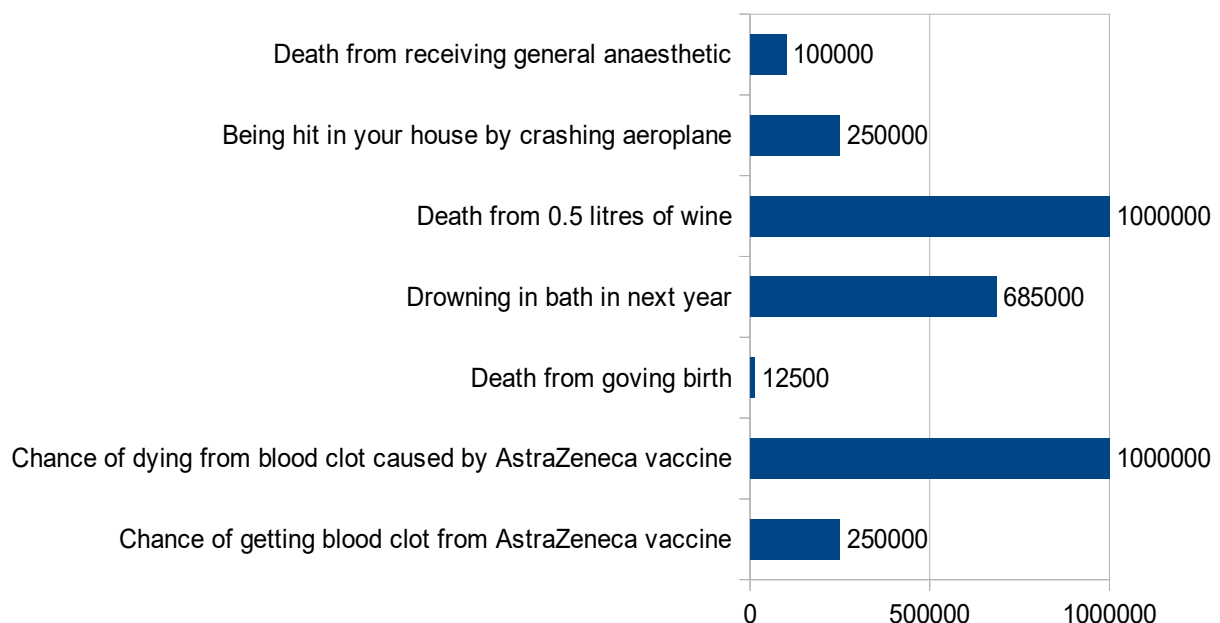
¹ The Oxford/AstraZeneca vaccine has 62-90% efficacy reported, depending on the dose (Voysey et al 2021).

² Editorial (2021) observed: "When it comes to public health in the 21st century, scientific breakthroughs and new technologies are likely to be the easy parts. Pfizer managed to develop, test, and get approval for their covid-19 vaccine in less than a year; a technical tour de force driven by novel mRNA vaccine technology. But the realities of getting this and similar vaccines into people's arms have begun to set in: insufficient infrastructure and clinical staff, systemic inequalities in health care, and widespread misinformation campaigns leading to vaccine hesitancy" (p259).

- Greinacher et al (2021) provided a case report of an association between the AstraZeneca vaccine and a prothrombotic disorder (abnormality of blood coagulation that increases the risk of blood clots).
- Nine patients in Germany and Austria in February and March 2021 were described. All individuals had thrombotic events (blood clot-related problems) approximately one week after vaccination.
- The researchers could not say if the vaccine triggered the problems or the vaccine stimulus on the immune system was the cause.

Table 1.1 - Prothrombotic disorder.

These cases showed the differences in responses between countries, and views of scientists as well as the assessment of rare risks - for example, CVST occurs in 2-15 cases per million "usually" (Liverpool 2021). Lucy Walker summarised the issue: "In weighing up the merits of a medical intervention, it's really important to consider both sides of the argument: how risky is it for someone to have it versus how risky is it for them not to" (quoted in Liverpool 2021) (figure 1.1).



(Estimates = 1 in ? where a large number means a small risk)

(Source: Roberts and Clark 2021)

Figure 1.1 - Event likelihood estimates for selected risks.

Writing in late April 2021, Ledford (2021) outlined five key questions about the covid-19 vaccines and blood clots:

a) What is the connection between them? "The clots that have been tentatively linked to the AstraZeneca and J&J [Johnson & Johnson] vaccines have particular characteristics: they occur in unusual parts of the body, such as the brain or abdomen, and are coupled with low levels of platelets, cell fragments that aid blood coagulation. These features are also seen in a condition called heparin-induced thrombocytopenia, a rare side effect sometimes seen in people who have taken the anti-coagulant heparin" (Ledford 2021 p496). But it is not known what element of the vaccine is causing the problem - eg: the vectors, the spike protein, or a "contaminant present in the vector" (Hildegund Ertl in Ledford 2021).

b) Are covid-19 vaccines other than Oxford/AstraZeneca and J&J linked to blood clots? The two "problem" vaccines use adenovirus as the vector, and this could be the source of the health risk. No reports about other types of vaccines and blood clots at this point (22nd April 2021; Ledford 2021).

c) How common are blood clots in covid-19 vaccinated individuals? Very low, but "the exact number of cases is in flux. Researchers are relying on reports of adverse events after vaccination, and such reporting is susceptible to biases and misclassifications..." (Ledford 2021 p496).

d) Are certain individuals more at risk? "Early reports suggested that relatively young women who received the vaccines were most likely to experience clots, but the European Medicines Agency reported that it could not identify any particularly high-risk groups from its data on the AstraZeneca vaccine" (Ledford 2021 p496).

e) What are the consequences of fear over side effects on vaccination uptake? Reporting the cases is evidence of safety monitoring and transparency, but, at the same time, it may have damaged public trust. "Negative information sticks longer and harder, and it's also heard louder" (Noni Macdonald in Ledford 2021).

Writing prior to covid-19, and in response to the increase in cases of measles in the USA, Editors (2019) argued against "non-medical waivers" for childhood vaccinations. These vaccinations are mandatory in US

states in order to attend public schools, but authorities offer exemptions. These can be medical (eg: compromised immune system), or non-medical (eg: religious or belief-based). It is the latter group that is rising and so hindering herd immunity for diseases for measles.

Editors (2019) ended: "Refusing to vaccinate is not a matter of freedom. it's a matter of public safety" (p6). How relevant this comment is to covid-19 vaccination.

Implicit in the concerns about the vaccine is the possibility of a "rushed unsafe vaccine" (appendix 1A). Figure 1.2 outlines the normal stages to making a vaccine. The Moderna vaccine used few animals, whereas Sputnik V was tested on rats, mice, hamsters, guinea pigs, rabbits, and monkeys, but only 38 humans before approval (Le Page 2020a).

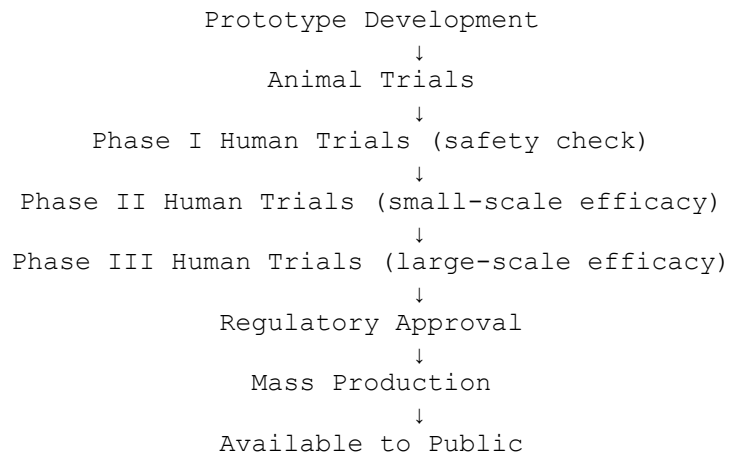


Figure 1.2 - Steps to making a vaccine (Le Page 2020a).

1.3. VACCINE DOSES

The number of doses of vaccine and the time between the two doses are the issues here.

The Oxford/AstraZeneca vaccine is recommended with a 28-day separation between the two doses, but "limited evidence [from clinical trials] suggests that longer intervals (2 to 3 months) did not affect, and may even have improved, vaccine efficacy" (Saad-Roy et al 2021a p363).

A number of countries have decided to extend the period between doses from the recommended 3-4 weeks to twelve weeks (eg: UK) to give more people a first dose from the limited stocks. Early data are suggesting

reduced risk of hospitalisation after one dose (Lawton 2021).

On the other hand, the Center for Disease Control and Prevention (CDC) in the USA advocated sticking to the recommended gap (Lawton 2021). The fear of vulnerability to new variants of covid-19 after one dose was a strong motivator of this decision (eg: Moore and Offit 2021) ³.

Saad-Roy et al (2021a) modelled different lengths between the two vaccine doses. They concluded that "spreading single doses in emergency settings (ie: rising infections) is beneficial in the short term and reduces prevalence. Furthermore, we find that if immunity after a single dose is robust, then delaying the second dose is also optimal from an epidemiological perspective in the longer term. On the other hand, if one-dose vaccinal immunity is weak, the outcome could be more pessimistic; specifically, a vaccine strategy with a very long inter-dose period could lead to marginal short-term benefits (a decrease in the short-term burden) at the cost of a higher infection burden in the long term and substantially more potential for viral evolution" (p369). Key to the positive outcomes is the strength and duration of clinical protection (ie: vaccinal immunity), and transmission-blocking of the virus ⁴.

Hanage and Russell (2021) argued for breadth of vaccine coverage (ie: more people with one dose) to reduce the opportunity for evolution of the virus.

Saad-Roy et al (2021b) admitted that "uncertainties in immunodynamics, and in particular evolutionary dynamics of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), dominate our ability to project key scenarios" (p354).

Romero-Brufau et al (2021) used computer modelling with US data to estimate the impact of delaying the second dose of the Pfizer/BioNTech and Moderna vaccines. It was assumed that the vaccines prevented infection and transmission of the virus, and that the efficacy of two doses was 95%.

Key variables were the efficacy of the first dose, the rate of vaccination of the population, and the prioritisation policy. So, a higher efficacy favoured delaying the second dose (ie: >70%), as did a high vaccination rate (ie: up to 1% of the population per

³ Concern over "antigenic drift" via immune escape from natural or vaccinal immunity (Saad-Roy et al 2021a).

⁴ "The virus does have the capacity to mutate into something worse, but can only do so if it is transmitted from human to human" (The Leader 2020b p5).

day), and where vaccination was prioritised for older adults (eg: over 65s). The outcome measures were deaths ⁵, hospital admissions, and infections. In summary: "A delayed second dose vaccination strategy, at least for people aged under 65, could result in reduced cumulative mortality under certain conditions" (Romero-Brufau et al 2021 p1).

This modelling study made many assumptions, including about infection spread (eg: rate of contact between individuals). Immune decay after vaccination was not included, nor how individuals' behaviour change after vaccination ⁶.

Also, Romero-Brufau et al (2021) explained, "our study did not measure the effect of mutant strains of SARS-CoV-2 and various infectivity rates, or differences in behaviour geographically, or the impact of other preventive measures such as digital exposure notification or availability and turnaround times of testing that vary between states and between countries" (p6).

As with any modelling study, it could be helpful to policy-makers who must make decisions in relation to the future with high degrees of uncertainty.

Two small studies (eg: Krammer et al 2021; table 1.2) have suggested that a single dose of vaccine could be enough for individuals already infected with covid-19 (Wilson 2021).

Vaccines assume the benefits of "herd immunity". But what is it, and can it be achieved for covid-19? Answers vary to both questions.

Firstly, the estimate of the amount of the population needing to be immune depends on the reproductive number (R) of the virus. For example, with an R of 2.5 -3, it is calculated that 60-70% of the population would need to be immune to benefit the whole population (Hamzelou 2020a).

For covid-19, R varies over time because human behaviour changes (ie: it is not like a herd of animals) (Julian Tang in Hamzelou 2020a).

One mathematical model that takes variable human

⁵ The definition of a "covid-19 death" varies depending on the definition used. Some countries only include individuals with a positive PCR test prior to death, while others accept "possible" covid-19 deaths (ie: based on symptoms but no PCR test). Also the use of hospital deaths only or the inclusion of those outside hospitals (eg: in care homes) (Vaughan 2020e).

⁶ Also the immune response to SARS-CoV-2 in children is different to adults (as is the case with the response to all pathogens). Yang et al (2021) showed this in a comparison of B cells in the blood samples of 93 1-3 year olds and 114 adults.

- Krammer et al (2021) analysed data from the ongoing "Protection Associated with Rapid Immunity to SARS-CoV-2" (PARIS) study in the USA on 110 participants. Of these, 43 had SARS-CoV-2 antibodies (sero-positive), while the others were sero-negative.
- All received the first dose of a mRNA SARS-CoV-2 vaccine ⁷. The sero-positive individuals showed a much higher level of antibodies (between 10-45 times higher) in the following 13-16 days.
- After the second dose of a vaccine, anti-bodies increased greatly among the sero-negative individuals with no increase for the sero-positive participants.
- In summary, the anti-bodies after the first vaccine dose in sero-positive individuals was as high as after the second vaccine dose in sero-negative individuals. Krammer et al (2021) ended: "Whether a single dose of mRNA vaccine provides effective protection in sero-positive persons requires investigation" (p3).
- Note that the sample was convenience, based on who in the PARIS study (n = 230) was available to give blood at the relevant times.
- In terms of any reported side effects after the first vaccine dose, 46% of sero-negative compared to 89% of sero-positive individuals.

Table 1.2 - Krammer et al (2021).

behaviour ⁸ into account has suggested that only 10-20% of the population (with an R of 2.5 - 3.0) needs to be immune to achieve herd immunity (Gomes et al 2020). This figure is challenged by real-world data in areas where more than 20% of a population has been infected, but herd immunity has not been seen (Samir Bhatt in Hamzelou 2020a).

Furthermore, if individuals refuse the vaccine, then herd immunity may never be reached in a population (Luis Barreiro in Hamzelou 2020a).

Tkachenko et al (2021) considered the idea of a state of "transient collective immunity" (TCI), which "emerges well below the HIT [herd immunity threshold] during early, high-paced stages of the epidemic. However, this is a fragile state that wanes over time due to changing levels of social activity, and so the infection peak is not an indication of long-lasting herd immunity:

⁷ Two of the main mRNA vaccines at the time are from Pfizer (BNT162b2) (Polack et al 2020) and Moderna (mRNA-1273) (Baden et al 2021).

⁸ "Heterogeneous populations" are more susceptible to infection and more exposed, so they become infected earlier than thus immune compared to "homogeneous populations" (Gomes et al 2020).

Subsequent waves may emerge due to behavioural changes in the population, driven by, for example, seasonal factors" (p1). In modelling the spread of diseases, TCI takes account of heterogeneous populations and uneven distribution of infection (eg: "superspreader accidents")⁹.

These researchers applied their model to data for New York City (NYC) and Chicago for March-September 2020. It was concluded that "the hardest-hit areas, such as NYC, have likely passed TCI threshold by the end of the first wave, but are less likely to have achieved real long-term herd immunity" (Tkachenko et al 2021 p10). Put simply, TCI could be mistaken for HIT, and consequently there is a reduction in social distancing policies¹⁰, which opens the possibility of second waves or more of infection.

The "Great Barrington Declaration" (named after the US town where an open letter was signed in early October 2020) advocated "focused protection", where the most vulnerable people isolate themselves and normal life continues for everybody else. It is based on the assumption of herd immunity (Lawton 2020e).

1.4. COVID-19 VARIANTS

The rise of covid-19 variants (or "variants of concern" (VOC); Montagutelli et al 2021) (appendix 1B)¹¹.

The B.1.1.7 variant (Pango designation; also known as 201/501Y.V1 or VOC202012/01; Montagutelli et al 2021) (first spotted in southern England; "Kent" variant)¹², the B.1.351 variant (also known as 20H/501Y.V2; Montagutelli et al 2021) (seen in South Africa first) and P.1 variant (also known as 20J/501Y.V3); Montagutelli et al 2021) (found in Manaus, Brazil initially) are potentially driving a global increase in cases (Le Page 2021).

In May 2021, B.1.617.2 variant¹³ (called the "Indian" variant in the popular press) was having a direct impact in India itself, but also raising concerns in the UK, for instance, in relation to the reduction of

⁹ Reinfection is also a concern. A study in South Korea of 285 reinfected individuals in 2020 found that none passed the virus on the second time. This would suggest "re-positive" rather than reinfection (Hamzelou 2020b).

¹⁰ What Tkachenko et al (2021) described as a "rewiring of social networks".

¹¹ For example, the D614G variant may be less deadly, but this is disputed (Vaughan 2020d).

¹² B.1.1.7 has 23 mutations (technically) (Thorne et al 2021).

¹³ The variant B.1.617 has three sub-types (Sridhar 2021).

lockdown restrictions (Smyth et al 2021). A mutation (L452R) may help viral replication, and thus increase the transmissibility of this variant (Wace 2021).

To avoid "stigmatising" countries, the WHO advocated Greek letters for the covid-19 variants rather than the "country of origin" (Gardner 2021):

- Alpha - "Kent" variant
- Beta - South Africa
- Delta - "Indian"
- Gamma - Brazil
- Epsilon - variant first noticed in USA in March 2020
- Theta - variant noticed in the Philippines in January 2021.

The focus of researchers has been on potential mutations in Spike protein that would improve viral entry into the cell. This has not happened so far, but other mutations could be important (Thorne et al 2021). Analysing the B.1.1.7 variant, Thorne et al (2021) found evidence of SARS-Cov-2's ability to suppress the host's immune responses in cells in the airways. The chemical-based changes appear to increase the likelihood of the virus's successful transmission.

The key point is that there is an "evolutionary arms race" around immunity between the virus and the immune system, which means strong selection pressure on the virus to evolve ways to "outwit" immune responses.

In terms of vaccines using mRNA technology, Wang, Z et al (2021) performed an analysis of the blood samples of twenty volunteers in the USA in late 2020 after they had received two doses of the Moderna or Pfizer-BioNTech vaccines.

The vaccines elicited anti-body responses eight weeks after the second dose that "resembles natural infection" (Wang, Z et al 2021 p620). But certain potential mutations of the SARS-CoV-2 virus could reduce the neutralising ability of anti-bodies. This study involved cultured cells in the laboratory.

