

COVID-19 – Returning to a ‘new’ normal

Contents

COVID-19 – Returning to a ‘new’ normal	1
1. Executive Summary.....	2
2. Introduction	3
2.1 Road ahead	6
2.2 Past	7
3. Science advice.....	8
4. Addressing the direct harms	10
Transmission and the environment	10
Virology and Testing	15
Understanding the road ahead	16
Behavioural and social Science	20
New Knowledge to mitigate harms and support recovery	21
COVID Evidence Centre.....	24
4. Addressing wider harms	25
Socioeconomic Harms.....	25
Children and Education.....	28
Inequalities.....	29
5. International.....	31
6. Conclusions.....	33

1. Executive Summary

Audience: Welsh Government – internal

The purpose of this paper is to consider future policy needs from scientific perspective for transition to a more complex, less technical – business as usual for COVID-19. This paper is intended to support broader policy led recovery discussions and planning.

The paper does not cover NHS or Social harms as this will be covered in a Health and Social Care Recovery Plan. It is limited in only considering the aspects of COVID-19 that are addressed by our existing technical advisory groups and is therefore not exhaustive. The report is likely to need updating as our understanding changes along with the epidemic.

What is 'new' normal? Currently we are still in a pandemic phase where the disease is still expanding and contracting in different parts of the world. New or old variants may lead to new waves in Wales. Population behaviours and vaccination will be key in shaping the coming months and whether we see a significant third wave or more managed phase or lower disease incidence. Over time the nature of the pandemic will change, our approaches will need to adapt with it such that we monitor and reduce harms including new and existing inequalities. A 'one health' evidence based approach that embraces these challenges, as well as future threats, is advised.

Key points from each section

Recommendation 1: Welsh Government should create a balanced scorecard for the five COVID harms to support policy development and decision making for COVID-19 and future public health challenges.

Recommendation 2: Maintain and strengthen Welsh Government's ability to coordinate and collaborate with others for the provision of scientific and technical information in order to support policy development and decision-making. Undertake a review of the existing engagement and involvement with UK science infrastructure, and look to resource and strengthen it to improve analytics and knowledge mobilisation within Welsh Government.

Recommendation 3: As we transition from a pandemic to endemic situation, Welsh Government will need to refocus on important environmental issues, climate change, sustainable consumption and protection of our natural assets needs to remain our long-term goal, particularly as these underpin the Wellbeing of Future Generations Act – future pandemic planning and response will need to be nested in these important ongoing

policies. A strategic, cross Government, multi-professional '**one health**' approach to environmental adaptations for a Wales with endemic SARS-CoV2 is advised.

Recommendation 4: Improving case finding through TTP and scaling sequencing capacity is essential to identify and break chains of transmission as well as detecting and responding to new variants early.

Recommendation 5: Get cases low, keep cases low and vaccinate.

Recommendation 6: Policy modelling and ongoing tracking of the impacts of the virus in Wales should be an important feature in our ongoing response. Welsh Government should consider how to build capability in this area. Our ability to develop more nuanced models that describe likely impacts of potential policies that are tracked over time should provide policy and decision makers with important insights.

Recommendation 7: Welsh Government should develop strategies to promote adherence to desired infection control behaviours with a longer term strategic approach to health risk communication; including building capacity for behavioural and social science.

Recommendation 8: Welsh Government should support a coordinated national research and knowledge mobilisation programmes for reconstruction, renewal and learning from the pandemic in Wales. Welsh Government should work collectively to agree important strategic areas for further evidence synthesis and review and knowledge mobilisation via the COVID-19 Evidence Centre.

Recommendation 9: Welsh Government should collect and use all appropriate evidence to formulate well-evidenced policies to mitigate socioeconomic harms across society addressing social inequalities, especially where they have been exacerbated by COVID-19.

Recommendation 10: Working with stakeholders Welsh Government should measure, understand and mitigate accrued educational and other harms to children and young people, as well as, improving approaches to respond to future waves will be important.

Recommendation 11: Welsh Government must retain vigilance of the international scene and must be willing to maintain existing and impose new tight travel controls or travel bans swiftly upon emergence of variants of concern.

2. Introduction

Following the arrival of COVID-19 in Wales much has changed. The past year has impacted each and every part of our society and wrought significant harm upon us as individuals and as a nation. Social deprivation, an aging population, ethnicity, close knit communities, employment, economic support, built environment, work and leisure places, travel, education, our NHS and social care services, public health infrastructure, mass and social

media, trust in government, personal and societal values and expectations have all contributed to our experience of COVID-19.

Like many diseases, COVID-19 has exposed our inequalities and the most vulnerable in our society to harm¹ and these inequalities have been exacerbated. It has placed immense pressure on our systems and shown that, like others, they were not designed with the challenges of a pandemic in mind. Controlling the disease and its impacts is as much a question of the behaviour of individuals and communities as it is of the characteristics of the virus itself. Science across a broad spectrum of disciplines from virology and epidemiology to the behavioural and social sciences has helped us understand and mitigate some of the challenges presented by the virus; progress has been made at incredible pace. Similar to running a marathon with no training is ill advised - planning and preparation for the uncertain future of SARS-CoV2 and future health threats, like epidemics and climate change, is key. SARS-CoV2 will become endemic, this is inevitable – embracing this will help us adapt and overcome the challenges it presents.