Wang, Z et al (2021) ended: "What the long-term effect of the accumulation of mutations on the SARS-CoV-2 pandemic will be is not known, but the common-cold coronavirus HCoV-229E evolves antigenic variants that are comparatively resistant to the older sera but remain sensitive to contemporaneous sera. Thus, it is possible that these mutations and others that emerge in individuals with sub-optimal or waning immunity will

erode the effectiveness of natural and vaccine-elicited immunity. The data suggest that SARS-CoV-2 vaccines and anti-body therapies may need to be updated and immunity monitored to compensate for viral evolution" (p621).

Montagutelli et al (2021) showed that these variants could infect common laboratory mice in a controlled situation. Previously, SARS-CoV-2 has been found in hamsters, ferrets, minks, and cats, but replication had not occurred in mice and rats (Montagutelli et al 2021).

The B.1.351 and P.1 variants were found to replicate in the lung tissues of two laboratory mice species (BALB/c and C57BL/6) that had been infected intranasally, but no individuals showed any symptoms nor lost weight. Note that the mice were young adults (8 weeks old), and that there was no evidence of transmissibility of the virus between individuals (Montagutelli et al 2021).

However, the findings "raise major questions on the risk of mice or other rodents living in proximity to humans of becoming secondary reservoirs for SARS-CoV-2 in regions where the B.1.351, P.1 or other specific variants circulate, from where they could evolve separately and potentially spillback to humans" (Montagutelli et al 2021).

The idea of two covid-19 pandemics has been voiced. In 2020, it was used to refer to 80% of the deaths in the wealthy countries (ie: 15% of the global population), while the rest of the world suffered less. In 2021, the massive increase in covid-19 deaths is in the developing world, and richer countries, with the benefits of vaccines, are believing the worst is over (Spinney 2021).

Concentrating on nations, ignores the reality that "there was only ever one pandemic" because the fate of one affects all: "Rampant covid in countries such as India and Brazil will shape the evolution of the virus and could cause new, even more dangerous variants to emerge, which neither our borders nor our vaccines are guaranteed to keep out. That's why it's too early to rest on our laurels and why vaccine equity is so important - because this is a pandemic, meaning it's global" (Spinney 2021 p3) ¹⁴.

The pattern of infection also changed in the "second waves" to more cases among younger adults, who did not become ill, but acted as "potent spreaders" (Jonathan Van

¹⁴ Different parts of the world have experienced different patterns of infection. For example, in June 2020, confirmed cases were rising in South America while decreasing very fast in China and New Zealand at that time (Taylor 2020).

Tam in Lu 2020a).

An open letter from the heads of the WHO, the IMF (International Monetary Fund), the World Bank, and the WTO (World Trade Organisation) (Georgieva et al 2021) in early June 2021 warned of the dangers of the growing gap in vaccination rates between rich and poor countries. This was leading to "a two-track pandemic", which was also evident in differences in testing and tracing, oxygen supplies, treatments, and public health measures.

1.5. APPENDIX 1A - MEDICINES

1.5.1. Pharmacovigilance

The World Health Organisation (WHO 2012) defined pharmacovigilance (Pv) as "the science and activities relating to the detection, assessment, understanding and prevention of adverse drug effects or any other drug-related problem" (quoted in Andrade et al 2020). Simply, it is dealing with the negative consequences of medicines, most prominently, adverse drug reactions (ADRs) ¹⁵.

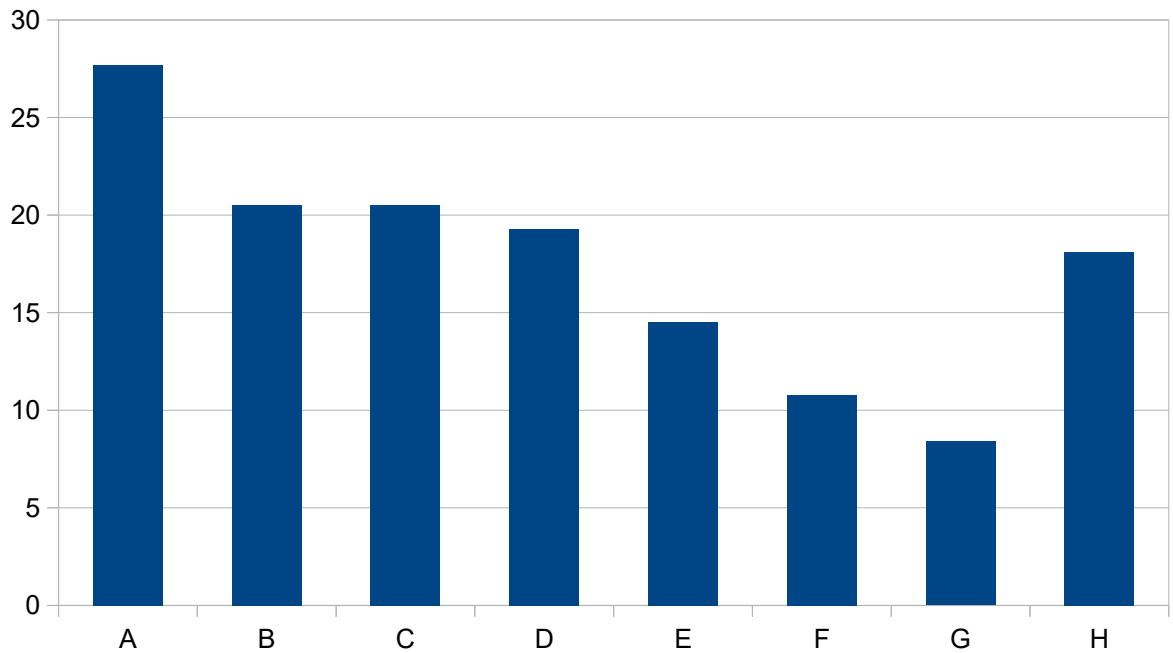
ADRs are met by medical staff, and they are the starting point in communicating their existence to appropriate authorities. The under-reporting of ADRs is due to factors like ignorance, insecurity, or indifference of health professionals, the culture of medical institutions, the existence of databases, resources for Pv, and the behaviour of appropriate authorities (eg: regulatory agencies) (Andrade et al 2020).

Hospital pharmacists play a key role. Andrade et al (2020) surveyed eighty-four such professionals in Brazil in 2018. The most common problem reported was difficulty in monitoring medications and establishing causality with ADRs (figure 1.3).

1.5.2. Quality

Medicines regulatory systems vary around the world, and "under-resourced National Regulatory Authorities in low- and middle-income countries (LMICs) lack the capacity to fully assure the quality of medicines circulating in their territory, and the most vulnerable

¹⁵ Pv increased in importance after the problems with the drug thalidomide between 1958 and 1962, when it was given to pregnant women for morning sickness resulting in severe birth defects (phocomelia syndrome) for thousands of children (van der Gronde et al 2017).



(Key:

A = Difficulty in drug monitoring and attribution of causality.

B = Difficulty in reporting ADRs.

C = Difficulty in searching medical records.

D = Difficulty in contacting patient or family.

E = Difficulty in carrying out research about medication.

F = Difficulty in communicating with health team.

G = Difficulty related to ADR database.

H = Other.

(Based on figure 1 p7 Andrade et al 2020)

Figure 1.3 - Percentage of hospital pharmacists reporting certain difficulties.

populations are exposed to the risk of receiving poor-quality medicines" (Ravinetto et al 2016 p1). For example, one estimate (Almuzaini et al 2013) suggested that one-third of medicines in sub-Saharan Africa are of poor quality (eg: chemical or packaging quality failure) (Ravinetto et al 2016).

Poor-quality medicines include genuine medicines that are sub-standard, and counterfeit products. "While in case of falsified medicines there is a deliberate (criminal) willingness to fraud, substandard medicines result from human error or negligence at manufacturing sites" (Ravinetto et al 2016 p2).

However, there is no agreed definition of "counterfeit medicine", while the WHO (2012) used the

terminology, "sub-standard, spurious, falsely labelled, falsified and counterfeit (SSFFC)" (quoted in Ravinetto et al 2016).

Whatever the cause of poor-quality medicines, "there are no differences in what concerns the risks for the patients, ie: therapeutic failure, toxicity and/or emergence of resistance ¹⁶, all leading to a great deal of avoidable human suffering, including possibly death" (Ravinetto et al 2016 p2).

1.5.3. Prices

"Recent public outcry has highlighted the rising cost of prescription drugs worldwide, which in several disease areas outpaces other health care expenditures and results in a sub-optimal global availability of essential medicines" (van der Gronde et al 2017 p1). Developed countries spend around one-sixth of their health care budgets on medicines, while, in LMICs, some drugs are simply out of reach. "In some cases, to prevent striking increases in premiums or taxes, regulators are forced to limit access to healthcare, which leaves patients without the best treatments" (van der Gronde et al 2017 p3).

The cost of pharmaceuticals to health authorities is determined by price and volume. "This means that regulation can either aim to lower drug prices, or reduce usage. On the one hand, there is a growing life expectancy (and ageing population worldwide), while there are increasing medical options for disease control. Therefore, following drug innovation expectations and usage growth statistics, it is likely that costs will continue to rise" (van der Gronde et al 2017 p3).

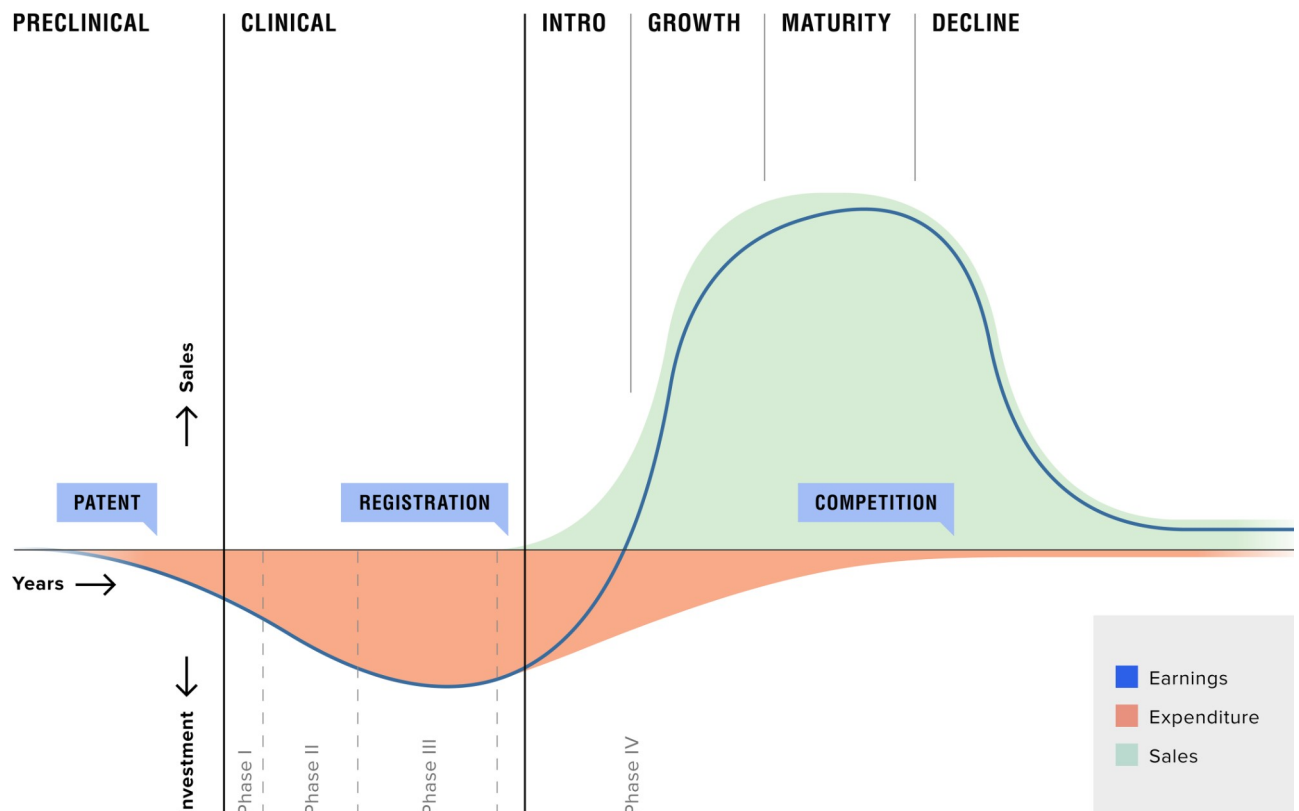
In terms of the pharmaceutical industry pricing strategies, critics have suggested that companies try to set the price for new drugs as high as they can get away with, particularly when there is no transparency over how the prices are set. Sudden "price hikes" for old drugs are also a concern (eg: imatinib suddenly rose fourfold in the USA in 2015) (van der Gronde et al 2017).

van der Gronde et al (2017) summed up that "the recent rise in drug prices is caused by uncontrolled market dynamics, changes in life-cycle dynamics and unanticipated policy side-effects" (p25).

The life cycle of a drug describes its "market

¹⁶"For instance, sub-standard anti-biotics are likely to be a powerful contributor to the emergence of resistances, since they may be underdosed or poorly bioavailable, resulting in sub-therapeutic doses" (Ravinetto et al 2016 p2).

behaviour": "Generally, the product life-cycle pattern is represented by a 'bell shaped' graph, a parabola... Though specifics can vary wildly, the general shape of the curve of investments during the drug development phase, exponential growth of sales after registration and decline through competition and patent term expiration is valid for most drugs" (van der Gronde et al 2017 p5) (figure 1.4).



(Source: figure 2 van der Gronde et al 2017)

Figure 1.4 - The drug life cycle curve.

Four stages of the life cycle can be distinguished (van der Gronde et al 2017):

- i) Clinical testing and official approval.
- ii) Introduction to the market and growing sales accompanied by widening use (ie: beyond the original patient group/indication).

iii) "Drug maturity" - Still high sales, but increasing criticism about effectiveness and side-effects.

iv) Contracting use (and alternative drugs appear).

"Most brand-name medicines continue their careers as generics after their patents expire. On average this results in a 20-25 year therapeutic life-time in 'the doctor's bag'- the portfolio of drugs available to a doctor - due to therapeutic substitution and competition between branded drugs and generics" (van der Gronde et al 2017 p6). Note that drugs under patent have no direct competitor, and only the patent-holder can make them, while generic drugs (ie: the patent has expired) can be made by anybody. Patents are granted for twenty years on average (van der Gronde et al 2017).

Various strategies are used by pharmaceutical companies to extend the life cycle of products including "improved formulations", new indications (ie: patient groups), and introducing an authorised generic (van der Gronde et al 2017).

"In debating the patent system, some analysts state that basic human rights like health and access to essential medicines should be equitable and should not be limited by property rights. Others use a utilitarian stance to argue that pharmaceutical companies are for-profit entities, and without patents these companies would not be incentivised to develop drugs" (van der Gronde et al 2017 p7). The cost of a drug from discovery of molecules to market is estimated at between \$60 million and \$2.6 billion (van der Gronde et al 2017). Safety testing and regulations account for a large amount of the cost, and Daemrich (eg: 2004) used the term, "double bind trade-off phenomenon" to describe the "tension between safety management and drug innovation" (van der Gronde et al 2017 p8). The top ten pharmaceutical companies have a profit margin of 20% (compared to 7% for similar companies in other industries) (van der Gronde et al 2017).

van der Gronde et al (2017) emphasised that "though the pharmaceutical market is often portrayed as a competitive market, it is not truly a free market. In addition to the patent system, skewed economic dynamics create further complexities. In free markets, a consumer decides on, buys, pays for and uses a product, whereas in healthcare, a doctor decides and the pharmacy or hospital pharmacy provides, the insurance company or government

pays and the patient uses the product" (p13).

"Since roughly 2000, Big Pharma has been struggling with the patent cliff, a series of blockbuster drugs whose patents have expired. This has caused a significant loss of turnover due to generic substitution. The effect cannot be compensated for by new drug introductions, since relatively few new blockbuster drugs have been introduced. This means that in order to maintain profitability, more revenue must be generated from fewer breakthrough drugs, which has led to increased prices for innovator drugs and increased merger and acquisition activity within the pharma industry" (van der Gronde et al 2017 pp11-12) (eg: sixty companies merged into ten in the 21st century).

In the USA, pharmaceutical companies set their own prices, but in other countries, regulators/governments can control the prices, or negotiate with the companies to set an agreed price. This can mean differences in pricing for the same drug between countries. Many factors influence the price, like the government's willingness to pay, more than the cost of development of the drug (van der Gronde et al 2017).

Introduction to the market and growth of sales depends on demand, which is helped by advertisements to doctors and pharmacists, and direct-to-consumer advertising (ie: patients) in the USA and New Zealand, for example (van der Gronde et al 2017).

Medicines regulators that keep drug prices low has the unintended consequence of high competition which sees some smaller companies fail and/or merge with larger ones. The upshot is less competition (van der Gronde et al 2017).

A number of strategies have been tried by regulators, like "orphan drugs" and "priority drugs". The former is to encourage the development of drugs for a small number of patients (ie: rare conditions) where sales volumes will be low and thus unattractive to the companies. Orphan drug regulations include less clinical testing required, market exclusivity, and corporate tax benefits, for instance. Priority drugs are those needed, but of no interest to profit-making companies (eg: new anti-biotics).

Health authorities' spending on drugs can be reduced by using cheaper versions, charging patients, forcing down drug prices, or reducing drug use, for instance (van

der Gronde et al 2017).

Strategies include incentivising prescribers to save on drug costs, or the system of pricing drugs when set by regulators (eg: value-based pricing - price related to life years saved, say). But calculating this is easier said than done. Also pharmaceutical companies may end up even more focused on a few drugs (van der Gronde et al 2017).

From a different angle, governments could stop mergers between pharmaceutical companies that reduce competition, change patent laws, develop public-private partnerships, or encourage "me-too drugs". "Me-too drugs or follow-on drugs are drugs with minor chemical variations relative to a drug already on the market within a given therapeutic class. These drugs are highly controversial since they often cost roughly the same as the first-in-class drugs, but offer few relevant therapeutic improvements" (van der Gronde et al 2017 p22). This may increase competition if companies can produce their own "version" of a drug (van der Gronde et al 2017).

1.6. APPENDIX 1B - EARLY GENETIC FAMILY TREE

The first six months of SARS-CoV-2 in 2020 presented a picture of limited evolution. Two mutations in the genome of the virus appeared quite early (eg: mid_January 2020). This was classed as a new lineage (though it may not be biologically different to the reference case). A new lineage that circulates and accounts for at least one-fifth of cases is classed as a clade ("19B" as opposed to the original "19A" clade)^{17 18}. The number 19 signifies that these clades were circulating in 2019 (Lawton 2020b).

In late January 2020, a new lineage with four mutations different to the reference case was found (though again not necessarily biologically different). This has become clade 20A, which subsequently diverged into 20B and 20C (Lawton 2020b)¹⁹.

¹⁷ A strain is a biologically different entity (eg: more virulent) (Lawton 2020b).

¹⁸ Clades can be monophyletic (all species in the clade share one common ancestor), paraphyletic (all species in the clade and some species outside the clade share the same common ancestor), or polyphyletic (members of a clade have more than one common ancestor) (Webb 2020).

¹⁹ One "mutational trick" is recombination, where an individual is infected simultaneously by two SARS-CoV-2 viruses with slightly different genomes, and they combine into a hybrid (Lawton 2020d). Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

2. COVID-19 AND NATURE

- 2.1. Impact
- 2.2. Emerging infectious diseases
- 2.3. Covid-19 and PCAs
- 2.4. Indigenous peoples
- 2.5. Appendix 2A - Biological invasions
 - 2.5.1. Biological diversity

2.1. IMPACT

Mitchell and Phillips (2021) introduced a special issue of the journal "PARKS" by reflecting on the relationship between covid-19 and protected and conserved areas (PCAs) with three themes:

1. The background to the pandemic - Human behaviours like "unregulated land use change, intensified agriculture, livestock production, the unregulated wildlife trade and wild meat consumption make it possible for zoonotic diseases (zoonoses) to emerge - jumping from wildlife or domesticated livestock into human populations²⁰. The stresses brought about by climate change create the circumstances in which such 'spillover' events become more likely" (Mitchell and Phillips 2021 p8) (table 2.1)²¹. But PCAs can limit the land use change.

- 1. The original host's infection, behaviour and ecology.
- 2. How the pathogen is shed into the environment and its survival there.
- 3. How humans are exposed to the pathogen.
- 4. The susceptibility of humans to infection and becoming hosts.

Table 2.1 - Four key elements involved in zoonosis (Keesing and Ostfeld 2021).

²⁰ The intersection of the food chain can be seen in the case of vultures poisoned from eating carcasses that contained diclofenac in Spain. Diclofenac is a non-steroidal anti-inflammatory drug used by vets on livestock (Margalida et al 2021).

²¹ "Thousands of pathogens circulate in the human population; hundreds of these are bacteria, hundreds more are viruses; a smaller but still sizeable number are fungi. Many of these infectious agents circulated first in other vertebrate animals, such as mammals and birds. In their original host species, the microbes might have lived without harming their hosts, or they might have caused disease. Regardless, at some point they spilled over into humans and began causing illness" (Keesing and Ostfeld 2021 p1).
causing illness.

2. The impact of covid-19 on PCAs - Around the world a number of common themes emerged: "sudden and massive reductions in visitor numbers (except near cities); associated losses of income for PCAs and for the economies linked to them, as income from tourism collapsed and government support was cut; reports of more incursions and illegal extraction of natural resources; the diversion of protected areas managers from their usual duties; and destabilising relationships between PCAs and Indigenous and local communities" (Mitchell and Phillips 2021 p9).

PCAs in or near cities have seen an increase in demand as urban dwellers seek refuge in nature from the virus or lockdowns.

3. Lessons learned - What to do in relation to nature to stop another pandemic (eg: stop the use and abuse of nature for profit) (appendix 2A).

2.2. EMERGING INFECTIOUS DISEASES

Zoonosis is the basis of SARS-CoV-2, but also Ebola, SARS and MERS. These are examples of "emerging infectious diseases" (EIDs), and there are reports of increasing numbers of these in recent years (Ferreira et al 2021) ²².

It is estimated that 60% of 1047 human pathogen species have jumped from non-humans, of which three-quarters are from wild species (versus domesticated animals) (Ferreira et al 2021).

Though zoonosis covers viral, bacterial, parasitic or other types (eg: fungi), viruses are most common because of their ability to rapidly adapt and thus increase the possibility to jump to a new host species. Acquiring the ability of human-to-human transmission gives the virus a better chance of embedding. Some pathogens, like yellow fever virus or Zika virus, are caught from non-humans, but have no human-to-human transmission (Ferreira et al 2021).

"Zoonotic disease emergence is a complex process. A combination of drivers provides conditions that allow pathogens to expand and adapt to new niches. The drivers are environmental, social, political and economic forces operating at local, national, regional and global levels" (Ferreira et al 2021 p15). These authors

²² The figure of 335 EID events between 1940 and 2004 is "often cited" (Hymas et al 2021). The WWF in 2010 suggested a tripling of spillover of pathogens from animal hosts to humans in the last decade (Hymas et al 2021).

concentrated on three direct drivers of zoonotic disease exposure:

i) Land use change - Logging, for example, brings humans into contact with potential pathogens in forest wild species. An association has been shown between deforestation in Central Africa and Ebola virus outbreaks, with an estimated time lag of two years (Ferreira et al 2021) ²³.

Also the loss of forest (fragmentation) "can stimulate the movement of wildlife into human-modified landscapes, especially when food for wild animals is no longer sufficient within the remaining natural habitat" (Ferreira et al 2021 pp17-18). For example, Hendre virus has been traced from flying fox fruit bats feeding near human settlements to domesticated horses and then to humans in Australia (Ferreira et al 2021).

ii) Wildlife trade and wild meat consumption - Human-animal contact, which is key for EIDs spillover, can occur in live animal markets in human settlements, on wildlife farms (ie: traditionally undomesticated species), and humans eating "bush meat".

iii) Intensification of livestock production - Livestock and poultry often have low genetic diversity, which means that a pathogen that jumps from wildlife has opportunities to thrive. For example, avian influenza viruses and swine flu, which are threats to humans, are present in livestock and poultry populations (Ferreira et al 2021).

PCAs are one solution to the risk of EIDs. These include national parks and protected areas along with Indigenous and Community Consensual Areas. Ferreira et al (2021) felt that "it is clear that PCAs can buffer against the emergence of novel infectious diseases by reducing rapid changes in host/reservoir abundance and distribution, and limiting contact between humans, livestock and wildlife... Furthermore, PCAs offer significant opportunities for EID monitoring and surveillance..." (p20).

This is important because the covid-19 pandemic is "not the first, nor will it be the last, zoonotic disease

²³ Hymas et al (2021) warned of care about the "myths of pristine landscapes and Eden-like wildernesses... untouched by human hands" (p26) in the past. A historical perspective shows that new diseases have occurred throughout human history. For example, hominid species moving from the forest with evolution encountered new tick species and their diseases, while the domestication of animals brought novel diseases into proximity (Hymas et al 2021).

to undermine economies and take human lives. Indeed, scientist warn that this may just be the beginning of a new cycle of emerging infectious diseases capable of gaining worldwide traction" (Ferreira et al 2021 p20).

2.3. COVID-19 AND PCAs

Waithaka et al (2021) synthesised data from ten online surveys sent in mid-2020 to PCAs to understand the impact of covid-19. There were over 300 responses covering ninety countries. The results were presented based on the different areas of the world and the different types of PCAs, with a brief survey of key points here:

- Africa - Reduced wildlife tourism and its revenue, and less ability to monitor the illegal wildlife trade.
- Asia - Engagement with local communities "fully or partially stopped in many cases.
- Tiger range states (eg: India; Thailand) - Compromised ability to achieve conservation goals.
- Oceania - Concerns about reduced public and private funding in the future.
- North America - Some natural habitats allowed to recover during closures to the public.
- Latin America and the Caribbean - Reduced income from visitors for the local communities has led to an increase in illegal activities, like logging or poaching. Evidence of species moving into different areas without human presence.
- Mediterranean marine protected areas - Fear of floods of visitors after lockdowns end.
- Privately protected areas - Income shortages meant the abandonment of investments.
- Frankfurt Zoological Society-supported protected areas (in sixteen countries) - Impact on staff with reduced salaries and furlough, and fear of getting covid-19.

There were many commonalities between the different PCAs. But those that could develop online materials, video blogs, and networked static cameras fared better (Waithaka et al 2021).

2.4. INDIGENOUS PEOPLES

It is estimated that Indigenous peoples and local communities (IPLCs) ²⁴ occupy, protect and conserve at least 38 million km² of land in 87 countries (Walters et al 2021). They have "a distinct relationship with the environment that is fundamental to their social, cultural and spiritual lives. They often possess cultures and laws based on mutual reciprocity between humans and nature, and on the principles of safeguarding the environment for future generations" (Walters et al 2021 p58).

IPLCs face many threats including climate change, industrial expansion, large-scale monoculture farming, and health and nutrition problems. In some cases, they are suffering more from covid-19 than the general population of the country, while, in others, they are doing better (Walters et al 2021).

Walters et al (2021) used the "SenseMaker" programme to analyse the stories of IPLCs in response to covid-19. The following statement was used (in the appropriate language): "Please share an experience about the covid-19 disease that shows how it has affected or is affecting Indigenous peoples' and local communities' use and relationship with their territories, lands and waters. This experience can be about you, your family, your community, or a community you work with. It could be a good, bad or neutral experience. It can be long or short" (p58). A total of 133 responses were collected between August and November 2020 from forty countries.

Analysis of the impact of covid-19 was categorised as social, economic, and environmental in that order of importance based on the replies. Traditional medicine use was high, and pride was associated with stories of its use with covid-19 symptoms.

On the positive side, increased community solidarity was reported. For example, the loss of tourist jobs meant that workers (usually younger) returned home. A Maasai man in Tanzania explained how the returnees "helped my community to reclaim pieces of lands which have been

²⁴ Also called "ICCAs - territories of life" - "territories and areas governed, managed and conserved by custodian Indigenous peoples and local communities" (Sajeva et al 2019 quoted in Walters et al 2021).

taken forcibly by cultivators following their absence. The youth who came back to their ancestral land, united in numbers and claimed their land" (p61). But, at the same time, some stories showed how covid-19 restrictions limited access to their lands.

Economically, there was a loss of livelihood for those who sold items and/or worked in tourist jobs. One respondent in Benin said: "We carry out income-generating activities such as gardening, fish farming, beekeeping. Its activities allowed us to meet certain subsistence needs and given... the arrival of the confinement we found ourselves unable to resell our products which leads us today to have no more financial and material resources" (p64).

Walters et al (2021) summarised the main themes overall: "rapid adaptation was possible in households where knowledge of traditional practices had been maintained; there was a paradoxical increase in solidarity but also of separation of people who used to work and live together; traditional festivities that represent bonding opportunities for remote communities did not take place; local leaders have learnt to react quickly by raising awareness of the dangers and avoiding them; traditional medicine and traditional fishing, hunting, farming and gathering have regained importance; many villages made decisions to self-isolate from the rest of the country; and restrictions sometimes prevented communities from protecting their lands" (p66). Notwithstanding the variety between and among IPLCs.

APPENDIX 2A - BIOLOGICAL INVASIONS

Invasive alien species are "species that have successfully been introduced, established and spread beyond their native range" (Diagne et al 2021 p571). These include plants, invertebrates (eg: mosquitoes), and vertebrates (eg: rodents). They can have "profound, negative effects on biodiversity, ecosystem functioning and services, human health and welfare, and the economy. In addition, biological invasions are increasingly exacerbated by globalisation and climate change" (Diagne et al 2021 p571). Diagne et al (2021) estimated an annual cost worldwide of US\$ 26.8 billion for "biological invasions".

Three factors than explain the increase in reported biological invasions in recent years - "the ongoing intensification of global trade and transport creates

many more opportunities for invasions; the growing 'land take' of the planet surface (for example, expansion of agriculture and infrastructures) makes our societies increasingly sensitive to impacts from these invasions; and the awareness and reporting of economic impacts of invasions have concomitantly grown over time" (Diagne et al 2021 p574).

2.5.1. Biological Diversity

Biological diversity is a contradictory risk for humans. On the one hand, diversity of organisms means potentially a diversity of pathogens and so increased risk of zoonotic diseases. On the other hand, "under some conditions, high biological diversity can decrease the transmission of zoonotic diseases that have already become established" (Keesing and Ostfeld 2021 p1) ²⁵.

Keesing and Ostfeld (2021) reviewed the evidence on biodiversity and new zoonotic diseases. There are three main conceptual models:

i) "Total host diversity" model - More biodiversity leads to a larger pool of potential zoonotic diseases - ie: all organisms are equally likely to be a risk.

ii) "Zoonotic host diversity" model - Some species are more likely to have zoonotic pathogens, and it is their diversity that is important.

iii) "Zoonotic host diversity and abundance" model - "In this model, the diversity and the abundance of zoonotic hosts determine the risk of zoonotic emergence" (Keesing and Ostfeld 2021 p2).

In terms of research, concentrating on mammalian diversity, Allen et al (2017), for instance, found that "mammal species richness had only the fourth strongest influence on the distribution of emerging infectious diseases, after the presence of evergreen broadleaf trees first, human population density second, and climate third" (Keesing and Ostfeld 2021 p2).

Woolhouse and Goutage-Sequeria (2005) analysed a database of around 800 zoonotic pathogens, and identified "ungulates" (hooved mammals) and carnivores as the sources of the most, and bats as the fewest. Johnson et

²⁵ This is through the "dilution effect" (Ostfeld and Keesing 2000), where "species in diverse communities dilute the impact of host species that thrive when diversity declines" (Keesing and Ostfeld 2021 p5).

al (2020) used a database of 142 zoonotic viruses, and Rodentia (eg: rats, mice) was the order with the largest number of mammalian-sourced viruses, followed by bats, carnivores, and hooved mammals.

Domesticated mammals have been found to be more of a risk than wild species and vice versa, depending on the study (Keesing and Ostfeld 2021). The variety of findings relates to the databases used. "The majority of spillover studies have not included quantitative measures of transmission, relying instead on databases compiled from qualitative host-pathogen associations" (Keesing and Ostfeld 2021 p5).

A different approach is to look at the characteristics of host or "reservoir" species - eg: larger litters, shorter gestation periods, and younger age at sexual maturity (classed as "faster" life histories) (Keesing and Ostfeld 2021). Such species are believed to have a stronger innate immunity, but weaker adaptive immunity than "slower" life histories/long-lived species. The upshot is that short-lived species are "thought to be more likely to maintain higher infectiousness, with an associated increase in transmission, as compared to hosts with stronger adaptive immunity" (Keesing and Ostfeld 2021 p6). Short-lived species are also more abundant in human-impacted habitats (Keesing and Ostfeld 2021).

3. LOOKING BACK AND FORWARD

- 3.1. Index case
- 3.2. Preparedness
- 3.3. Other diseases
 - 3.3.1. Learning from influenza
 - 3.3.2. Other deadly diseases
 - 3.3.3. Interactions

3.1. INDEX CASE

The first case of covid-19 was described in late December 2019 in Wuhan, Hubei province, China (eg: Zhu et al 2020). Epidemiologists like to find the "index case" (ie: the first case of an outbreak).

The first case outside China was reported in Thailand on 13th January 2020, then 21st January in the USA and 24th January in Europe. But symptoms take time to appear and testing was limited at that stage, so there could have been cases outside China in 2019 (Le Page 2020c).

An individual has been retrospectively diagnosed with covid-19 on 1st December 2019 (Huang et al 2020). However, "newspaper reports document retrospective covid-19 diagnoses recorded by the Chinese government going back to 17 November 2019 in Hubei province" (Pekar et al 2021). But studies diagnosing patients in retrospect have weaknesses. Just because people had "symptoms resembling covid-19 doesn't mean they had it" (Le Page 2020c p10).

Genetic analysis for the most recent common ancestor (tMRCA) (ie: an ancestor of SARS-CoV-2 in non-humans at the point of the jump to humans) has suggested October 2019 (Pekar et al 2021). But this is not necessarily the date of zoonosis (ie: transfer to humans) or the index case, warned Pekar et al (2021).

Pekar et al (2021) tried for a more accurate timing of the index case using genetic and epidemiological data. They calculated the period between mid-October and mid-November 2019 as "the plausible interval" for the first case in Hubei province. The prevalence of the virus was low at this time to be noticed, and when it was first identified at the end of 2019, "the virus had firmly established itself in Wuhan" (Pekar et al 2021 p415).

Pekar et al (2021) also modelled the zoonotic event, and suggested that two-thirds of SARS-CoV-2-like jumps from animals to humans would die out without causing human-to-human transferable infection. Pekar et al (2021)

stated: "It is reasonable to postulate that the variant of SARS-CoV-2 that first emerged was less fit than the variant that spread through China and that evolutionary adaptation was critical to its establishment in humans. Therefore, we simulated two-phase epidemics in which the index case was infected with a less-fit variant (ie: half as transmissible) that went extinct, but not before giving rise to a mutant strain matching the transmission dynamics estimated in Wuhan" (p413).

Reacting to non-Chinese cases in 2019, Pekar et al (2021) felt that "our results suggest that polymerase chain reaction evidence of SARS-CoV-2 in wastewater outside of China before November 2019 is unlikely to be valid, and the suggestion of international spread in mid-November or early December 2019 should be viewed with scepticism, given that our results suggest that fewer than 20 people were infected with SARS-CoV-2 at this time. Our results also refute claims of large numbers of patients requiring hospitalisation because of covid-19 in Hubei province before December 2019" (p416).

Finally, Pekar et al (2021) could not discount the possibility that the index case was outside Hubei province as their data focused on date not geography. Saying that, the researchers continued that "our results suggest that if the virus first emerged in a rural community, it would have needed to migrate to an urban setting to avoid extinction. The lack of reports of covid-19 elsewhere in China in November and early December [2019] suggests that Hubei province is the location where human-to-human transmission chains were first established" (Pekar et al 2021 p416) ²⁶.

²⁶ Bloom et al (2021) argued for an open mind about the origin of covid-19 - ie: "We must take hypotheses about both natural and laboratory spillovers seriously until we have sufficient data" (p694). The problem is that material on the internet has appeared making claims which are felt to be linked to political opinions rather than scientific evidence (eg: pre-print by Yan et al 2020 and critiques at <https://rapidreviewscovid19.mitpress.mit.edu/pub/78we86rp/release/2>, and Lawton 2020c).

Yan et al (2020) argued that SARS-CoV-2 could be "a laboratory product created by using bat coronavirus ZC45 and/or ZXC21 as a template and/or backbone" (p1). The response to these claims has been highly critical. Gkikas Magiorkinis, for example, stated that the paper "does not provide any robust evidence of artificial manipulation and is highly speculative" (quoted in Lawton 2020c).