The nature of the public health challenge presented by COVID-19 meant that a significant amount of scientific advice was required to help inform policies, support decisions of Welsh ministers and inform public debate. The lexicon and understanding of once abstruse scientific words like exponential growth and mutations alongside concepts like RT-PCR, clinical trials and modelling are more widely understood, although there is scope to extend this further. Our understanding and control of the epidemic will likely continue to rely heavily on science. As we transition to a new normal indirect non-COVID harms accrued in the past twelve months will need to be carefully balanced with ongoing health harms. A much more nuanced policy and science approach will be required to better measure and mitigate harms. The road to recovery will require both a flexible and dynamic approach whereby new knowledge is carefully integrated into policy thinking and debate. Sustainable scientific and public health approaches will need to be carefully worked through whereby SARS-CoV2 surveillance and response is explicitly referenced in business plans of stakeholders and agreed by multi-professional groups.

Five harms

1. Harm directly arising from SARS-CoV2 infections;
2. Indirect COVID-19 harms due to surge pressures on the health and social care system and changes to healthcare activity, such as cancellation or postponement of elective

¹ <https://gov.wales/technical-advisory-cell-coronavirus-COVID-19-and-health-inequalities>

- surgeries and other non-urgent treatments (e.g. harm from cessation of screening services);
3. Harms arising from population based health protection measures (e.g. lockdown) such as, educational harm, psychological harm from shielding and other measures.
 4. Economic harm arising both from COVID-19 directly and population control measures, like lockdown.
 5. Harms arising from the way COVID-19 has exacerbated existing, or introduced new, inequalities in our society.

The narrative associated with the challenges should increasingly be less about SARS-CoV-2 in isolation, and increasingly about SARS-CoV-2 in a broader context and nested within important wider and longer-term policy thinking (e.g. the Wellbeing of Future Generations Act, Climate Change, Life-Sciences Sector). In health policy terms, there should be a strategy for a coherent integrated response to seasonal respiratory viruses and transitioning of focus into NHS and social care recovery. This will encompass such factors as vaccination, testing, non-pharmaceutical interventions and potentially myriad other diverse interventions. Such a framework could also be deployed for other public health challenges and future health threats².

Four harms associated with COVID-19 have previously been described (box 1) we have also included a fifth that explicitly recognises the exacerbation on inequalities, as well as the introduction on new inequalities in our society due to COVID-19. The five harms should be at the centre of our thinking and more work is required to provide evidence and decision making support tools such that these harms can be mitigated, reduced or balanced.

Recommendation 1. Creation of a balanced scorecard for the five COVID harms (alongside other strategic objectives) to support policy development, decision making and evaluation both for COVID-19 recovery and for future public health challenges.

As we consider the future and our recent experience of COVID-19 we should purposely describe a 'new' normal – this shouldn't just be about developing new ways of working but also include keeping the elements that have worked well and withstood the challenges of the pandemic. For example COVID-19 services for communicable disease surveillance, pathogen genomics, and local health protection were built on well-established procedures

² <https://www.gov.scot/publications/COVID-19-framework-decision-making-assessing-four-harms-crisis/>

and past investment with experienced and expert professionals in Wales. Similarly, previous investments and partnership working in medical data systems and data sharing supported a rapid deployment of numerous IT developments and data sharing agreements for the purposes of COVID-19. Each of these areas served us well in reducing harm and helping us understand how best to respond. This should not detract from the huge investments and enormous amount of work that was undertaken in these areas over the past year. However, building on a solid base of strategic investment, professional experience and trusted partnerships have shown to be key elements in responding to the technical, scientific and public health challenges of the pandemic in Wales.

In defining a 'new' normal we should seek to better understand areas (local, regional and national) where we did less well or had to work much harder to establish, develop and grow both our understanding and response to COVID-19. In doing so we should look to others' experiences and their subsequent actions (within Wales, nationally and internationally) and ask ourselves whether we measure-up and if our future strategic objectives are sound.

2.1 Road ahead

SARS-CoV2 is widespread across the world and is here to stay – elimination of the disease in the coming years is highly unlikely, but achieving very low levels of infection may not be impossible³⁴. Living with SARS-CoV2 is much more realistic than elimination, whereby control measures, like vaccination, an ongoing local and national public health response and new social norms (face coverings, hand washing and social distancing), will need to act in concert to keep infections low where population health benefits are balanced with other harms, such as economic and educational. As above, complex calculations will need to be made to estimate short and long-term harms in order to transition to a new normal – whereby health impacts may need to be balanced with other societal considerations. This is not a one-way street and will need to be an iterative process of collaboration, coproduction, learning and redesign. As with the acute phase of the pandemic, everyone will need to play a role in the transition to endemic whether the public, our communities, businesses and charities, public sector and the Government.

Given that there will be reservoirs of virus in people, laboratories and animals, there will remain a risk of the emergence of new (or existing) viral strains. The virus could become

³ <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

⁴ [https://www.thelancet.com/journals/laninf/article/PIIS1473-3099\(20\)30633-2/fulltext](https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30633-2/fulltext)

less infectious and a seasonal virus (most likely) but it could also become more pathogenic and transmissible through new variants.

Unlike the UK most countries do not and will not have a wide-scale vaccination programme – many countries can neither afford nor deliver such a programme alone. Unless this is specifically agreed as a WHO strategic objective, SARS-CoV2 will persist in poorer countries, new variants will arise where SARS-CoV2 is more prevalent and more harm will be accrued. As we have seen previously we will continue to import new variants into the UK and this will likely lead to new cycles of disease growth and need for coordinated action.

Pandemic – an epidemic on an international or worldwide scale

Epidemic - periods of rapid possibly uncontrolled growth with high numbers infected.