Leaving aside the science, critics have noted that Yan is affiliated to US organisations funded by Steve Bannon (advisor to former US President Trump). Yan has claimed that she was working on a secret investigation in Hong Kong and discovered the Chinese government's laboratory in Wuhan was creating a coronavirus (Lawton 2020c).

Morens et al (2020a) dismissed a "man-made" origin to SARS-CoV-2 because "it contains neither the genetic fingerprints of any of the reverse genetics systems that have been used to engineer coronaviruses nor does it contain genetic sequences that would have been 'forward engineered' from pre-existing viruses, including the genetically closest sarbecoviruses. That is, SARS-CoV-2 is unlike any previously identified coronavirus from which it could have been engineered. Moreover, the SARS-CoV-2 receptor-binding domain, which has affinity for cells of various mammals, binds to human ACE2 receptors via a novel mechanism" (pp957-958).

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3.2. PREPAREDNESS

Morens et al (2020a) made this point about covid-19: "We need to understand what happened so that we can prevent it from happening again, and be better prepared to contain similar pandemics at their onsets" (p955).

At the most basic, it is important to understand what viruses are. "Viruses are compact nucleic acid packages of either DNA or (in the case of coronaviruses) RNA associated with proteins, and in some cases with lipids. Viruses are not living organisms and can only reproduce inside living cells susceptible to viral entry and with the capacity to replicate viral nucleic acids and translate nucleic acid signals into amino acids to build viral proteins. Viruses are therefore non-living self-contained genetic programs capable of redirecting a cell's machinery to produce more of themselves" (Morens et al 2020a p955).

So, initially, the virus must host-switch (or spillover) (ie: from another host species to the human host) ²⁷. This process is influenced by factors like contact between the species, as well as shared biology (eg: host cell receptors) (Morens et al 2020a).

"There are many potentially pandemic viruses out there, and some are far worse than the one we are currently fighting. Disease experts have been issuing warnings for years, but covid-19 showed how unprepared the world was for an outbreak" (MacKenzie 2020 p46) ²⁸.

The consequences of the covid-19 pandemic has turned attention to the prevention of future such events. For example, prevent transmission from wild animals to humans in the first place, or eliminate the viruses in those animals. In the latter case, vaccinating animals as in the case of wild dogs to prevent rabies. Technology is developing to allow "self-disseminating vaccines" applied to the fur of an animal, say, and subsequently spread by social grooming, or the genetic engineering of a vaccine (Nuismer and Bull 2020).

Bats and bat viruses in China, for instance, are viewed as a risk for future pandemics because of the proximity to large human populations, and the market in

²⁷ A well-studied host-switching is influenza virus, which moved from wild waterfowl and shore birds to humans in the past (Morens et al 2020a).

²⁸ In terms of the predictability of the covid-19 pandemic, Cheng et al (2007) warned: "The presence of a large reservoir of SARS-CoV-like viruses in horseshoe bats... is a time bomb. The possibility of the re-emergence of SARS and other novel viruses... should not be ignored" (quoted in Morens et al 2020a).

wildlife products (eg: "Ye Ming Sha" (night brightness sand) includes dried, powdered bat faeces and is used in traditional Chinese medicine for eye problems) (MacKenzie 2020). Suggestions include monitoring "hotspots" where viruses could emerge, and the creation of drugs and vaccines on the "off-chance" (MacKenzie 2020) ²⁹.

Morens et al (2020a) made this sobering observation: "We must also realise that the problem is larger than just coronaviruses. In recent years, we have seen emergences and re-emergences of numerous other human infectious diseases such as Ebola fever, Lassa fever, hantavirus pulmonary syndrome, human monkeypox, HIV, dengue, chikungunya, Zika, and epizootic avian influenza. We have entered a new pandemic era [Morens et al 2020b], one in which epidemic and pandemic emergences are becoming commonplace; some are likely to be highly pathogenic" (p958).

Assessing future risks to society has to be done "under conditions of uncertainty", and this is challenging to individuals and societies (Sandberg and Moynihan 2020). There are risks that could happen but are uncommon, like a large asteroid impact on the planet, and others that did not, like the predicted "Y2K" computer crash of the Year 2000. How much effort by IT staff behind the scenes stopped the latter is not the point, but rather it all adds to the difficulty of risk assessment.

Covid-19 has shown that the uncommon could happen, and Sandberg and Moynihan (2020) argued that not being prepared is the issue. "Yet planning for every conceivable disaster or blocking everything new as a precaution is also foolish" (Sandberg and Moynihan 2020 p23). What is required is building the capacity to respond to an unseen or uncommon emergency (eg: having "emergency playbooks") (Sandberg and Moynihan 2020).

In terms of predicting future pandemics, it is interesting to see the predictions about covid-19 made in mid-2020. In early September 2020, the "New Scientist" magazine asked five experts to predict how the pandemic would develop (Wilson 2020c) (table 3.1).

Everyday understanding of risk, which is not good at the best of times, can be further complicated by the difference between absolute and relative risk.

²⁹ "Ominously, bat-to-human transmission of SARS-like viruses has already been detected, perhaps representing pandemic near-misses" (Morens et al 2020a p957).

Prediction (September 2020)	Situation (June 2021)
Fear of second wave of infections.	There have been/are different waves of infection.
Need for better testing.	Some improvements.
Fear of more infectious mutations.	Still a fear, particularly if a mutation is immune to the vaccine.
Hope for a vaccine programme.	A number of vaccines in use.
Concern that low-income countries will suffer more, particularly with the vaccine programme implementation.	Still a concern.
Practical problems with vaccinating the world.	Distribution of vaccines fairly is an issue.

Table 3.1 - Predictions in September 2020 about covid-19 and the state of play in early June 2021.

Take the example of a serious side effect of a medication:

a) Absolute risk

- Medication A: 1 in 1000
- Medication B: 2 in 1000

b) Relative risk is thus: Medication B is twice as great as Medication A.

Hearing about the relative risk can lead individuals to reject Medication B as dangerous, but it is safe (in absolute risk terms).

A real life example is the contraceptive pill and thrombosis. In the mid-1990s the UK Committee on Safety on Medicines warned that newer pills doubled the risk. Many women stopped taking the pill and unwanted pregnancies were the consequence. But the absolute risk was 1 in 7000 for older pills and 2 in 7000 for newer ones (Jones 2020).

Epidemiologist Eleanor Murray used the idea of "contact budget" as a way to cope with the risk of infection. Using the analogy of financial budgeting, individuals find an average level of risk that suits them. This means that a "risky day" should be followed by a "safe day". For example, visiting a crowded shop on one day, and isolate the next day (Jones 2020).

3.3. OTHER DISEASES

3.3.1. Learning From Influenza

With the focus on the covid-19 pandemic, it should not be overlooked that up to half a million people die each year around the world from flu (Brody 2019).

The success or otherwise of the attempts at a "universal" flu vaccine can be enlightening for the covid-19 vaccine. The flu vaccines can vary from 60% to 10% effectiveness (Eisenstein 2019), and the vaccine in a particular year is a guess at the likely strain. Microbiologist Peter Pakese described the main problem that the vaccine produced a focused immune response but against a moving target (in Eisenstein 2019).

"Universal protection need not entail eliminating all traces of influenza virus but simply providing sufficient immunity to minimise the symptoms of infection" (Eisenstein 2019 pS6). Is this a way to view covid-19?

It should be noted that the influenza virus has high genetic variability and thus mutates rapidly (Jarhult 2019).

Anti-viral drug-resistance is a concern. These drugs (eg: oseltamivir, known as "Tamiflu", which inhibits a protein that helps the virus to spread between cells) can be passed in human urine into the water supply by users. Jarhult et al (2011) reported mallard ducks, that harbour influenza, living on sewage waste water, had oseltamivir-resistant strains.

Researchers are looking for different targets on the virus with the possibility of drug-resistance. This includes "scouring databases of known compounds to see whether any might make effective treatments" (Savage 2019 pS9).

Another common issue between influenza and covid-19 research is accurate and swift tests for the viruses (Svoboda 2019). Also the development of tools to forecast the spread of the viruses, particularly using machine-learning (Schmidt 2019).

3.3.2. Other Deadly Diseases

Three deadly diseases have been particularly impacted by covid-19 - tuberculosis (TB), measles, and

polio (Roberts 2021).

For example, lockdown has meant that childhood vaccination campaigns were halted (eg: measles; polio), while health facilities and workers, other than to fight covid-19, were not available. "Shipments of essential medicines and devices were delayed, and fewer people than usual sought treatment at clinics for fear of catching covid-19" (Roberts 2021 p503).

How to quantify the impact? It is too early to see direct increases in illnesses and deaths clearly, so indirect measures are used, like falls in cases diagnosed compared to the average. For example, the WHO received information about 21% less cases (approximately 1.4 million people) of TB in 2020 compared to 2019, and this is estimated to manifest as half a million extra deaths from TB worldwide (Roberts 2021).

In the case of measles, numbers were also down in 2020. "Hampered surveillance might explain part of the drop, and because so many children caught measles in 2019, natural immunity levels are high. But the biggest factor, measles scientists say, is that covid-19 lockdowns, travel restrictions and physical distancing have reduced the population mixing that fuels the spread of the measles virus. (In the United States, for instance, where the virus is typically brought in by travellers, measles cases fell from almost 1300 in 2019 to just 13 in 2020)" (Roberts 2021 p503). But delayed measles vaccinations, and the easing of covid-19 restrictions may mean a rebound of cases (Roberts 2021).

Polio is expanding in countries like Pakistan and Afghanistan, for instance, with the postponement of mass vaccination campaigns. As well as factors like "rumours about vaccine safety, vaccine refusals, the killing of polio workers, apathy and, in Afghanistan, a Taliban ban on polio vaccinations that has left some 3.3 million children out of reach" (Roberts 2021 p504).

Focusing on India, where TB is an issue, McQuaid et al (2020), for example, predicted an extra 150 000 TB deaths above the average in the next four years because of the covid-19 pandemic. While Bhargava and Shewade (2020) calculated an extra 80 000 TB deaths in 2020.

Undernutrition increases the risk of TB - for example, an average weight loss of 2-3 kgs across the Indian population could mean over 10% more TB cases (Bhowmick 2020).

3.3.3. Interactions

During the winter months, SARS-CoV-2 interacts with other seasonal infections (eg: influenza, respiratory syncytial virus (RSV), and other coronaviruses). For example, with past pandemics, rhinovirus infection reduced the chance of infection by 2009 strain of H1N1 swine flu (Vaughan 2020a).

There is the possibility of the combination of another coronavirus and SARS-CoV-2 (described as a "Frankenvirus" in the popular press) (Lawton 2020a). In favour is the fact that coronaviruses are tolerant of co-infection of the same cell, but the new recombination is highly unlikely to be viable (Lawton 2020a).

The focus is upon the behaviour of the single virus particle (virion) in entering the host cell, but virions can actually work together. Discovery of this has led to a new field of microbiology called "sociovirology" (Lawton 2020f).

For example, as in co-infection, where two or more unrelated viruses infect the same cell together. "One variant is highly efficient at entering cells, the other is efficient at exiting. Neither is very successful on its own, but when they work together they are dynamite" (Lawton 2020f p37).

Co-infection can involve the combination of different viruses' genetic material, which may explain the origin of SARS-CoV-2 ("a mash-up of two different bat coronaviruses"; Samuel Diaz-Munoz in Lawton 2020f).

4. TRANSMISSION, CONTROL AND RISK

- 4.1. Long covid
- 4.2. Shift work
- 4.3. Temperature/weather
- 4.4. Vaccine hesitancy
- 4.5. Miscellaneous risk
- 4.6. Miscellaneous control

4.1. LONG COVID

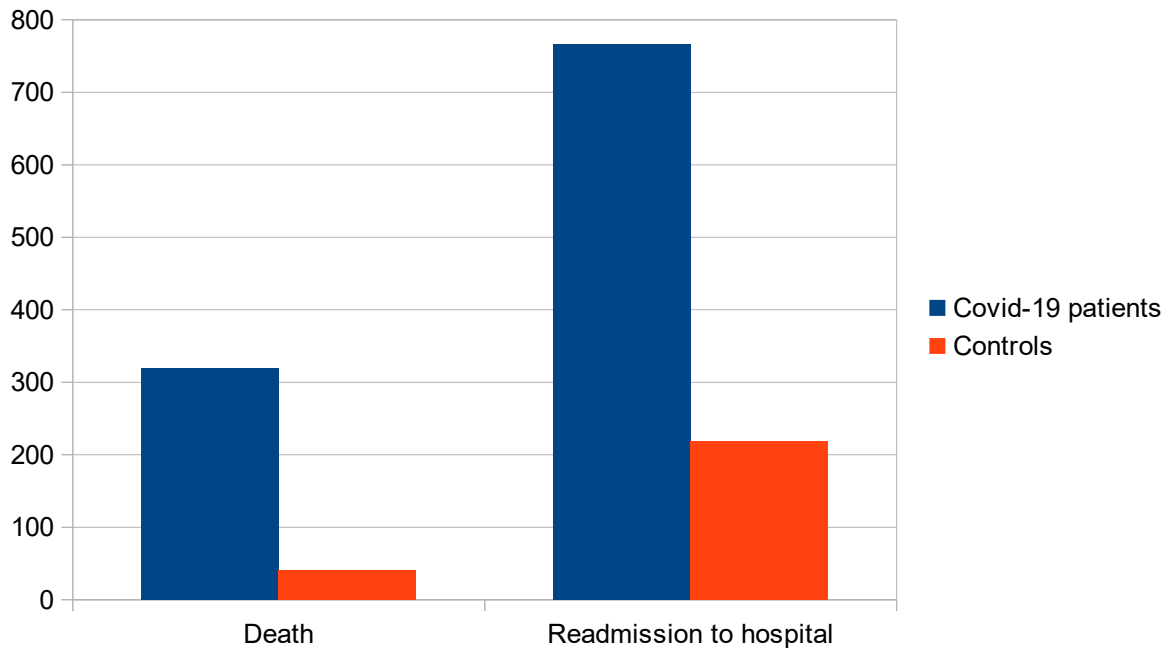
"Long covid" or post-covid syndrome has become recognised as "signs and symptoms that develop during or after an infection consistent with covid-19 which continue for more than twelve weeks and are not explained by an alternative diagnosis" (Williamson et al 2020 quoted in Ayoubkhani et al 2021). The official estimates in the UK for March 2021 suggest 1.1 million people with long covid symptoms (Sherwood et al 2021).

Ayoubkhani et al (2021) used electronic health records in England to gain a better picture of the epidemiology of post-covid syndrome. Data on 47 780 individuals hospitalised with covid-19 in 2020 and discharged alive by 31st August 2020 were matched with controls (on age, sex, ethnicity, region, and deprivation).

Compared to the general population controls, individuals admitted to hospital with covid-19 were more likely to be male, over fifty years old, living in a deprived area, a former smoker, overweight or obese, and have a co-morbidity. These findings confirmed previous patterns.

Following discharge, covid-19 sufferers were more likely to be readmitted to hospital, have multi-organ dysfunction, and die than controls (figure 4.1). The absolute risk of these events was greater for individuals aged seventy years and above, and for those with White ethnicity, but the relative risk was greater for younger patients and non-White ethnicity.

In this study 29% of covid-19 patients were readmitted to hospital and 12% died compared to 20% and 9% respectively in a US study of 1775 veterans hospitalised with covid-19 (Donnelly et al 2021). Another US study (McCarthy et al 2020), but of only 213 individuals reported 10% and 2% respectively. The follow-up periods varied between these studies, however (Ayoubkhani et al 2021).



(Data from table 2 Ayoubkhani et al 2021)

Figure 4.1 - Rates per 1000 person years for two outcomes.

In terms of the multi-organ dysfunctions, Ayoubkhani et al (2021) found diabetes (4.9% of patients), major adverse cardiovascular event (MACE) (4.8%), chronic kidney disease (1.5%), and chronic liver disease (0.3%) after discharge. Similar problems had been observed among 201 low-risk individuals after covid-19 in the UK (Dennis et al 2020), but at a higher rate and only mild dysfunction (Ayoubkhani et al 2021). Greater organ problems post-covid-19 among US veterans (compared to patients with seasonal influenza) (Xie et al 2020), in a hospital in Wuhan, China ((Liu et al 2020), and in Germany (Puntmann et al 2020), for instance. But these studies had small samples (Ayoubkhani et al 2021).

Concerning the methodology of Ayoubkhani et al (2021):

i) (+) Large sample size.

ii) (+) Analysis of common reasons for readmission to hospital after covid-19, but Donnelly et al (2021) found sepsis, pneumonia and heart failure were most common (which Ayoubkhani et al (2021) did not analyse) (-).

iii) (-) Always the possibility of uncontrolled confounders (eg: socio-economic factors).

iv) (+) (-) Dependent on electronic health records, which are assumed to be complete, but only individuals hospitalised with covid-19 included. Ayoubkhani et al (2021) admitted: "We could not access testing data so some individuals with covid-19 who did not require admission to hospital might have been matched in the control group. Also, our results are unlikely to fully capture the lived experiences of individuals with post-covid syndrome who were possibly asymptomatic and untested at the time of infection" (p8).

v) (-) Certain symptoms of post-covid syndrome not included like fatigue, anxiety, and disturbances in taste and smell.

vi) (+) (-) Choice of the matched control group from the general population, while other studies have used non-covid-19 hospital patients, for instance (eg: Xie et al 2020).

Sherwood et al (2021) reported a survey by the "LongCovidSOS" website of 900 people. Around three-quarters had been experiencing symptoms of covid-19 for nine months or more (fatigue, "brain fog", and shortness of breath in order of reported frequency). Just under 60% reported an improvement in some symptoms after the first dose of the vaccine, while just below 20% showed deterioration. Only 11% reported an improvement in all symptoms. The Moderna vaccine was associated with more improvements than AstraZeneca or Pfizer/BioNTec.

There was no control group, the data were self-reports, and the sample was volunteers recruited via social media (mostly White and female).

4.2. SHIFT WORK

Shift work has emerged as a potential factor in covid-19 severity and hospitalisation. "The adverse health effects of shift work are increasingly being recognised. Shift work is associated with respiratory disease, diabetes, cancer and non-covid-19 infectious diseases. The mechanisms underlying these associations remain uncertain; however, sleep disruption, poor diet and circadian misalignment may account for some of the effects" (Maidstone et al 2021 p1).

Maidstone et al (2021) used data from the UK Biobank (over half a million 40-69 year-olds). During recruitment to the UK Biobank between 2006 and 2010, individuals completed detailed questionnaires about themselves, which included occupation/employment informed. Shift work was defined as a work schedule outside 9 am to 5 pm (categorised as afternoon, evening, night, or rotating, and from "never/rarely" to "always"). Data on covid-19 covered the 16th March to 24th August 2020, and involved in-hospital PCR [polymerase chain reaction] testing.

In the statistical analysis, never shift workers were compared to permanent shift work and irregular shift work (ie: self-reported "sometimes"), firstly. There was a significant association between any shift work and a covid-19 positive test, even controlling for sleep disruption, and health variables like smoking and obesity. The risk was over twice as great as never shift work.

Next the timing of shift work was analysed - no shift work, day, and night work. The shift work groups were again over twice as likely to test positive for covid-19 than no shift work.

Maidstone et al (2021) observed that the "size of effect of shift work as a risk factor for covid-19 is comparable with other reported risk factors for covid-19 such as being non-white, being most socio-economically deprived and having a BMI ≥ 40 kg/m²" (p5) ³⁰.

Possible explanations for the findings include circadian misalignment, and/or the type of jobs done by shift workers. In the former case, the immune system is regulated by the circadian clock, and so disruption of this clock could reduce the effectiveness of the immune system to fight infections.

Variables related to the job "might include increased occupancy of workspaces over 24 hours for shift workers, reduced time for cleaning between shifts and tiredness resulting in less awareness of health and safety measures" (Maidstone et al 2021 p5). Put very simply, greater risk of exposure to the virus.

Maidstone et al (2021) accepted that the data on shift work "were recorded a minimum of 10 years before covid-19, and although some of the data have been updated through hospital episode statistics, it cannot be viewed as a contemporaneous record" (p6).

The sample was large (over 280 000 individuals), but middle-aged volunteers who lived within reasonable travelling distance of twenty-two assessment centres in

³⁰ Shift work is an example of a social determinant of health, and Dua (2020) argued that these factors were more important than biology in explaining ethnic differences in infections and deaths. Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

the UK between 2006 and 2010. Thus, "any conclusions drawn here are made in relation to the UK Biobank cohort only and therefore need to be validated in other populations" (Maidstone et al 2021 p6).

4.3. TEMPERATURE/WEATHER

The relationship between weather (temperature) and covid-19 has been an issue from early on in both hemispheres.

The evidence for covid-19 spreading more in cold temperatures includes (Vaughan 2020a):

- Flu viruses more stable on surfaces.
- Increased shedding of flu virus.
- Less UV sunlight which damages an exposed virus.
- Immune system are less effective (eg: due to vitamin D deficiency).
- Staying indoors with other people.

In a study of thirty Chinese provinces, Qi et al (2020) found a significant negative association in Hubei province only. For every 1°C increase in temperature, covid-19 cases declined by up to around half, and with every 1% increase in relative humidity, cases decreased by up to one-fifth (Kifer et al 2021). Similar relationships have been reported in studies in Turkey, Mexico, Brazil, and the USA, for example (Kifer et al 2021).

An Australian study found that increased humidity, but not temperature, was associated with less covid-19 cases (Ward et al 2020), while studies in Brazil, Spain and Iran, for instance, found no relationship (Kifer et al 2021).

Globally, Kifer et al (2021) used patient data from eight European hospitals and thirteen in China, and responses to the Covid Symptom Study in the UK. The data covered March to May 2020 for 6194 patients and 37 187 individuals reporting symptoms in the Covid Symptom Study. Severity of covid-19 was measured as median hospital stay, probability of transfer to an intensive care unit, and need for mechanical ventilation.

It was found that covid-19 mortality and severity of symptoms declined over the period of the study. By a process of elimination, increasing temperature was determined as the key factor. The following variables were excluded:

- Age - Older individuals became ill early in the pandemic and these individuals suffered more, and so the decline in cases later was due to younger individuals becoming ill. This idea was dismissed as the average age of patients did not change during the study period.
- Changes in hospital policy and management of patients - No evidence of "overwhelmed" hospitals changing their policies as only one of the European hospitals reached peak capacity. No major treatment appeared during the study period either, while non-hospitalised individuals in the Covid Symptom Study reported shorter and less severe symptoms.

Kifer et al (2021) explained: "Exchanging hospital admission date with local temperature showed that temperature strongly correlated with decrease in covid-19 mortality. Since reverse causation is not possible, it is reasonable to conclude that covid-19 as a disease has a strong seasonal nature" (p6). Saying that, the researchers accepted the possibility of unidentified factors, including social distancing policies and other prevention measures.

Smit et al (2020) considered whether the relationship between temperature and covid-19 may be different between the northern and southern hemispheres. The latter has a larger proportion of developing countries "with significant resource limitations in their healthcare systems" (p3). Furthermore, "many of the countries in the southern hemisphere, and on the African continent in particular, have a much higher incidence of pulmonary diseases such as tuberculosis, immunocompromising diseases such as HIV-AIDS, and a higher prevalence of diseases such as cholera and malaria, which may not be recognised as co-morbidity risks in covid-19 but do place coinciding stressors on the health system" (Smit et al 2020 p3). On the other hand, the arrival of covid-19 later in the southern hemisphere allowed time for preparation.

Smit et al (2020) found 42 peer-reviewed and 80 pre-print publications on environmental drivers of covid-19 (by mid-July 2020), of which "one published and potentially four pre-print studies that offer credible insight into the climate-related SARS-CoV-2 and covid-19 dynamics and epidemiology with a reasonable degree of confidence and rigour" (Smit et al 2020 p16). The problem was mostly lack of data at that point (eg: no full annual

cycle of covid-19), and so the studies did not "equitably address the specific dynamics and considerations pertaining to the 'Global South'" (Smit et al 2020 p17).

More widely, Smit et al (2020) noted that there were methodological issues like good metrics for viral transmission, the time period of data (eg: daily cases versus cases averaged over several days), and controls (eg: social distancing policies). There has been subsequent improvement here.

Smit et al (2020) felt that with "a highly infectious disease such as covid-19, manifesting in a densely populated location, the effect of daily weather variations on transmission mechanisms is likely to be overwhelmed by the sheer magnitude of exposure. It may be that environmental modulation is still an important factor in these circumstances, but may reflect in indoor environments rather than outdoor ambient conditions. Once the disease spread begins to approach an equilibrium..., the environmental effect may become more apparent" (p17).

Cohen et al (2020) admitted that they could not make a statistical inference about the relationship between covid-19 and the weather because of the limitations of publicly available covid-19 data. This was written in May 2020, but the points made are applicable now and to "other epidemiological datasets obtained with insufficient testing and monitoring, either during exceptional epidemics or seasonal outbreaks" (Cohen et al 2020 p2).

Firstly, there are many confounders, including government policy on small distancing etc, which influence the spread of the disease. Then there are issues related to the counting of covid-19 cases. Simplistically, the more tests for the disease performed, the more cases will be found. Furthermore, there is the accuracy of the tests used (figure 4.2). Too many false-negatives produces an underestimation of cases, while false-positives overestimate the number of cases.

Cohen et al (2020) pointed out that the relationship between covid-19 and weather is confounded by the weather's influence on the number of tests carried out. "For example, other respiratory diseases are often similar to covid-19 in their symptoms and are more common during cold weather, which could influence the number of tests performed on people displaying symptoms of respiratory infection. Therefore, even if the model correctly identified the impact of the weather on covid-19 case counts, it could not distinguish between the

		Test result	
		Has disease	Does not have disease
Reality	Has disease	TRUE POSITIVE	FALSE NEGATIVE
	Does not have disease	FALSE POSITIVE	TRUE NEGATIVE

Figure 4.2 - Accuracy of tests.

impact of the weather on the spread of the disease and its impact on testing" (Cohen et al 2020 p4).

Other respiratory diseases increase the possibility of false-positives in covid-19 tests, while "[A]t risk individuals suffering from unrelated conditions are more likely to be tested for covid-19, even if they only have mild symptoms for covid-19" (Cohen et al 2020 p5). Medical help-seeking is also influenced by weather (Cohen et al 2020).

4.4. VACCINE HESITANCY

Concerns about a greater impact of covid-19 on ethnic minorities in the UK, for instance, is heightened by greater vaccine hesitancy among such groups (Woodhead et al 2021).

"Hesitancy is a 'delay in acceptance or refusal of vaccination despite the availability of vaccination services' (MacDonald 2015), occurring on a continuum from acceptance with no doubts to refusal with no doubts, with vaccine-hesitant individuals existing between these two stances" (Woodhead et al 2021 p2).

Woodhead et al (2021) investigated covid-19 vaccine hesitancy among healthcare staff in the UK, with particular focus on ethnic minorities staff. The data were collected between October 2020 and January 2021 as part of the Tackling Inequalities and Discrimination Experiences in health Services (TIDES) study. Twenty-five volunteers were interviewed at length, of which two-thirds identified as a racial or ethnic minority group.

Just over half of respondents were "vaccine acceptors" (already vaccinated or would be as soon as available), around one-third were hesitant, and the remainder definite decliners.

Concentrating on the reasons for acceptance, hesitation or refusal, a number of themes emerged. These can be summarised as "decliners focused on perceived risk (fear of harm to self) and less on benefits to self and others. In contrast, hesitants described both fears of harm (particularly unknown long-term effects) as well as benefits to self and others, equally. Accepters also described fears but primarily in relation to what they had heard other's say; instead, they most commonly focused on vaccination benefits" (Woodhead et al 2021 p7).

Themes:

1. Fear of harm - eg: immediate or long-term side-effects. Three sub-themes were found:

a) Trust in the vaccine - This was related to the speed of vaccine creation, as summed up by one hesitant Black Caribbean healthcare staff respondent: "A vaccination that should have taken 10-20 years to develop and test properly has been produced in a matter of months. And, um... so it hasn't been - it hasn't been tested and it hasn't been scrutinised the way it should have been" (p7).

There was also mistrust, for some respondents, in government and pharmaceutical companies - eg: "If you look at things historically, Black and Asian communities have been misused in research [...] we have been abused and violated in previous vaccination trials and we can't deny that" (Asian; decliner; management; p8).

b) Personal vulnerability and risk - Particularly among decliners, worries about the effect of the vaccine on underlying health conditions were voiced.

c) Precedence and past experience - eg: reference to past "medical scandals", like Thalidomide.

2. Moral, ethical or religious objections - Woodhead et al (2021) explained: "hesitants and accepters were fairly evenly split across those who did or did not identify themselves as being religious though decliners did identify as religious. However, there were no clear patterns when examining reasons for hesitancy or refusal

and decliners did not cite religious or ethical objections as affecting personal decision-making" (p9).

3. Potential benefits to self and others - A White healthcare staff member who wanted the vaccine summed up the view of protecting yourself to protect others: "It's not all about me, I may be a healthy person but obviously all the vulnerable people, so we might be carrying something that is deadly for them. Who knows, it might be deadly for my kids. Me protecting myself is not just about protecting myself, it's about whoever surrounds me as well" (p10).

Related to this there was a desire to get back to normal life, as described by another White healthcare staff member who was an acceptor: "We have to go back to normal. We have to start visiting our families again, and it's for our patients as well. And then you need like, for it to work you need a percentage of the population to be getting the vaccine, otherwise it won't. It won't work" (p11).

4. Information and misinformation - "For hesitants and decliners, in particular, a lack of trustworthy information left a void into which doubt could be fuelled by media speculation and misinformation. There was mistrust that information could be manipulated to fit government or institutional agendas, alongside confusion about messaging" (Woodhead et al 2021 p11).

5. Workplace influences - Hesitant respondents, in particular, "talking mainly before or just at the start of vaccine roll-out - expressed worries about being 'forced' by employers to be vaccinated. This was reinforced by media speculation and workplace rumours about whether there would be sanctions from employers (e.g: job loss, redeployment from patient-facing roles) or government (eg: travel restrictions) if they declined. Mandating and being 'forced' was a worry because it would restrict autonomy in 'weighing up' their vaccination decision. Others pointed to the unfairness about being forced to take something with a perceived limited evidence-base" (Woodhead et al 2021 p12).

All the themes can be seen as part of a single overarching concern for all respondents of weighing up potential risks and benefits for themselves and others. This process was not static as described by a Black Caribbean manager who had the vaccine: "I was neutral for a long time on it and only last week, I made a decision

to have the vaccine and I've had it and um [...] I weighed up the evidence and come to that decision for myself. But as I say, it is a personal thing that people have to decide for themselves" (p6).

In terms of other research on vaccine hesitancy, MacDonald (2015) referred to the "World Health Organisation's Vaccine Hesitancy Determinants Matrix", which has three groups of factors:

i) Contextual influences - eg: historic, socio-cultural, and political factors. This is seen, for instance, in mistrust of government and health authorities by ethnic minority individuals. Woodhead et al (2021) found evidence of this.

ii) Individual and group influences - eg: personal perceptions of the vaccine; peer group. This was important in Woodhead et al's (2021) findings.

iii) Vaccine specific issues - "Reasons for hesitancy related specifically to vaccines or the vaccination process mainly pertained to suspicions about fast-tracking, pressure to be vaccinated, and perceived legitimacy of the evidence-based" (Woodhead et al 2021 p15).

Woodhead et al (2021) ended: "For healthcare staff, our findings indicate that approaches to encourage uptake (eg: promotional materials, engaging racial and ethnic minority staff groups to address specific concerns, and in-house vaccinations) may help increase trust through peer social norms and greater convenience. However, they are unlikely to be sufficient without acknowledging, validating and actively counteracting deep concerns linked to past and ongoing discrimination. Our study also indicates the centrality of personal decision-making; discriminating against hesitant staff will likely further alienate and intensify mistrust, undermining attempts to increase uptake" (p16).

4.5. MISCELLANEOUS RISK

(1) There is a concern that the transmission of SARS-CoV-2 from mother to baby may be different to the usual route of respiratory secretions (eg: in the womb; via breastmilk).

Lui, Wei et al (2021) reported a case study related

to breastfeeding. In February 2020 in China, "Patient A" was diagnosed with covid-19, and she was a 33 year-old mother who had been exclusively breastfeeding her newborn for three months. She was hospitalised, though asymptomatic. No evidence was found of "vertical transmission" (ie: from mother to baby via the breastmilk).

This was a single-person case study, and early in the pandemic. Thus, generalisability of findings is not possible. But detailed information was collected on this mother at a time when data were scarce.

(2) Hodcroft et al (2021) tracked a variant of SARS-CoV-2, 20E (or EU1), that emerged presumably in Spain in summer 2020. Genetic sequences of the virus were collected from around Europe to show the spread of the variant (and also outside of Europe). The variant accounted for the majority of sequences in autumn 2020 in Europe.

"The variant seems to have initially spread among agricultural workers in Aragon and Catalonia, then moved into the local population, where it was able to travel to the Valencia Region and on to the rest of the country" (Hodcroft et al 2021 p2). Its subsequent spread further afield appeared to not be due to the variant having increased transmissibility, but rather to human behaviour - namely, the resumption of travel and returning holiday-makers ³¹, and "lack of effective screening and containment" (Hodcroft et al 2021 p1).

4.6. MISCELLANEOUS CONTROL

(1) In the UK, four "pillars" of testing were used - swab tests to confirm infection among hospital patients and staff (1), and for individuals not in hospitals (2), while 3 and 4 involve anti-body tests. Pillar 3 tests to see who has had covid-19, and pillar 4 for research on the spread of the infection (Vaughan 2020b). Official data were sometimes unclear about the different pillars,

³¹ The risk of infection on an aeroplane depends on the presence of an infected individual on that flight. The ventilation system is effective in removing airborne pathogens, so face-to-face talking is the main risk. The rough estimates of risk of infection vary from 1 in 4000 to 40 000 depending on the number of passengers and the length of the flight (Le Page 2020b).

while pillar 1 did not distinguish between patients and staff (Sheila Bird in Vaughan 2020b). There is also no way of knowing the extent of double counting (Vaughan 2020b).

Accurate test data would allow information about local infection rates and so encourage high-risk groups to shield as necessary rather than permanently (George Davy Smith in Wilson 2020a) ³².

"Social bubbles" have been used during lockdowns, where meeting is limited to certain individuals indoors. This can be important for those living alone with a high risk of mental health problems (ie: "need rather than want" in a social bubble; Nicholas Long in Vaughan 2020c)

³³.

(2) Contact tracing is a strategy whereby individuals who have been in contact with an infected individual are informed of their risk and encouraged to self-isolate. It has been used with covid-19 in a number of countries including the UK, where a survey in April 2020 found that less than half of respondents were confident about protection of personal data with a government app (Duffy 2020 in Samuel et al 2021).

Samuel et al (2021) reported more in-depth interviews about the public perceptions of covid-19 contact tracing apps. Thirty-five adults in the UK were interviewed online or via telephone in April 2020 for up to one hour. At this time the NHS was developing a smartphone app to use.

Consequently, there was limited awareness about such apps, and so, for some of the interviewees, the understanding of "tracking" and "tracing" were confused - "interviewees constructed a picture of tracking, quite literally, as functioning at the individual level, in which they imagined an individual being able to 'see' or 'visualise' their every move. They spoke about being identified when they were 'in the middle of a field' or joked about being tracked in their houses, and during their shifts at work..." (Samuel et al 2021 p5).

Interviewee 16 summed up the ambivalence: "it's a whole double-edged sword, isn't it? On the one hand, yes, technology to try and contain something horrendous. Brilliant. On the other hand, how flipping Orwellian is that?" (p6).

³² "Despite the claims to the contrary, face coverings don't reduce the amount of oxygen in the blood or raise the level of carbon dioxide" (Wilson 2020b p11).

³³ Immunity to the suffering of covid-19 is a risk, particularly when individuals are unhappy about lockdowns and restrictions on movement (The Leader 2020a).

For some interviewees, "the use of an app was not considered as a discrete or independent endeavour, but for some, sat within their broader concerns about the prospect of surveillance in society more generally - which some interviewees had expressed that they have been fighting against for many years - while others associated contact tracing apps as a potential encroachment on liberties and freedoms. The app, in this sense, was used as a hook for their broader concerns about infringements of privacy" (Samuel et al 2021 p6). The fear of surveillance included private companies, like Facebook, as well as the government.