Endemic - constant persistence of a disease in a population, either at a steady state, or with seasonal fluctuations

Syndemic - the aggregation of two or more concurrent epidemics, disease clusters or social conditions in a population, which exacerbate the prognosis and burden of disease.

2.2 Past

There is much to learn from previous pandemics and history would support the thesis that the current pandemic will not be a short-lived. The RNA based SARS-CoV2 virus will continue to evolve over time findings ways in which to replicate itself and move between living hosts, with selective pressures (e.g. vaccination, control measures) leading to the emergence and propagation of new variants. The challenges that we face are not new. Problems related to the importation of communicable diseases have existed for hundreds of years and will require significant effort and technical solutions to overcome. The disproportionate health impacts in areas of social deprivation were observed in the times of Roman Empire and will continue until education, living conditions and employment opportunities improve across society. Reducing hospital or social care acquired transmission of communicable diseases is important, but not new – vaccination, improvements in estates, outbreak management, rapid testing, training, health literacy, personal protective equipment and a range of infection prevention and control measures will all be required to lessen the impact of transmission in closed settings. History and our recent experience have shown us that there are no silver bullets and that the challenges presented by this pandemic are complex and not new – importantly with science and evidence based decision-making they are tractable. Necessity is the mother of invention – if risks are

deemed too great to live with or impacts are considered too high for society – technological solutions are sought.

3. Science advice

Science advice⁵ related to the pandemic has covered a broad range of topics extending across ministerial portfolios from forward looking projections of health impacts to control measures for places of worship. Understanding the evidence to inform decision-making has been a fundamental aspect of the Welsh Governments' approach to the pandemic. Expectations have increased in the supply and granularity of scientific advice to support effective policy-making. The need to capture, interpret and mobilise new knowledge has increased throughout the past year with a new infrastructure established to oversee and coordinate this function⁶. A federated approach to science has been built and expanded upon in Wales and at a UK level with academic institutions, public health agencies, and government departments working collectively to address important questions.

In UK Government (UKG) the Scientific Advisory Group for Emergencies (SAGE), operated through the offices of the UK Chief Scientist has been the main coordinator of scientific advice. Separate clinical and public health discussions and decisions have been mediated via the four Chief Medical Officers (CMOs) and senior clinicians group. It will be important to continue to actively share scientific and clinical discussions within Welsh Government to ensure that the necessary rigour has been applied to UK policy discussions and decisions.

Increasingly departmental Chief Scientific Advisers (CSAs) are expected to lead sector specific commissions. Leads from the Technical Advisory Cell (TAC) have actively participated in these discussions – however, the lack of scientific leads for some policy areas creates opportunity for inequities in access to direct commissions from UKG. Ensuring equitable access and ongoing collaborative working between different Government Departments and devolved nations will be important as we transition into an endemic and recovery phase. It will be important that Welsh Government works closely with relevant devolved and non-devolved Departments to ensure sector specific scientific understanding is shared and that an open collaborative approach is adopted.

More recently, the Joint Biosecurity Centre (JBC) has been established to provide further analytical functions, lead operational research and support four nations working. Work is

⁵ <https://www.gov.uk/government/publications/scientific-advice-to-government-principles>

⁶ <https://healthandcareresearchwales.org/about-research-community/wales-covid-19-evidence-centre>

ongoing to establish how JBC can be integrated into the processes within Welsh Government such that ministers and policy officials benefit from additional capacity and capability to address important questions and access a wider array of relevant analysis. There is a clear need to provide evidence based guidance for a more effective utilisation of resources during the response. Significant work has been led both within Welsh Government and Public Health Wales to develop meaningful data collection, surveillance tools and dashboards to support risk assessment. These synergies significantly speed up and support decision making and have a broad transformative impact on risk management processes as well as the resulting recommendations upon real-world operational scenarios. Integrating new tools and outputs in a sustainable manner will be important so that the most up-to-date, timely and insightful information is used for risk management and decision making.

It should be recognised that approaches used for predicting and monitoring large waves will likely be replaced by a need to monitor and better understand local conditions on a more granular level; for example by the inclusion of genomic data or defining syndemic potential in local risk assessments. Where appropriate analysis should be undertaken at a UK, regional and local level using robust models and techniques that add confidence to assessment of the state of the disease in Wales. Sharing best practice and working together with all partners in a trusted partnership will provide conditions where scientific rigour, transparency and progress can thrive.

The pandemic has evolved in an unrelenting manner alongside an increasing volume of scientific evidence; this has required the making of rapid decisions based on incomplete information. This has meant that the provision of scientific advice, policy formation and ministerial decisions alongside public and stakeholder engagement has evolved much more quickly than in normal times. This feature of the pandemic is likely to continue as decisions to reverse the current lockdown in a risk based and evidence informed manner prevail. Capacity development within Wales in key disciplines, for example, behavioural science and policy modelling, will be vital. The timely provision of scientific evidence and interpretation needs to be closely monitored and resourced to ensure ministers and policy officials have access to relevant material in a timely manner.