A digital tracing app is an example of public health technology development, and Samuel et al (2021) emphasised the importance of understanding attitudes towards such technology in a context. In this case, the context was surveillance, data protection, and general trust of the government. For example, Interviewee 31 said: "I'm very sceptical at the moment of anything that comes out of the NHS and the government, as to what it will be used for... We're leaving the EU (European Union), so our data sharing and data security standards will completely bomb because... we won't still continue to co-opt the European system, we will use the American system where security and sharing of data is far less robust" (p8).

Those supportive of the app referred to it as "a short-term measure, that it was for the 'common good'" (Samuel et al 2021 p7).

Samuel et al (2021) ended by pointing out "the need for a forward-looking, anticipatory strategy for public engagement as part of the responsible innovation of the covid-19 contact-tracing app in the UK" (p1).

(3) Many countries have closed schools during covid-19 lockdowns, and replaced them with online tuition. This is less satisfactory than the physical classroom. "Early data from online learning platforms suggest a drop in coursework completed and an increased dispersion of test scores. Survey evidence suggests that children spend considerably less time studying during lockdown, and some (but not all) studies report differences by home background" (Engzell et al 2021 p1).

Engzell et al (2021) used data from the Netherlands to quantify the "learning loss" of school closures. Biannual test scores (January and June) in core subjects (mathematics, spelling and reading) for 8-11 year-olds for 2017 to 2020 were analysed. Schools were closed for

eight weeks from early March 2020. Using standardised scoring, it was calculated that students lost an average three percentile points due to the school closure. This loss was higher for students from less-education homes (based on parental educational qualifications). "Possible explanations for a learning delay gap are related to parental involvement with education, socio-economic differences in information and communications technology (ICT) access and skills among students and the schools they attend, and parents' ability to help with homework during the school closures" (van de Werfhorst 2021 p1).

The analysis controlled for variables like social distancing on the day of the test, and the stress of returning to school, so it seemed that "differences in knowledge learned account for the majority of the drop in performance" (Engzell et al 2021 p3).

van de Werfhorst (2021) commented that control for number of days between tests was important, and noted that other sources of data on students were not used.

(4) Short pre-emptive lockdowns (eg: for two weeks) to control the virus's spread has been suggested as a strategy. Supporters argue that infection thresholds should be the trigger rather than setting dates in advance. Though sudden announcements make forward planning difficult for businesses (Wilson 2020d).

(5) The success of public health measures depends upon the general acceptance in a population, especially in the case of behaviour changes like social distancing and staying at home. Siegrist and Bearth (2021) reported a longitudinal study in the German-speaking part of Switzerland on trust, worldview, and risk perception on acceptance of such measures.

The same 1223 adults were surveyed in early April 2020 (wave 1) and late April 2020 (wave 2). From 16th March 2020 a number of policies had been introduced (eg: closure of schools, restaurants, and most shops).

Social trust was measured by items like, "The government intentionally exaggerates the hazards associated with the coronavirus" (scored on a seven-point scale), and general interpersonal trust by six items (eg: "Most people are basically honest"). Cultural worldview covers general beliefs and value orientations, and can be simplified into individualism or communitarianism. Items used here included, "The government should stop telling

people how to live their lives". Risk perception was measured by five items (eg: "I am afraid I will be infected"). The outcome measure was support for public health measures (eg: "In my view, it is justified that, in Switzerland, one is discouraged from leaving the home").

It was found that between waves 1 and 2 (a period of 2-4 weeks), there were "substantial differences" in responses to the same items - "The participants perceived fewer risks in survey wave 2 compared with survey wave 1... Social trust also significantly decreased..., and the conviction that the costs of covid-19 measures were too high increased between the two waves"... (Siegrist and Bearth 2021 p2).

Perception of risk was linked to worldview and general interpersonal trust. "The participants with more individualistic worldviews perceived fewer risks compared with those who had more communitarian worldviews. Furthermore, the participants who scored high in general interpersonal trust perceived fewer risks compared with those who scored low in this construct. Finally, the participants' objective risk influenced their risk perception. The participants who belonged to a risk group perceived more risks compared with those who did not belong to a risk group" (Siegrist and Bearth 2021 p2).

A clear pattern emerged for acceptance of public health measures - "The participants with individualistic worldviews, a low level of perceived risks, perceived high costs of covid-19 measures, and a high level of general interpersonal trust but a low level of social trust showed lower levels of acceptance of the implemented measures compared with the participants who had communitarian worldviews, a high level of perceived risks, perceived low costs of covid-19 measures, and a low level of general interpersonal trust but a high level of social trust" (Siegrist and Bearth 2021 p3). This pattern seems to follow common sense - less acceptance of public health controls if an individual does not perceive a risk, if they think the "cost" of the policies is too high, if they do not trust authorities, and value individual responsibility.

But high interpersonal trust and low acceptance seems strange. Siegrist and Bearth (2021) tried to explain this finding: "General interpersonal trust is an important enabler for interactions among people who do not know one another; therefore, a high level of general interpersonal trust is important for economic development because it facilitates cooperative behaviour among people. This very same feature makes it desirable to have

high levels of general interpersonal trust in a country, yet it acts as a barrier to the acceptance of the measures implemented in the case of covid-19. For people with a high level of general interpersonal trust, the idea that all people should primarily be perceived as posing health risks seems difficult to accept" (p4).

Three key evaluative points can be made about the methodology of the study:

a) The longitudinal method shows changes in responses to the same items. "This is by no means a proof of causality, but it undoubtedly provides stronger support for a causal mechanism when compared with cross-sectional data analyses" (Siegrist and Bearth 2021 p4). The time between the two data collections, however, was quite short.

b) Context - One part of one country at one particular time in the pandemic (ie: low familiarity with covid-19). The participants were recruited by a professional provider of consumer panels using quota sampling (ie: equal distribution of age and sex).

c) Variables not measured - eg: perceived controllability of infection risk.

5. MENTAL HEALTH

- 5.1. Mental disorders
- 5.2. Personality
- 5.3. Touch and hugging
- 5.4. Cash transfer programmes
- 5.5. Bereavement support
- 5.6. Miscellaneous
- 5.7. Appendix 5A - Rosenberg et al (2021)
- 5.8. Appendix 5B - Social support

5.1. MENTAL DISORDERS

In a nationwide cohort study in South Korea, Lee et al (2020) found that individuals with a severe mental disorder had a slightly higher risk of severe covid-19 than the general population.

The data came from the national health insurance claims database, and national covid-19 related registers. Adults over twenty years old who underwent a SARS-CoV-2 test between 1st January and 15th May 2020 were included (n = 216 418). The primary outcome measure was a positive test, and the secondary outcome was the severity of covid-19 symptoms.

From the test sample, 51 878 were identified with a mental disorder. Of these, 47 058 were matched with the same number of individuals with a test, but without a mental disorder diagnosis. There was no difference in the numbers in both groups who tested positive. Conclusion 1: "Diagnosis of a mental illness was not associated with increased likelihood of testing positive for SARS-CoV-2" (Lee et al 2020 p1025).

In total, 7160 individuals tested positive for SARS-CoV-2, of which 1443 were diagnosed with a mental disorder. Of these, 1320 individuals were matched with the same number of positive tests but no mental disorder diagnosis. The likelihood of severe covid-19 symptoms was higher in the mental disorders group (adjusted odds ratio of 1.27) and of death with covid-19 (adjusted odds ratio of 1.38). Conclusion 2: "Patients with a severe mental illness had a slightly higher risk for severe clinical outcomes of covid-19 than patients without a history of mental illness" (Lee et al 2020 p1025).

There was no information on psychotropic medications which might have affected the severity of covid-19. For example, benzodiazepines could increase the susceptibility to infection (Lee et al 2020).

Some confounders were not controlled for, like

obesity, cigarette smoking, and pre-existing cardiovascular and respiratory diseases, as well as socio-economic variables (Lee et al 2020).

The records on psychiatric diagnoses covered only the last 3.5 years (Lee et al 202).

Reacting to Conclusion 2, Park and Rhim (2021) pointed out an uncontrolled confounder of a rapid local outbreak of covid-19 in one city which led to a shortage of hospital beds. The authors stated: "More severe clinical outcomes of covid-19 are likely in settings where health-care facilities are overwhelmed" (Park and Rhim 2021 p270).

This city, Daegu, also has the highest prevalence of severe mental disorders in the country. Furthermore, two psychiatric hospitals in the city had clusters of covid-19 infections, but lacked the facilities to treat the virus. Also lockdowns were implemented to contain the virus, "thus delaying the transfer of patients to treatment facilities with adequate resources. Such delays might have contributed to the development of more severe clinical outcomes of covid-19 among these patients" (Park and Rhim 2021 p270).

In response to these points, Lee et al (2021) reanalysed their data by region and found no difference for Daegu compared to the national picture.

In reference to Conclusion 1, Hirakawa and Ishii (2021) raised an issue related to the definition of severe mental disorders. Lee et al (2020) used the ICD-10 categories of non-affective psychotic disorders, affective psychotic disorders, anxiety-related and stress-related disorders, alcohol and drug misuse, mood disorders without psychotic symptoms, eating disorders, and personality disorders. Hirakawa and Ishii (2021) explained that Lee et al (2020) "did not mention the exact proportions of these diagnoses for the analysis. We considered the differences in the proportions of psychiatric diagnoses might have affected the differing research findings, and we recommend that the authors mention the number of patients with each psychiatric diagnosis" (p271).

This is important because other research has found an association between pre-pandemic mental disorders and an increased likelihood of testing positive for covid-19, particularly for depression, anxiety, and substance misuse (eg: Yang et al 2020) (Hirakawa and Ishii 2021).

Lee et al (2021) responded by a re-analysis of the data based on specific pre-existing psychiatric

disorders. The risk of testing positive for covid-19 was only higher for alcohol and drug misuse, but was lower for anxiety and depression, and much lower for eating disorders.

Armitage (2021) reported a 4% increase in the prescribing of anti-depressants in England in the period April-September 2020, which was attributed as a consequence of covid-19.

Walker et al (2021) queried this work. They quoted their earlier work (Curtis et al 2019) that found an "ongoing upward trend" in prescribing over the previous five years. The pandemic period was an extension of this trend, and so "it is therefore highly misleading to attribute this increase to the pandemic" (Walker et al 2021 p278).

Walker et al (2021) also criticised Armitage (2021) for a lack of information about the different types of anti-depressants prescribed. "Are tricyclic anti-depressant drugs, which are more commonly used for pain, included or were all anti-depressant drugs included" (Walker et al 2021 p278)?

5.2. PERSONALITY

Proto and Zhang (2021) investigated the impact of covid-19 and lockdowns on mental health based on personality type.

The UK Household Longitudinal Study (UKLHS) dataset covering over 5000 adults was used, and it covered the period of the pandemic as well as one year before. Personality was based on the "Big Five" (Neuroticism (N), Openness to Experience (O), Extroversion (E), Agreeableness (A), Conscientiousness (C)) (table 5.1).

Mental health deterioration was worse among high Extroversion scorers, and especially high Openness scorers, and least by high Agreeableness scorers. High Neuroticism was expected to be linked to poor mental health, but this was not found.

High Openness scorers prefer exploration and new experiences, which were limited by lockdowns, while Extroverts are sociable, again limited during the pandemic. "Agreeableness reflects a tendency toward the maintenance of social stability, for this reason an individual with a more Agreeable personality can cope better in the constrained environment following the lockdown" (Proto and Zhang 2021 p13).

- I see myself as someone who:
 1. (A) Is sometimes rude to others (reverse-scored).
 2. (C) Does a thorough job.
 3. (E) Is talkative.
 4. (N) Worries a lot.
 5. (O) Is original, comes up with new ideas.
 6. (A) Has a forgiving nature.
 7. (C) Tends to be lazy (reverse-scored).
 8. (E) Is outgoing, sociable.
 9. (N) Gets nervous easily.
 10. (O) Values artistic, aesthetic experiences.

(Source: Proto and Zhang 2021)

Table 5.1 - Example of statements used to measure personality in the UKHLS.

5.3. TOUCH AND HUGGING

Field et al (2020) surveyed 260 US adults in 2020, of which over 60% reported feeling "touch deprived" and this was linked to anxiety and depression, for example. The majority of the respondents lived with another adult (67%) (table 5.2) ³⁴.

- Participants recruited via Facebook and Survey Monkey in April 2020 under the title "Covid-19 activities lockdown survey".
- Questionnaire included 87 items covering eleven scales measuring exercise, touch, contact with others, and stress, for example, and five outcome measures (eg: anxiety - "my worries overwhelm me").
- "Touch deprivation" was measured on a four-point scale: 0 (not at all), 1 (rarely), 2 (sometimes), and 3 (a lot), and the respondent numbers reported were 40%, 23%, 16% and 22% respectively. "Touch deprivation" was categorised as 0 and 1.
- The following significant correlations were found with "touch deprivation":
 - * Living alone
 - * Less exercise
 - * Less liking being home
 - * Less self-care
 - * Higher scores on anxiety, depression, fatigue, sleep disturbance, and PTSD (post-traumatic stress disorder) outcome measures.

Table 5.2 - Details of Field et al (2020).

³⁴ The sample was volunteers, who self-reported. Though the sample was "reputedly representative of Survey Monkey samples" (Field et al 2020 p10), 79% of respondents were female, 68% non-Hispanic White, and 8% "blue collar".

While Rosenberg et al (2021) found that, among over 1000 US adults, frequently hugging, kissing, and meeting others were associated with less depression, for instance (appendix 5A).

So do the benefits of hugging/human touch outweigh the covid-19 infection risks? Linsey Marr stated: "Because most hugs are just a brief encounter - and the short time is really key here - I think there are ways to lower the risks to what is, to me, an acceptable level, especially given the benefits of hugging" (quoted in Geddes 2020).

5.4. CASH TRANSFER PROGRAMMES

Bauer et al (2021) argued that young adults in low- and middle-income countries (LMICs) are experiencing negative consequences of covid-19 worse than peers in high-income countries because of "limited support from social and other government programmes" (p340). Such consequences do not end when the pandemic is no longer a problem. Bauer et al (2021) explained: "Evidence from past crises and economic shocks suggests that mental health and economic impacts endure well beyond the crisis period. For example, suicide rates can remain high for years after the crisis ends..." (p340).

LMICs have younger populations, and so "the effects of covid-19 could strongly influence countries' future economic growth. Thus, there are strong economic arguments for governments to support young people's economic circumstances and also their mental health" (Bauer et al 2021 p340). These authors favoured cash transfer programmes (CTPs), which are financial support schemes (sometimes linked to specific behaviours like attendance at college or school - known as conditionalities).

Bauer et al (2021) noted 559 social assistance programmes (CTPs in some form) in response to covid-19 in 168 countries. "Inevitably during crises, policymakers prioritise the most immediate concerns, such as providing food and medical care to those at risk of malnutrition and physical illness. Mental health is typically given lower priority, in part because it is perceived to have a less immediate effect on mortality (other than suicide). Even when policymakers are aware that poor mental health is more costly than most other major non-communicable diseases,³⁸ they might not invest in mental health" (Bauer et al 2021 p342).

Bauer et al (2021) made five recommendations for integrating mental health needs into CTPs:

i) Target CTPs at young adults at high risk of mental health problems.

ii) "Providing accurate, up-to-date, and non-stigmatising information about covid-19, as well as increasing mental health literacy and signposting to locally relevant community support and resources, is an important part of an effective mental health response" (Bauer et al 2021 p343). CTP staff can help here.

iii) Increase mental health services and access to them (ie: combine financial support and mental health treatment).

iv) Evaluate CTPs with reference to their mental health impact.

v) "Mental health impacts should be considered when making decisions about the amount, duration, and administration of CTPs. For example, irregular payments can lead to increased stress among youth, and longer duration of payments could reduce depression among young people" (Bauer et al 2021 p344).

Bauer et al (2021) concluded that CTPs based on their recommendations "could help support young people's future life chances and break the vicious cycle between mental illness and poverty that spirals many young people into both socio-economic and mental health disadvantage" (p340).

5.5. BEREAVEMENT SUPPORT

Harrop et al (2021) described the covid-19 pandemic as "a mass bereavement event". They stated: "Lack of access to, and physical contact with, loved ones at the time of death, restrictions surrounding funerals and the sudden nature of most covid-19 deaths have caused high levels of distress to those bereaved during the pandemic. Traumatic end-of-life and death experiences add to the complexity of grief, whilst limited access to usual support networks and severe societal disruption are also likely to increase risks of poor bereavement outcomes" (Harrop et al 2021 p4) (appendix 5B).

Bereavement support was the focus of these

researchers' survey which was completed by 711 adults bereaved in the UK in March-April 2020. It was an open web survey disseminated by social media, and via voluntary sector and bereavement support organisations. Bereavement of a family member or close friend since social distancing began (16th March 2020) was the key eligibility criterion ³⁵.

Most participants had not sought formal support for bereavement (around 50-60%), but of those who did, there were barriers like limited availability, not knowing how to access services, and discomfort about asking for help. Two quotes as examples of the responses. Firstly, a bereaved daughter said: "I feel awkward making a phone call to say that I am struggling, especially as a couple of months has passed since she died. I had hoped that time would settle things down (it has to an extent) and now it seems too late to seek help. No one offered/directed me to any support either so I wondered if not actually available?" (RID024; p14). While a bereaved grandson admitted: "I am reluctant to reach out to bereavement services because I feel uncomfortable about the idea of making myself vulnerable to a complete stranger" (RID071; p14).

Around 40% of respondents reported difficulties in getting informal support (ie: from friends and family). The open-ended responses produced three themes:

i) Difficulties connecting and communicating - eg: "I have not really sought support from family as they are affected too. We talk about Dad in a positive way, and joke about him as well. This helps. I would not 'seek support' from any friends - what would I ask them? No idea. I suppose what could happen would be getting a bit drunk together and getting a few things off my chest, but this isn't likely to happen in times of covid" (Bereaved son; RID340; p15).

ii) Disrupted grieving - The disruption of mourning rituals made the deaths seem "surreal" or "a constant prolonging of a goodbye". A bereaved son said: "Just not being able to hug and be in the same room. After funeral I would have liked to have been in a room with my mother's friends, my friends and family, sharing memories and stories, crying and laughing etc. For a while I thought I would still organise a wake after covid but now I think the moment has passed and that ritual will be

³⁵ The sample was convenience, which meant that it was not representative of the general population (eg: 89% of respondents female, 95% White, and 66% have at least a degree as highest educational qualification).

missing too" (RID723; p16).

iii) Lack of understanding and empathy -
"Participants perceived friends and family members as feeling awkward and uncomfortable talking about grief or the deceased person, changing the subject or implying that they should have 'moved on'. Many described receiving frequent calls in the first weeks of bereavement, but noted the decline as the months went on" (Harrop et al 2021 p17).