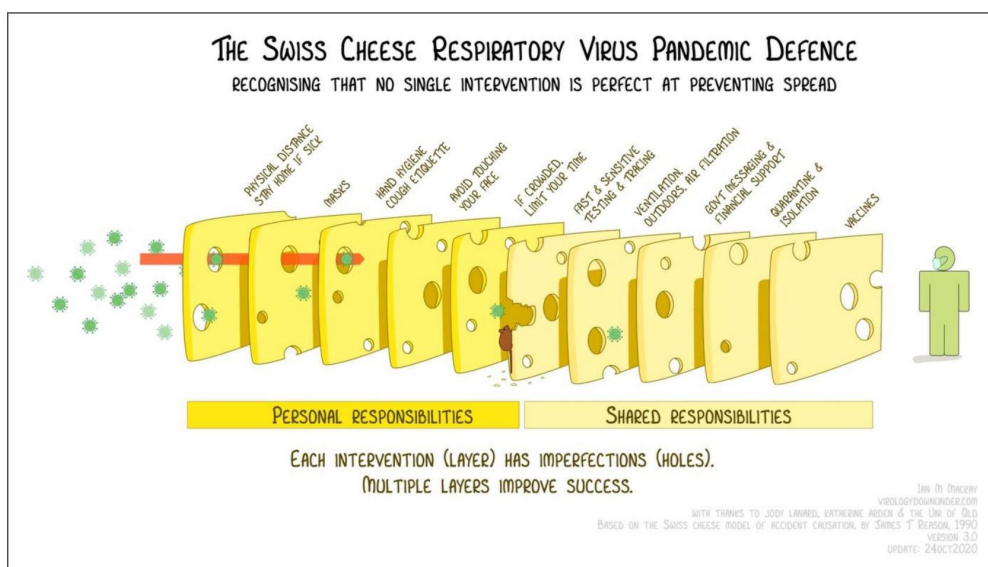
Recommendation 2: Maintain and strengthen Welsh Government's ability to both coordinate and collaborate with others for the provision of scientific and technical information in order to support policy development and decision-making for COVID-19. Undertake a review of the existing engagement and involvement with UK science

infrastructure, and look to resource and strengthen it to improve analytics and knowledge mobilisation within Welsh Government.

4. Addressing the direct harms

Transmission and the environment

Despite a global focus on SARS-CoV2 transmission the relative contribution from different routes of exposure to new infection is not well understood. Scientific investigations whether through outbreak analysis, animal or human studies will inevitably improve our understanding of how the virus is transmitted. Depending on this knowledge e.g. if either fomite, aerosol or contact transmission is shown to be the main contributing route of exposure then risk mitigation strategies can be more tailored and become more effective. As it is a Swiss cheese defence or doing many things well, continually revisiting risk assessments and the assumptions contained therein, and applying the principles of the risk control hierarchy will be important⁷.



Much work has been undertaken from a scientific perspective to better understand the relationship between transmission and the environment. Developments in environmental monitoring (e.g. Waste Water Surveillance) have shown the potential for on ongoing environmental surveillance not just for SARS-CoV2 (or other communicable diseases) but also wider environmental determinants of health (e.g. air pollution). A determined effort is needed to define what good looks like to help realise a sustainable environmental public

⁷ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1117770/>

health surveillance system that is able to provide actionable information to inform policy and reduce harm.

In the return to the 'new' normal, things won't be as they were before. There will need to be adaptations to the way we live our lives. However, there will be a need to consider what practical steps can best be taken to return lives to the new normal and ensure we can live with COVID. It will be important to consider and model different environmental scenarios both on the micro level (produce items such as safe operating times and time to infection to support planning) and at the macro environmental level (to highlight environmental harm such as the plastic impact of disposal of PPE). These models could provide evidence that may prevent or highlight potential risk of transmission whilst supporting the aim of returning to the 'new normal'.

Eventually, we will need to move away from the costly mass testing of the population, there will be a need to be a lower cost more sustainable continuous health surveillance system to firstly monitor the progress of the current virus and variants as a benchmark, secondly - to use as an early warning indicator for any future viruses and thirdly use the opportunity to monitor other public and environmental health issues.

The current pandemic/epidemic has also brought about unexpected physical environmental benefits, and so it is important to capture these learnt lessons to provide evidence and inform policy areas. It has shown us we can work and live in different circumstances and so these sustainable future opportunities and learnt lessons post COVID should be highlighted so they can be carried forward to meet the seven WBFG Act goals. There is also need longer term to learn lessons about what to do to prepare for future pan/epidemics.

Our current knowledge of the virus and transmission is at risk of being re-set with each new mutation and variant and so it is important to limit new variants as best as possible. We know the main transmission routes of the virus, however it has been recognised, there is more to learn about the effectiveness of these routes and there still a lot we don't know about the virus.

It is likely that SARS-CoV-2 will spread into wildlife where it will become endemic. In a Welsh context, we need to identify potential wildlife vectors for SARS-CoV-2 and better understand the survival and mutation rate in these intermediate hosts. If this occurs, we need to have action plans to effectively monitor the spread of the disease and also the identification of potential control measures to reduce further transmission (incl. human contact). A '**one health**' approach that connect sectors and enables greater knowledge mobilisation to inform risk assessments and risk management measures will be key.

Environmental consequences of Personal Protective Equipment

It is likely that we will be wearing personal protection equipment (PPE; face coverings, gloves) for the foreseeable future. Almost all PPE is non-biodegradable. Inappropriate disposal will lead to its progressive accumulation in the environment. It is inevitable that this PPE-litter will transfer from the terrestrial environment to freshwaters and marine waters, where it may subsequently pose a risk to wildlife. There is therefore a need to develop new biodegradable, but effective PPE (including face coverings, gloves etc) which causes minimal environmental damage. We also need to quantify the environmental impact of non-biodegradable PPE on terrestrial, freshwater, and marine ecosystems in a Welsh context. We also need to investigate the opportunities for the safe recycling of these materials to prevent them entering landfill. Inappropriate disposal of non-biodegradable products may also lead to an increased incidence of clogging issues within the sewer network. Efforts to reduce environmental impacts of face covering usage should be considered at a local and national level – co-producing solutions with the public and applying this learning to other existing environmental challenges that are compounded by COVID-19 (e.g. microplastics)⁸.

Waste Water Surveillance

Although the severity of COVID-19 is likely to greatly reduce in Wales due to the roll out of the vaccine programme, it is expected that a base-load of SARS-CoV-2 infections will still occur. It is well established that SARS-CoV-2 is shed in faeces, however, the infectious nature of the virus in this matrix remains very poorly understood. In addition, the potential for infectious viral particles to persist in sanitary settings (e.g. public toilets) and wastewater and thus enter the wider environment remains unknown. There is therefore a need to better understand how SARS-CoV-2 survives in faecal material, surfaces in sanitary environments and wastewater. Knowledge of how the viral-RNA degrades in sewerage would also be useful for the models used in the national wastewater-based surveillance of COVID-19. There is also a need to understand what the infectious dose of the virus is to help identify the efficacy of mitigations. Employing differing research techniques such as mannequin studies in order to find the answers to these questions will be important to see how the virus travels and survives in different circumstances.

Surface contamination

Following on from above, it is likely that sterilisation of surfaces will continue for the foreseeable future to help mitigate the spread of SARS-CoV-2 and to reduce the potential for flare-ups. The persistence of SARS-CoV-2 on both indoor and outdoor surfaces and the

⁸ *Co-production is an asset-based approach to public services that enables people providing and people receiving services to share power and responsibility, and to work together in equal, reciprocal and caring relationships. It creates opportunities for people to access support when they need it, and to contribute to social change.*

potential for fomite transmission remains poorly understood. More work is therefore required to understand how long infectious particles remain on a range of both indoor and outdoor surfaces in is able to survive in the air. This research needs to focus away from the measurement of viral RNA on surfaces, which provides no measure of infectivity, towards cell culture-based infectivity screening methods. More nuanced experiments on SARS-CoV-survival also need to be undertaken to better understand the impact of key factors (e.g. temperature, UV, disinfectants, pressure, humidity, detergents, moisture etc) both individually and in combination. This will also allow us to better understand the seasonal dynamics of SARS-CoV-2.

Wider environmental adaptations

COVID-19 has increased home-working and a reduction in people commuting to work. This change in working practice is likely to continue in the near term. This practice will have an impact on the environment in terms of increased domestic energy and water use and changes in patterns of consumption, reduced road traffic leading to a reduction in outdoor noise and improved air quality in urban areas. There is research needed to quantify the benefits and disbenefits of home working in terms of resource use efficiency (e.g. energy, water, paper), climate change mitigation (e.g. greenhouse gas emissions), wildlife behaviour in urban areas (e.g. birds, insects, plants), potential benefits to human health that further impact the environment (e.g. Norovirus infections and subsequent contamination of coastal waters by wastewater). There is also a need to understand how this affects waste generation and recycling in different areas. A strategic national approach to future home working (e.g. in winter months to reduce seasonal transmission) could be considered across sectors. For example, Housing design (ventilation and occupancy thresholds), Economic (work well from Wales or investment in local business schemes) and Health (community mental health and loneliness schemes) and digital exclusion.

The presence of COVID-19 both in Wales and overseas is likely to reduce or prevent travel to many foreign destinations for the foreseeable future. This will, however, lead to an increased number of people in Wales holidaying in Wales and also an increase in visitor numbers from England to Wales. The increased density of people in destinations across Wales will require careful consideration from a behavioural perspective in order to manage transmission risk during physical and social interactions. Furthermore, this increased tourism is likely to put increased pressure on the management of National Parks and associated infrastructure (e.g. roads, footpaths, water resources, etc). Similar pressures will also be placed on other parts of the rural landscape (e.g. agricultural land with access rights, National Trust land, SSSIs). It is also likely to impact heavily on coastal resources (e.g. beaches and bathing waters). The impact of increased tourist/outdoor activity on the Welsh

environment therefore needs to be closely monitored to help prevent lasting damage to critical infrastructure and natural resources (e.g. biodiversity, air, water and soil quality, cultural assets). It is recommended that mitigation plans be formulated and implemented as soon as possible.

If SARS-CoV-2 becomes endemic, then we need to design new tools to effectively monitor SARS-CoV-2 in both indoor (e.g. air) and outdoor (e.g. water) environments in near-real time. We currently lack these technologies. There is therefore a need to develop, test, validate and commercialise new tools that can be deployed at scale for the rapid in-situ detection of SARS-CoV-2 in public places. In addition, tools are needed for the rapid detection of new variants of concern in water.

Built environment

Indoor environments are likely to remain the environments where the risk of COVID-19 transmission is greatest. Mitigation measures to prevent transmission are therefore likely to remain in place for the near-future. Our detailed knowledge of the impact of these mitigation measures (e.g. PPE, screens, ventilation, social distancing) in different contexts (e.g. offices, schools, hospitality venues, supermarkets, food processing plants, homes), however, is still fragmentary. Further work is therefore needed to enable us to provide 'safe operating times' or 'exposure time to infections' for enclosed, semi-enclosed and outdoor environments and for a wide range of contextual settings. Indeed, an opportunity also exists to consider architectural design and the potential to future-proof our buildings and cities through a multidisciplinary view on urban planning and building design. We also need to develop improved mathematical simulation models that can better predict the movement and persistence of the virus, and thus enable the design of more effective mitigation strategies in different settings. It will also allow the opening up of settings that are deemed very low risk. It should be noted that the model outputs are only as good as the assumptions of the model and its subsequent parameterisation. The development of better models will therefore rely on a better fundamental understanding of SARS-CoV-2 persistence as highlighted above.