Younger participants whose peer groups were not used to parental loss was an added problem, while outright criticism on social media did not help. As a bereaved daughter described: "Other people don't want to keep hearing it and some people who believe covid is a hoax or conspiracy, it's heart-breaking to have to listen to that crap continuously. People look at you like you are lying if you say Mum died if covid. The ignorance out there is stifling sometimes" (RID 318; p17).

Harrop et al (2021) concluded: "People bereaved during the pandemic have high levels of support needs alongside difficulties accessing support. We recommend increased provision and tailoring of bereavement services, improved information on support options, and social/educational initiatives to bolster informal support and ameliorate isolation" (p2).

5.6. MISCELLANEOUS

In the United Arab Emirates (UAE), a policy of exclusion of individuals with mental illness from covid-19 vaccination existed, but this changed after demands from psychiatrists (Stip et al 2021).

Individuals with a recent diagnosis of a mental disorder in the USA have a death rate from covid-19 around twice that of individuals without a diagnosis (8.5 vs 4.7% of patients respectively) (Wang, Q et al 2021). "This fact alone is a major reason to actively prioritise vaccination of people with mental illness globally" (Stip et al 2021 p276).

5.7. APPENDIX 5A - ROSENBERG ET AL (2021)

The data came from a nationally representative online survey in the USA in April 2020 (the 2020 National Survey of Sexual and Reproductive Health) with 1010 18-94

year-olds.

The outcome variable of depression was measured by the 10-item (shortened version) Centre for Epidemiologic Studies-Depression (CES-D) scale (Andresen et al 1994), with a cut-off of ≥ 10 . Items include: "I was bothered by things that usually don't bother me", and "I felt fearful", and the response options were "Rarely/none of the time (<1 day)", "Some or a little of the time (1-2 days)", "Occasionally or a moderate amount of time (3-4 days)", and "All of the time (5-7 days)".

The other main outcome variable was loneliness measured by the UCLA 3-item Loneliness Scale (Hughes et al 2004), with a cut-off of ≥ 6 (range of 3-9). The items were: "I lack companionship", "I feel left out", and "I feel isolated from others". Each item scored as "I rarely ever feel this way" (1) to "I often feel this way" (3).

Eight social and sexual connection exposures in the last month were measured as "not at all", "once or a few times", "1-3 times a week", and "almost every day". For example, "in-person hug/kiss a family member", "visit a non-household friend or family member", "video chat with friend/family", "partnered sexual activities", and "sex over phone, video chat, or texting".

Overall, the prevalence of major depressive symptoms at 31.7% of respondents, which compared to 8% in US adults in 2013-16 (Rosenberg et al 2021). These individuals were more likely to be female, 20-29 years old, unmarried, the lowest income group, and living alone (compared to the no-depressive symptoms group). The depressed group had a significantly higher loneliness scale score (mean 5.5 vs 3.9 no-depressed group), and 23.8% of respondents had a score of ≥ 6 .

Very frequent in-person social and sexual connections ("almost every day") were associated with lower depression and loneliness prevalence, but no relationship was found for very frequency remote social and sexual connections.

There was a question over the applicability of the scales during lockdown. For example, "it is not yet known how these scales perform during times of social restrictions when daily lives have shifted so dramatically. It is possible that the wording of certain items (eg: "How often do you feel isolated from others?") may lose their discriminatory ability in times where isolation is essentially mandated" (Rosenberg et al 2021 p10).

5.8. APPENDIX 5B - SOCIAL SUPPORT

Low social support as seen in infrequent social contact and isolation has an effect on mortality, "comparable to or exceeds that of other well-established risk factors such as smoking, obesity, high blood pressure, and elevated cholesterol" (Chen et al 2021 p1). This has been established by many studies since observed in 1988 by House et al (1988).

This is receiving help, but what about giving social support as beneficial to health? Both mental and physical health are improved (eg: Qu et al 2020). "Giving to others is thought to be beneficial because it can lead to higher self-esteem, self-efficacy, and positive affect, activate neural pathways related to compassion, and reduce one's responses to stress" (Chen et al 2021 p1).

Chen et al (2021) investigated both giving and receiving social support together, and physical health. "Theories of equity postulate that there are norms of reciprocity in everyday social relationships and that an imbalance (receiving more than one gives or giving more than one receives) can leave individuals feeling distressed, guilty, or overburdened" (Chen et al 2021 pp1-2).

These researchers analysed data from 6325 US adults in the National Survey of Midlife Development in the United States (MIDUS). A questionnaire about social support was completed in 1995-6, and all-cause mortality data were collected until late 2018. The questionnaire included estimates of the number of hours per month of giving or receiving two types of support - instrumental (eg: unpaid childcare) and emotional (eg: listening to others) - involving individuals outside one's household. A disproportionate social support score was subsequently calculated with a minus number meaning more support received than given, and positive score vice versa.

By the end of the follow-up, 1286 individuals had died, and these were compared to the rest of the sample. Those who had died were more likely to have reported disproportionate instrumental support (either way) than balanced support. There was a similar relationship for emotional support (table 5.3). "All associations persisted net of demographic (age, gender, race, marital status, and education), medical (history of heart disease or cancer), and other psychological/behavioural (mental health problems or health practices) variables" (Chen et al 2021 p4).

	Giving > receiving	Receiving > giving
Instrumental	1.19	1.28
Emotional	1.16	1.14

Table 5.3 - Hazard ratios for all-cause mortality based on social support (where balanced giving and receiving = 1.00).

The findings were associations, and so other variables may explain causation. Social support was measured at one point in time, and was limited in scope. Concerning the latter point, Chen et al (2021) stated: "For example, assessing the support that others provide in combination with the conflict that arises in a relationship (ambivalent social relationships) may be important in future studies. Considering the breadth, size, or web of connections characterising one's social network might also be important for future work. In addition, people may not always realise when they are receiving help from others ('invisible social support'; Zee et al 2019), which may result in inaccurate estimates of support in... questionnaires" (p6).

The operationalisation of social support as number of hours per month was easy to calculate, but missed the quality of support. For example, with listening or telling others about problems (emotional support), quality matters more than quantity (Chen et al 2021).

6. CONSPIRACY THEORIES AND MISINFORMATION

Appendix 6A - Conspiracy socialisation

Social media is full of stories related to covid-19 of varying degrees of factual accuracy. There are anecdotes, speculations, wishful thinking, "rumours and gifts and scams", and "conspiratorial fantasy" (Shahsavari et al 2020) ³⁶.

Shahsavari et al (2020) drew a parallel with folklore: "stories such as those circulating on social media, however anecdotal, are not created from whole cloth, but rely on existing stories, story structures, and conceptual frameworks that inform the world view of individuals and their broader cultural groups. Taken together, these three features (a shared world view, a reservoir of existing stories, and a shared understanding of story structure) allow people to easily generate stories acceptable to their group, and to try to convince others to see the world as they do" (p2).

Five central processes were evident in the structure of conspiracy theories related to the covid-19 pandemic (Shahsavari et al 2020):

i) Attempts to incorporate it into already existing conspiracy theories (eg: Q-Anon).

ii) The appearance of new conspiracy theories (eg: 5G network as cause of the virus).

iii) The alignment of various ideas to form larger conspiracy theories (eg: Bill Gates, vaccines containing micro-chips, and global surveillance).

iv) New conspiracy theories that grow and develop from existing ones (eg: 5G network uses Chinese equipment and the virus as bio-weapon developed in Wuhan).

v) The interaction of conspiracy theories - eg: conspiracies about the "Jews" linking with covid-19 as a hoax).

Unlike past events, with the covid-19 pandemic,

³⁶ John Gregory (of "NewsGuard" that rates the trustworthiness of news and information sites) referred to 36 Facebook pages that were covid-19 misinformation "super-spreaders" in Europe with over thirteen million users in June 2020. Most of these sites had existed prior to covid-19, spreading conspiracy theories, but had repurposed. For example, the false claim of 5G network signals causing cancer became 5G linked to the pandemic (Lu 2020b).

Shahsavari et al (2020) explained, "a single unifying corpus of special or secret knowledge does not yet exist – there are no 'smoking guns' to which the conspiracy theorists can point. Consequently the social media space is crowded by a series of potentially explanatory conspiracy theories. In the various forums we considered, proponents of different narratives fight for attention, while also trying to align the disparate sets of actants and interactant relationships in a manner that allows for a single narrative framework to dominate and, by extension, to provide the 'winning' theorists with the bragging rights of having uncovered 'what is really going on'" (p16). Ultimately, the aim is a single explanatory framework (what Goertzel (1994) called "monological thinking").

Shahsavari et al (2020) collected data from "Reddit" and "4Chan" threads related to the pandemic in March-April 2020. Algorithms were used to model the narratives in the data (appendix 6A).

At the time of the study, four main competing theories related to covid-19 were vying for dominance - 5G network and China; accidental or deliberate bio-weapon (from China); covid-19 as hoax/not serious health risk; and Bill Gates and global surveillance.

Individuals share misinformation even when they do not agree with the underlying views. Pennycook et al (2021) tested three competing theories to explain the sharing of misinformation on social media:

- i) Confusion about what is true/untrue.
- ii) Partisanship (ie: information that fits with worldview or group allegiance) matters more than truth.
- iii) Inattention to accuracy of information.

Study 1 involved over 1000 US individuals recruited via Amazon Mechanical Turk, who were presented with thirty-six actual news stories (headline, lede (opening sentence), and image) from social media. Half the stories were true and half false, and half appealed to Democrat supporters and half to Republicans. Participants were asked to judge the accuracy of the story or whether they would share it online. In the accuracy condition, true stories were rated as so more often than false ones, and irrelevant of the political stance of the story. In the sharing condition, participants' willingness to share was based on political stance (ie: agreeing with their

worldview) more than accuracy. Pennycook et al (2021) commented that "the pattern of sharing intentions that we observe here matches the pattern of actual sharing observed in a large-scale analysis of Twitter users [Grinberg et al 2019], in which partisan alignment was found to be a much stronger predictor of sharing than veracity" (p591).

Take this false headline used by the researchers - "Over 500 'migrant caravaners' arrested with suicide vests". Of self-reported Republican supporters in this study, 16% rated the story as accurate, but over 50% said they would consider sharing it. So, the confusion-based explanation (i above) cannot explain the behaviour (Pennycook et al 2021).

The second explanation above is not, however, able to explain sharing behaviour either because Study 2 (an online survey) found that accuracy was most important among sharers (compared to surprising, politically aligned, funny, or interesting).

Pennycook et al (2021) favoured the attention-based explanation (iii above). In five more similar online studies they found that when participants were primed to think of accuracy, the sharing of false information declined. The researchers suggested that "when deciding what to share on social media, people are often distracted from considering the accuracy of the content. Therefore, shifting attention to the concept of accuracy can cause people to improve the quality of the news that they share" (Pennycook et al 2021 p594).

They continued that "the current design of social media platforms - in which users scroll quickly through a mixture of serious news and emotionally engaging content, and receive instantaneous quantified social feedback on their sharing-may discourage people from reflecting on accuracy" (Pennycook et al 2021 p594).

Wong (2020) noted the sudden appearance of "science-based" "corona diets" in mid-2020 that claimed to shield against covid-19 (by boosting the immune system). Writing in June 2020, he observed wryly: "Covid-19 is such a new disease that there is very little research in this area. Most of the tiny handful of studies that have been done to date are just weeks old and haven't been peer-reviewed. It is impressive, then, that fully illustrated cookery books with hundreds of recipes could have been developed based on scientific evidence, despite being published at the same time" (Wong 2020 p23). The reality is "boring" - "Following any healthy diet... will support immune function. Not much of a book in that though" (Wong

APPENDIX 6A - CONSPIRACY SOCIALISATION

The Internet allows for online conspiracy communities that "bring together multiple heterogeneous groups of individuals with different background beliefs and motivations, sharing similar epistemological concerns. Once joined, conspiracy community users may radicalise, increasingly engaging with conspiracy and neglecting other communities" (Phadke et al 2021 pp223.1-2).

Phadke et al (2021) investigated the social factors involved in joining such online groups using a socio-constructionist approach that "meanings are developed in co-ordination with others rather than separately within each individual and consider online conspiracy discussions as a shared pursuit by a collection of individuals towards making sense of the reality around them" (p223.2).

The researchers identified 56 conspiracy communities ("sub-reddits") on the social network, "Reddit", and mapped six factors to predict who would contribute on these sites ("future conspiracist"; FC). These individuals were compared to current contributors ("current conspiracist"; CC) and individuals contributing to non-conspiracy Reddit threads ("non-conspiracist"; NC).

The six social factors, based on Sunstein and Vermeule (2009), were:

i) Availability of conspiracists - Reddit makes conspiracy content available to FCs.

ii) Information pressure - The pressure of information through social interactions between CCs and FCs.

iii) Reputational pressure - "When users interact with conspiracists, the reputation of conspiracists can also exert additional pressure to join the conspiratorial belief system. Due to the reputational pressure, people often ignore their own beliefs to avoid social sanctions" (Phadke et al 2021 p223.16).

iv) Emotion snowballing - Personal emotional accounts from CCs influence the emotions of FCs.

v) Group polarisation - The shared identity of the community strengthens and polarises the beliefs of all members.

vi) Self-selection - Certain individuals become involved in this "socialisation process" for FCs. Sunstein and Vermeule (2009) talked of "crippled epistemologies" to describe individuals' willingness to listen to limited informational sources and/or trust certain sources over others. "The tendency to adhere to epistemologically isolated information sources increases the likelihood to accept conspiracy theories. On Reddit, users can exhibit crippled epistemologies by refraining from participating in diverse communities, participating in communities that might foster a conspiratorial worldview, and contributing content similar to the conspiratorial themes" (Phadke et al 2021 p223.15).

The researchers also considered two key factors from previous research - anxiety, and negative sentiments.

In total, six million Reddit posts were analysed covering over 60 000 CCs, and 30 000 FCs and 30 000 NCs.

FCs expressed more anxiety and negative sentiments in their posts.

FCs and CCs interacted a lot based on post exchanges (factors i-iii above), and the negative emotional states mirrored each (factor iv above). Group polarisation was operationalised as the use of two-person pronouns in posts (eg: "we"; "us"), which FCs and CCs showed more than NCs (factor v above). FCs were less likely to seek alternative information than NCs based on membership of sub-reddit groups (factor vi above).

All the social factors significantly predicted joining conspiracy communities, both individually and together.

The researchers then fitted the "socialisation process" with Buss's (1987) three mechanisms of individual integration into the group:

a) Selection - Certain individuals decide to participate in certain groups. This was shown by the initial comments of FCs being similar to those of the communities they later joined. In other words, the individuals already had some belief (or at least openness) to the conspiracy.

b) Evocation - Emotional connections within the group. The affective state, particularly negative, of FCs was mirrored by CCs and vice versa.

c) Manipulation - How current members influence new members to conform. The interactions between CCs and FCs were crucial "to understand how conspiracy communities self-sustain and thrive" (Phadke et al 2021 p223.23).

The findings of Phadke et al (2021) confirmed the idea of social media as "echo chambers" (Bessi et al 2015) - ie: "future conspiracists live in an information bubble. In fact, not only do they contribute content similar to conspiracy discussions, they also engage disproportionately in sub-reddits similar to those in the conspiracy communities" (Phadke et al 2021 p223.24).

Another finding was that FCs were marginalised by non-conspiracy sub-reddits (ie: receiving negative feedback to their comments). This fits with the self-selection factor. Phadke et al (2021) explained: "A two-fold process can then explain joining conspiracy communities. First, social sanctions make users feel like outsiders in mainstream sub-reddits. Such socially outcast users then find home in the conspiracy communities for their rejected thoughts" (p223.24).

Altogether, the social factors described above show how individuals become FCs, and it is the same as how individuals become involved in any "deviant" group. Initially, they are attracted to such a group/idea, and social interactions draw them in. Within the group, they take on its identity and their views become more polarised.