Further research into a built environment that reduces the risks of airborne and droplet (And fomite) transmission, through space, air circulation, materials technology should be considered in future strategic reviews of research priorities.

All the available evidence suggest that we will experience more pandemics in the future. It has become clear over the course of the current pandemic that our understanding of viral behaviour in the environment is very poor. We therefore recommend that we train, and critically retain, the next generation of environmental virologists. Welsh universities have strength, but not depth, in environmental virology. Despite this, a Welsh university

partnership linked directly to Public Health Wales and other national agencies has the capacity to deliver world-leading training which will enable us to address many of the policy relevant questions highlighted above. A determined approach to build upon this area of excellence in Wales will help us understand and adapt to future environmental challenges.

Recommendation 3: As we transition from a pandemic to endemic situation, Welsh Government will need to refocus on important environmental issues, climate change, sustainable consumption and protection of our natural assets needs to remain our long-term goal, particularly as these underpin the Wellbeing of Future Generations Act – future pandemic planning and response will need to be nested in these important ongoing policies. A strategic, cross Government, multi-professional '**one health**' approach to environmental adaptations for a Wales with endemic SARS-CoV2 is recommended.

Virology and Testing

In the past year Test, Trace and Protect (TTP) has grown to a huge operation whereby over 1.7 million COVID-19 tests have been delivered. Recent estimates suggest TTP alone acted to reduce R_t by 0.3 in Wales during the Autumn, from approximately 1.6 to 1.3. As the shape of the epidemic changes and levels of infection decrease in the community greater epidemiological understanding should be realised from the practice of both forward and backward (enhanced) contact tracing. By doing so will help inform not only who may have been exposed but also the source of the infection, or index case. Improving case acquisition through testing will remain a key challenge. Understanding how and when to integrate TTP in business as usual functions and whether other communicable disease should be adopted will be important. This year we had not had a flu season; this is atypical and as with other diseases evidence suggests that co-infections with flu and SARS-CoV2 are both possible and more severe. There is therefore an increased risk of more severe flu seasons in the future and with it an increased need to maintain respiratory hygiene measures over the long term.

Advances in near patient/person testing through lateral flow devices and Point of Care Testing devices will also reduce system lag and improve secondary case acquisition. Used with clear purpose, such a triage of hospital admissions, alongside other infection prevention control efforts, will reduce nosocomial transmission. Settings that are high risk now, will likely remain high risk – unless the setting fundamentally changes (e.g. multi-bed wards, to single room occupancy hospitals). As such, these 'high-risk' settings for SARS-Cov2 will require

continuous monitoring. Ensuring information, and material, from positive cases is collected and collated will be important for disease surveillance and pathogen genomics.

The detection and assessment of new variants by sequencing viral material is an evolving science and service. Currently pathogen genomics is restricted by the coverage, technical requirements and timeliness, but is rapidly developing as a key part of the armament in understanding and responding to SARS-CoV2. Using genomics to identify, track and manage outbreaks involving new variants or monitor vaccine/immune response escape is not yet fully realised in the UK, or globally. However, work is in train to develop this capacity and capability. Part of the Welsh and UK Governments response to COVID-19 has been the upscaling of pathogen sequencing and analysis. Further work is required to ensure that the potential of pathogen genomics is realised both with Wales and across the UK.

As we move towards a new state of the pandemic whereby a significant proportion of the population are vaccinated it will be important that testing approaches for COVID-19 are sustainable and integrated into existing NHS services such that scaling can be achieved easily without impacting upon other clinical services.

Recommendation 4: Improving case finding through TTP and scaling sequencing capacity is essential to identify and break chains of transmission as well as detecting and responding to new variants early.

Understanding the road ahead

A further epidemic wave will take place if population based health protections start being lifted before vaccine rollout is well advanced. With the arrival of the new variants (e.g. imported or sporadic) it is highly likely that the epidemic will rebound quicker if NPIs are relaxed quickly. A new wave would be less likely to return hospital occupancy to levels that endanger the usual standard of care if cases are driven low, kept low and vulnerable groups are vaccinated.

Until a high percentage of the population is vaccinated a quasi-epidemic state is likely as we transition to an endemic. This is likely to be characterised by seesawing between states of viral growth and suppression. Seesawing will depend on local and national responses, the health system and accrued health impacts, population behaviours, vaccine efficacy (in terms of disease sequelae and transmission reduction) and uptake, success of treatments, TTP performance, continued support to address structural determinants (e.g. support for self-

isolation, COVID secure workplaces) and the emergence of new variants and co-infections (e.g. seasonal flu).

In the event of a further epidemic, transmission would be highest in the most vulnerable, deprived communities with lowest vaccination coverage, likely leading to uncontrolled growth. Reaching herd immunity from vaccination alone may not be possible; it would require very high coverage in all adult age groups and for the vaccine to be highly effective against transmission, and long lived.

The age profile of those being admitted to hospital is less skewed towards the oldest in society than the age profile of deaths. For that reason, vaccines (being administered in line with JCVI categories) will reduce pressure on the NHS more slowly than they will reduce the number of deaths. If, in future, the Government were to follow a strategy of allowing R to be sustained above 1 before vaccines have been offered to all adults, very high coverage in older and more vulnerable groups is absolutely critical to avoid the NHS being so stretched that it cannot provide its usual levels of care during the epidemic that would follow.

Recommendation 5: Get cases low, keep cases low and vaccinate.

Given the availability of several approved vaccines it is highly likely that in the short to medium term wide-scale deployment will significantly reduce deaths and then hospital admissions as more age groups and disease groups are covered. Inevitably, this will create opportunities to relax stricter interventions (e.g. return of face-to-face teaching).

As has been shown in the pre-Christmas period in London and East of England the new dominant variant will grow quickly where there is mixing, if schools reopen when case rates are high and the vaccination programme has not rolled out sufficiently, rapid community growth will likely be observed.

Prior to widespread vaccination, a strategy of reducing cases rates to as low as practicably possible has the benefit of enabling a more focussed public health response to identify and manage outbreaks. Forward and backward contact tracing will remain a key part of the armament to identify and isolate infectious individuals and their contacts, to prevent onward transmission. This is particularly important for the emergence of new strains that evade the vaccine response.

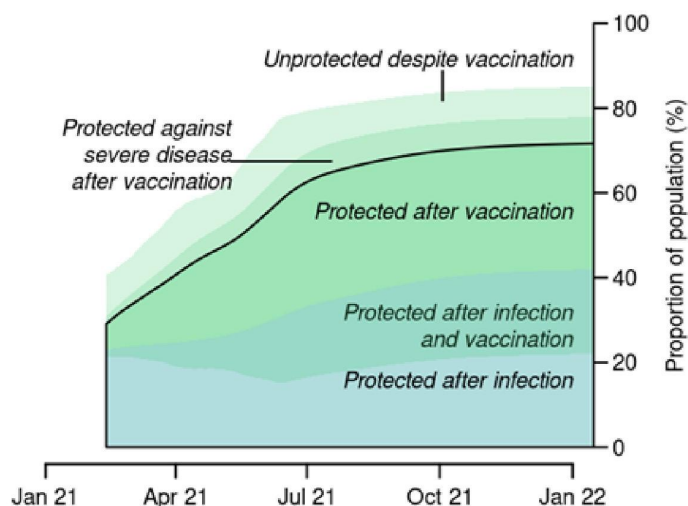


Figure 1. SAGE: Illustration of protected versus unprotected population over time with vaccine roll-out and acquired immunity.

A strategy of creating sufficient 'headroom' to then operate more normally, will reduce immediate indirect harms (e.g. loss of face-to-face learning, economic losses) for example, but could in turn lead to higher direct harms (e.g. long COVID harm), sustained pressure on the NHS and public health response; which in turn could lead to additional periods of lockdown.

Currently it is unclear what the longer-term health impacts will be from 'Long COVID'⁹. Whilst evidence is still emerging, 'Long COVID' is likely to be a cluster of syndromes that may have different long-term outcomes. If the virus is allowed to circulate more freely in the population once deaths are reduced from vaccination, the longer-term health impacts from long-COVID could be significant. Complications arising following hospitalisation and worse functional outcomes have been shown to be common even in younger, previously healthy patients. COVID-19 complications and long COVID syndromes are likely to cause significant challenges for individuals and for the health and social care system in the coming years.

Similarly, it is possible that loss of QALYS (Quality Adjust Life Years) from education or economic harm arising from NPIs could be disproportionately higher than those accrued during the pre-vaccine phase of the pandemic¹⁰¹¹.

⁹ <https://gov.wales/technical-advisory-group-long-COVID>

¹⁰ <https://www.scottishmedicines.org.uk/media/2839/guide-to-qalys.pdf>

¹¹ TAC paper on socioeconomic harms

It is possible the new variants of SARS-COV2 could emerge that bypass the immune or vaccine response, disproportionately affect younger people, become more transmissible or pathogenic leading to more severe health outcomes and deaths.

Modelling future scenarios and policies has been an important component of government discussions. Wales has benefitted from access to the SAGE modelling group (SPI-M) and developments within Wales, working closely with Swansea University to develop a set of policy models and reasonable worst-case scenarios. In doing so we have been able to look back and show that, forward projections have closely matched forecast estimates. In moving forward, it will be important that we continue to revisit modelling assumptions and included parameters as our understanding of important factors changes (e.g. understanding of vaccine efficacy or long COVID). Adopting a more nuanced and adaptive approach to policy modelling will help ensure projections are realistic and support decision making.