7. REFERENCES

Allen, T et al (2017) Global hotspots and correlates of emerging zoonotic diseases Nature Communications 8, 1124

Almuzaini, T et al (2013) Sub-standard and counterfeit medicines: A systematic review of the literature BMJ Open 3, 8, e002923

Andrade, P.H.S et al (2020) Challenges to the consolidation of pharmacovigilance practices in Brazil: Limitations of the hospital pharmacist Therapeutic Advances in Drug Safety 11, 2042098620933248

Andresen, E.M et al (1994) Screening for depression in well older adults: Evaluation of a short form of the CES-D American Journal of Preventive Medicine 10, 2, 77-84

Armitage, R (2021) Anti-depressants, primary care, and adult mental health services in England during covid-19 Lancet Psychiatry 8, e3

Ayoubkhani, D et al (2021) Post-covid syndrome in individuals admitted to hospital with covid-19: Retrospective cohort study BMJ 372: n693

Baden, L.R et al (2021) Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine New England Journal of Medicine 384, 403-416

Bauer, A et al (2021) Integrating youth mental health into cash transfer programmes in response to the covid-19 crisis in low-income and middle-income countries Lancet Psychiatry 8, 340-346

Bessi, A et al (2015) Science versus conspiracy: Collective narratives in the age of misinformation PLoS ONE 10, 2, e0118093 (Freely available at <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118093>)

Bhargava, A & Shewade, H.D (2020) The potential impact of the covid-19 response related lockdown on TB incidence and mortality in India Indian Journal of Tuberculosis 67, 4, S139-S146

Bhowmick, N (2020) Pandemic is leading to more TB deaths in India New Scientist 24th October, p9

Bloom, J.D et al (2021) Investigating the origins of covid-19 Science 372, p694

Brody, H (2019) Editorial Nature 573, Outlook Supplement: Influenza, pS3

Buss, D.M (1987) Selection, evocation and manipulation Journal of Personality and Social Psychology 53, 6, 1214-1221

Chen, E et al (2021) The balance of giving versus receiving social support and all-cause mortality in a US national sample Proceedings of the National Academy of Sciences, USA 118, 24, e2024770118

Cheng, V.C.C et al (2007) Severe acute respiratory syndrome coronavirus as an agent of emerging and re-emerging infection Clinical Microbiology Reviews 20, 4, 660-694

Cohen, F et al (2020) The challenge of using epidemiological case count data: The example of confirmed covid-19 cases and the weather medRxiv
(<https://www.medrxiv.org/content/10.1101/2020.05.21.20108803v1>)

Curtis, H.J et al (2019) Opioid prescribing trends and geographical variation in England, 1998-2018: A retrospective database study Lancet Psychiatry 6, 140-150

Daemmrich, A (2004) Pharmacopolitics: Drug Regulation in the United States and Germany Chapel Hill, NC: University of North Carolina Press

Dennis, A et al (2020) Multi-organ impairment in low-risk individuals with long covid medRxiv
(<https://www.medrxiv.org/content/10.1101/2020.10.14.20212555v1>)

Diagne, C (2021) High and rising economic costs of biological invasions worldwide Nature 592, 571-576

Donnelly, J.P et al (2021) Readmission and death after initial hospital discharge among patients with covid-19 in a large multi-hospital system JAMA 325, 304-306

Dua, A (2020) The wrong question New Scientist 12th September, p23

Editorial (2021) Digital psychiatry: Moving past potential Lancet Psychiatry 8, p259

Editors (2019) End vaccine exemptions Scientific American November, p6

Eisenstein, M (2019) A shot for all seasons Nature 573, Outlook Supplement: Influenza, S4-6

Engzell, P et al (2021) Learning loss due to school closures during the covid-19 pandemic Proceedings of the National Academy of Sciences, USA 118, 17, e2022376118

Ferreira, M.N et al (2021) Drivers and causes of zoonotic diseases: An overview PARKS: The International Journal of Protected Areas and Conservation 27, March (special issue), 15-24

Field, T et al (2020) Touch deprivation and exercise during the covid-19 lockdown April 2020 Medical Research Archives 8, 8, August

Gardner, B (2021) Covid strain first detected in India to be named Delta The Daily Telegraph 1st June, p4

Geddes, L (2020) Is it ever safe to hug someone? New Scientist 8th August, p11

Georgieva, K et al (2021) Two-track pandemic is holding us all back The Daily Telegraph 1st June, p16

Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

Goertzel, T (1994) Belief in conspiracy theories Political Psychology 15, 4, 731-742

Gomes, M.G.M et al (2020) Individual variation in susceptibility or exposure to SARS-CoV-2 lowers the herd immunity threshold medRxiv
(<https://www.medrxiv.org/content/10.1101/2020.04.27.20081893v3>)

Greinacher, A et al (2021) A prothrombotic thrombocytopenic disorder resembling heparin-induced thrombocytopenia following coronavirus-19 vaccination Research Square
(<https://www.researchsquare.com/article/rs-362354/v2>)

Grinberg, N et al (2019) Fake news on Twitter during the 2011 US Presidential election Science 363, 374-378

Hanage, W.P & Russell, C.A (2021) Partial immunity and SARS-CoV-2 mutations Science 372, p354

Hamzelou, J (2020a) Can herd immunity ever happen? New Scientist 22nd August, 10-11

Hamzelou, J (2020b) How worried should we be about reports of reinfection? New Scientist 19th September, 14-15

Harrop, E et al (2021) Support needs and barriers to accessing support: Baseline results of a mixed-methods national survey of people bereaved during the covid-19 pandemic medRxiv
(<https://www.medrxiv.org/content/10.1101/2021.06.11.21258575v1>)

Hirakawa, H & Ishii, N (2021) Association between mental illness and covid-19 in South Korea Lancet Psychiatry 8, 270-271

Hodcroft, E.B et al (2021) Spread of a SARS-CoV-2 variant through Europe in the summer of 2020 Nature
(<https://www.nature.com/articles/s41586-021-03677-y>)

House, J.S et al (1988) Social relationships and health Science 241, 540-545

Huang, C et al (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China Lancet 395, 497-506

Hughes, M.E et al (2004) A short scale for measuring loneliness in large surveys: Results from two population-based studies Research in Aging 26, 6, 655-672

Hymas, O et al (2021) There's nothing new under the sun - lessons conservationists could learn from previous pandemics PARKS: The International Journal of Protected Areas and Conservation 27, March (special issue), 25-40

Jarhult, J.D (with Lubick, N) (2019) Resistance in the world Nature 573, Outlook Supplement: Influenza, pS7

Jarhult, J.D et al (2011) Environmental levels of the anti-viral oseltamivir induce development of resistant mutation H274Y in influenza A/H1N1 virus in mallards PLoS ONE 6, e24742 (Freely available at

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0024742>)

Johnson, C.K et al (2020) Global shifts in mammalian population trends reveal key predictors of virus spillover risk Proceedings of the Royal Society B 287, 20192736

Jones, D (2020) The problem with risk New Scientist 24th October, 40-45

Kifer, D et al (2021) Effects of environmental factors on severity and mortality of covid-19 Frontiers in Medicine 7, January, article 607786

Keesing, F & Ostfeld, R.S (2021) Impacts of biodiversity and biodiversity loss on zoonotic diseases Proceedings of the National Academy of Sciences, USA 118, 17, e2023540118

Krammer, F et al (2021) Anti-body responses to sero-positive persons after a single dose of SARS-CoV-2 mRNA vaccine New England Journal of Medicine
(<https://www.nejm.org/doi/full/10.1056/NEJMc2101667>)

Lawton, G (2020a) Could co-infection cause coronavirus to evolve? New Scientist 12th September, 10-11

Lawton, G (2020b) Family tree of a deadly virus New Scientist 19th September, p13

Lawton, G (2020c) Still no evidence the coronavirus was made in a lab New Scientist 26th September, p10

Lawton, G (2020d) The evolving coronavirus New Scientist 24th October, 10-11

Lawton, G (2020e) Absurd about the herd New Scientist 24th October, p23

Lawton, G (2020f) The great viral team-up New Scientist 24th October, 34-38

Lawton, G (2021) US won't delay second dose New Scientist 20th March, 8-9

Lee, S.W et al (2020) Association between mental illness and covid-19 susceptibility and clinical outcomes in South Korea: A nationwide cohort study Lancet Psychiatry 7, 1025-1031

Ledford, H (2021) Covid vaccines and blood clots: Five key questions Nature 592, 495-496

Lee, S.W et al (2021) Association between mental illness and covid-19 in South Korea; A post-hoc analysis Lancet Psychiatry 8, 271-272

Le Page, M (2020a) The rush to develop a vaccine New Scientist 29th August, 8-10

Le Page, M (2020b) How likely are you to catch coronavirus on a Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

plane? New Scientist 29th August, p11

Le Page, M (2020c) Virus probably didn't take hold in the US and Europe last December New Scientist 26th September, p10

Le Page, M (2021) Global cases on the rise again New Scientist 20th March, p10

Liu, D et al (2020) The pulmonary sequelae in discharged patients with covid-19: A short-term observational study Respiratory Research 21, article no. 125

Liu, Wei et al (2021) A case study supporting lack of SARS-CoV-2 spread to a three-month old infant through exclusive breastfeeding Journal of Human Lactation 37, 2, 269-272

Liverpool, L (2021) Blood clot controversy New Scientist 20th March, p7

Lu, D (2020a) Huge surge in UK cases New Scientist 12th September, p7

Lu, D (2020b) Scams, lies and online hate New Scientist 13th June, p14

MacDonald, N.E (2015) Vaccine hesitancy: Definition, scope and determinants Vaccine 33, 34, 4161-4164

Mackenzie, D (2020) pandemic warnings New Scientist 19th September, 46-49

Maidstone, R et al (2021) Shift work is associated with positive covid-19 status in hospital patients Thorax (<https://thorax.bmj.com/content/early/2021/03/30/thoraxjnl-2020-216651>)

Margalida, A et al (2021) Ban veterinary use of diclofenac in Europe Science 372, 694-695

McCarthy, C.P et al (2020) Early clinical and socio-demographic experience with patients hospitalised with covid-19 at a large American healthcare system EClinicalMedicine 26, 100504

McQuaid, C.F et al (2020) The potential impact of covid-19-related disruption on tuberculosis burden European Respiratory Journal 56, 2, 2001718

Mitchell, B.A & Phillips, A (2021) A global tragedy in search of answers: Editors' introduction PARKS: The International Journal of Protected Areas and Conservation 27, March (special issue), 7-12

Montagutelli, X et al (2021) The B.1.351 and P.1 variants extend SARS-CoV-2 host range to mice bioRxiv (<https://www.biorxiv.org/content/10.1101/2021.03.18.436013v1>)

Moore, J.P & Offit, P.A (2021) SARS-CoV-2 vaccines and the growing threat of viral variants JAMA 325, 821-822

Morens, D.M et al (2020a) The origin of covid-19 and why it
Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

matters American Journal of Tropical Medicine and Hygiene 103, 3, 955-959

Morens, D.M et al (2020b) Pandemic covid-19 joins history's pandemic legion mBio 11, 3, e00812-20

Nuismer, S & Bull, J (2020) How to stop pandemics New Scientist 22nd August, p23

Ostfeld, R.S & Keesing, S (2000) Biodiversity series: The function of biodiversity in the ecology of vector-borne zoonotic diseases Canadian Journal of Zoology 78, 2061-2078

Park, J & Rhim, H.C (2021) Association between mental illness and covid-19 in South Korea Lancet Psychiatry 8, p270

Pekar, J et al (2021) Timing the SARS-CoV-2 index case in Hubei province Science 372, 412-417

Pennycook, G et al (2021) Shifting attention to accuracy can reduce misinformation online Nature 592, 590-595

Phadke, S et al (2021) What makes people join conspiracy communities? Role of social factors in conspiracy engagement_ Proceedings of the ACM Human-Computer Interactions 4, CSCW3, article 223

Polack, F.P et al (2020) Safety and efficacy of the BNT162b2 mRNA covid-19 vaccine New England Journal of Medicine 383, 2603-2615

Proto, E & Zhang, A (2021) Covid-19 and mental health of individuals with different personalities medRxiv (<https://www.medrxiv.org/content/10.1101/2021.05.24.21257581v1>)

Puntmann, V.O et al (2020) Outcomes of cardiovascular magnetic resonance imaging in patients recently recovered from coronavirus disease 2019 (covid-19) JAMA Cardiology 5, 1265-1273

Qi, H et al (2020) Covid-19 transmission in mainland China is associated with temperature and humidity: A time-series analysis Science of the Total Environment 728, 138778

Qu, H et al (2020) Which type of giving are associated with reduced mortality risk among older adults Personality and Individual Differences 154, 109668

Ravinetto, R et al (2016) Fighting poor-quality medicines in low- and middle-income countries: The importance of advocacy and pedagogy Journal of Pharmaceutical Policy and Practice 9, 36

Roberts, L (2021) How covid hurt the fight against other deadly diseases Nature 592, 502-504

Roberts, L & Clark, A (2021) Only one young person in a full Wembley Stadium would get blood clot from jab The Daily Telegraph 9th April, p9

Romero-Brufau, S et al (2021) Public health impact of delaying second dose BNT162b2 or mRNA-1273 covid-19 vaccine: Simulation agent Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

based modelling study BMJ 373, n1087

Rosenberg, M et al (2021) Depression and loneliness during covid-19 restrictions in the United States, and their associations with frequency of social and sexual connections Social Psychiatry and Psychiatric Epidemiology
(<https://link.springer.com/article/10.1007%2Fs00127-020-02002-8>)

Saad-Roy, C.M et al (2021a) Epidemiological and evolutionary considerations of SARS-CoV-2 vaccine dosing regimes Science 372, 363-370 & eabg8663

Saad-Roy, C.M et al (2021b) Response Science 372, 354-355

Samuel, G et al (2021) Covid-19 contact tracing apps: UK public perceptions Critical Public Health
(<https://www.tandfonline.com/doi/full/10.1080/09581596.2021.1909707>)

Sandberg, A & Moyhian, T (2020) Hiroshima's lesson New Scientist 8th August, 21-23

Savage, N (2019) A bigger arsenal Nature 573, Outlook Supplement: Influenza, S8-9

Schmidt, C (2019) The social forecast Nature 573, Outlook Supplement: Influenza, S12-13

Shahsavari, S et al (2020) Conspiracy in the time of corona: Automatic detection of covid-19 conspiracy theories in social media and the news ArXiv (<https://arxiv.org/abs/2004.13783>)

Sherwood, O et al (2021) The impact of covid vaccination on symptoms of long covid. An international survey of 900 people with lived experience, May (<https://www.pslhub.org/learn/coronavirus-covid19/data-and-statistics/the-impact-of-covid-vaccination-on-symptoms-of-long-covid-an-international-survey-of-900-people-with-lived-experience-may-2021-r4636/>)

Siegrist, M & Bearth, A (2021) Worldviews, trust, and risk perceptions shape public acceptance of covid-19 public health measures Proceedings of the National Academy of Sciences, USA 118, 24, e2100411118

Smit, A.J et al (2020) Winter is coming: A southern hemisphere perspective of the environmental drivers of SARS-CoV-2 and the potential seasonality of covid-19 International Journal of Environmental Research and Public Health 17, 5634

Smyth, C et al (2021) Race to stop Indian strain Times 14th May, 1-2

Spinney, L (2021) Rich countries ignore covid's global surge at their peril Guardian 27th April, Opinion p3

Sridhar, D (2021) Caution now is key to avoiding a third wave Guardian 18th May, Opinion p4

Stip, E et al (2021) People with mental illness should be included in covid-19 vaccination Lancet Psychiatry 8, 275-276

Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

Sunstein, C.R & Vermeule, A (2009) Conspiracy theories: Causes and cures Journal of Political Philosophy 17, 2, 202-227

Svoboda, E (2019) A sticking point for rapid flu tests? Nature 573, Outlook Supplement: Influenza, S10-11

Taylor, L (2020) The pandemic's new centre New Scientist 13th June, 12-13

The Leader (2020a) A heavy toll New Scientist 19th September, p5

The Leader (2020b) Now is not the time New Scientist 24th October, p5

Thorne, L.G et al (2021) Evolution of enhanced innate immune evasion by the SARS-CoV-2 B.1.1.7 UK variant bioRxiv (<https://www.biorxiv.org/content/10.1101/2021.06.06.446826v1>)

Tkachenko, A.V et al (2021) Time-dependent heterogeneity leads to transient suppression of the covid-19 epidemic, not herd immunity Proceedings of the National Academy of Sciences, USA 118, 17, e2015972118

van de Wefhorst, H.G (2021) Inequality in learning is a major concern after school closures Proceedings of the National Academy of Sciences, USA 118, 20, e2015243118

van der Gronde, T et al (2017) Addressing the challenge of high-priced prescription drugs in the era of precision medicine: A systematic review of drug life cycles, therapeutic drug markets and regulatory frameworks PLoS ONE 12, 8, e0182613 (Freely available at <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0182613>)

Vaughan, A (2020a) What winter holds for covid-19 New Scientist 12th September, 8-10

Vaughan, A (2020b) Testing confusion New Scientist 13th June, p9

Vaughan, A (2020c) Social "bubbles" unlikely to be allowed in UK soon New Scientist 13th June, p9

Vaughan, A (2020d) Getting less deadly? New Scientist 29th August, p7

Vaughan, A (2020e) One million global deaths New Scientist 19th September, 10-12

Voysey, M et al (2021) Safety and efficacy of the ChAdOx1 nCov-19 vaccine (AZD1222) against SARS-CoV-2: An interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK Lancet 397, 99-111

Wace, C (2021) Bolton faces long wait for freedom as cases spiral Times 14th May, p5

Waithaka, J et al (2021) Impacts of covid-19 on protected and Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

conserved areas: A global overview and regional perspectives PARKS: The International Journal of Protected Areas and Conservation 27, March (special issue), 41-56

Walker, A.J et al (2021) Trends in anti-depressant prescribing in England Lancet Psychiatry 8, 278-279

Walters, G et al (2021) Covid-19, Indigenous peoples, local communities and natural resource governance PARKS: The International Journal of Protected Areas and Conservation 27, March (special issue), 57-72

Wang, Q et al (2021) Increased risk of covid-19 infection and mortality in people with mental disorders: Analysing from electronic health records in the United States World Psychiatry 20, 324-330

Wang, Z et al (2021) mRNA vaccine-elicited anti-bodies to SARS-CoV-2 and circulating variants Nature 592, 616-622

Ward, M.P et al (2020) The role of climate during the covid-19 epidemic in New South Wales, Australia Transboundary and Emerging Diseases 67, 2313-2317

Webb, R (2020) Sadistic cladistics New Scientist 26th September, p49

Williamson, E.J et al (2020) Factors associated with covid-19-related death using OpenSAFELY Nature 584, 430-436

Wilson, C (2020a) Is it safe for everyone to go outside? New Scientist 13th June, 10-11

Wilson, C (2020b) Why some people cannot wear a face covering New Scientist 29th August, p11

Wilson, C (2020c) What can we expect for the future of the pandemic New Scientist 19th September, 14-15

Wilson, C (2020d) Lockdown again and again? New Scientist 24th October, p8

Wilson, C (2021) One dose of vaccine may be enough for some New Scientist 20th March, p9

Wong, J (2020) Beware the corona diet New Scientist 13th June, p23

Woodhead, C et al (2021) Race, ethnicity and covid-19 vaccination: A qualitative study of UK healthcare staff Ethnicity and Health (<https://www.tandfonline.com/doi/full/10.1080/13557858.2021.1936464>)

Woolhouse, M.E.J & Gowtage-Sequeria, S (2005) Host range and emerging and re-emerging pathogens Emerging Infectious Diseases 11, 1842-1847

Xie, Y et al (2020) Comparative evaluation of clinical manifestations and risk of death in patients admitted to hospital with covid-19 and seasonal influenza: Cohort study BMJ 371: m4677

Psychology Miscellany No.150; July 2021; ISSN: 1754-2200; Kevin Brewer

Yan, L-M et al (2020) Unusual features of the SARS-Cov-2 genome suggesting sophisticated laboratory modification rather than natural evolution and delineation of its probable synthetic route (<https://zenodo.org/record/4028830>)

Yang, F et al (2021) Shared B cell memory to coronaviruses and other pathogens varies in human age groups and tissues Science 372, 738-741

Yang, H et al (2020) Pre-pandemic psychiatric disorders and risk of covid-19: A UK Biobank cohort analysis Lancet Healthy Longevity 1, e69-e79

Zee, K.S & Bolger, N (2019) Visible and invisible social support: How, why and when Current Directions in Psychological Science 28, 314-320

Zhu, N et al (2020) A novel coronavirus from patients with pneumonia in China, 2019 New England Journal of Medicine 382, 727-733