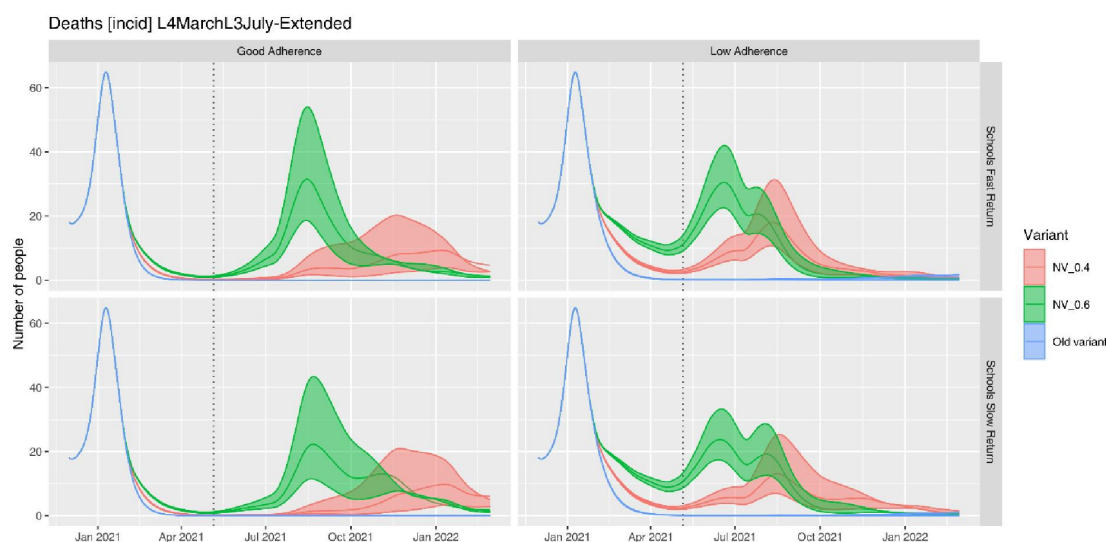


Figure 2. Swansea University Model - Case scenarios following the Wales vaccine roll out under strong non pharmaceutical interventions (level 4 until the end of March, Level 3 until the end of July), but with reduced adherence to restrictions and fast or slow re-opening of schools. Intervals represent 90% (lower), 75% (central) and 60% vaccine efficacy. Upper (Green) and lower (Red) estimates for the transmissibility of the newly dominant B.1.1.7 variant are shown. The earlier restrictions are lifted, the higher the third wave scenario.

Looking further ahead it will be important to consider and model different scenarios that reflect different potential outcomes in the medium to long term in order to support planning. This could include scenarios like waning population immunity, resurgent winter cases or emergence of vaccine escape variants with differing properties. These more pessimistic reasonable worst-case scenarios should be considered alongside optimistic and central futures

Policy modelling should be extended to include more consideration of health inequalities, indirect health harms, socioeconomic harms, and specifically educational harms to enable more of an integrated impact assessment approach to control of the virus. As an example, model not only COVID admissions but elective surgery cancelled as a result of COVID admissions. Modelling may also factor the interaction between COVID and other long term risk factors, in the context of COVID being a syndemic. (As an example of these interactions, someone who chose to lose weight or quit smoking at the start of the pandemic may already be lower risk of dying from COVID now.)

Recommendation 5: Policy modelling and ongoing tracking of the impacts of the virus in Wales should be an important feature in our ongoing response. Welsh Government should consider how to build capability in this area. Our ability to develop more nuanced models that describe likely impacts of potential policies that are tracked over time should provide policy and decision makers with important insights.

Behavioural and Social Science

Behavioural and social science has proven an essential component in understanding public behaviours and helping inform the government response to the pandemic. Conveying the combined importance of taking personal protective behaviours such as social distancing, self-isolation, hand washing, wearing a face covering when required, respiratory hygiene and household ventilation has been critical in reducing the number of COVID-19 infections. These new normative behaviours will highly likely need to remain and ensuring approaches encouraging core protective behaviours are underpinned by behavioural science remains key. This requires an acknowledgment that some behaviour is driven by non-conscious processes, limited by social, economic or emotional capabilities and may go against good intentions. Irrespective of vaccine efficacy, long-term routine adoption of certain core protective behaviours such as handwashing will increase protection for individuals and the population for COVID-19 and other infectious diseases, including influenza.

As the pandemic has evolved, self-reported adherence to guidance has remained broadly high but with some areas of uncertainty and/or concern including a potential gap between intention and action and an over-reporting in the media of where lapses occur in a small number of individuals and contexts (e.g. celebrations such as Christmas). Core protective behaviours are a key response to the current pandemic and also offer a long-term sustainable solution to the likely endemic future of COVID-19 but will only do so alongside an effective Test, Trace, Protect system. It is essential that structural inequalities and

existing barriers are addressed through the provision of adequate financial, practical and emotional support and information necessary to encourage test-seeking behaviour, identification of contacts and self-isolation.

It is necessary to redress the balance towards policies and messaging focused on transmission within and between households (rather than outdoors), including the practical steps that can be taken to avoid transmission within households. Given the high levels of adherence across the population, positive messaging to reinforce this norm is recommended, as is the use of inspiring stories of adherence. Messaging that highlights non-adherence or that could be perceived as blaming the population for current rates of transmission will likely undermine such efforts. Uncertainty about the future needs to be acknowledged and transparently communicated, alongside providing information about what is being done to resolve uncertainties.

Active consideration of acceptability, practicality, effectiveness, affordability, spin-off effects, and equity of recommendations is needed – to ensure adherence. Otherwise perfect policies are akin to the perfect pill, trapped in a bottle. The impact of inequity throughout the pandemic has been well documented, without active consideration in the ‘new normal’ we risk ‘intervention generated inequality’¹².

Recommendation 7. Welsh Government should develop strategies to promote adherence to desired infection control behaviours with a longer term strategic approach to health risk communication; including building capacity for behavioural and social science.

New knowledge to mitigate harms and support recovery

Over the last twelve months, we have seen the value of investing in health research that has helped to manage the pandemic and understand the use of interventions to control infection, to develop new therapeutics and improve clinical management, and to develop, manufacture and deliver vaccines at unprecedented pace and scale.

National research and development programmes, such as the national core studies will further our understanding of the disease including viral transmission, treatment and vaccines, longitudinal health and well-being, immunity, epidemiology and surveillance. Field,

¹²<https://jech.bmj.com/content/67/2/190.long>

case control trials and animal studies will help describe main routes of transmission (e.g. aerosol or contact), which in turn will enable more effective control measures.

The Randomised Evaluation of COVID-19 thERapY (RECOVERY) trial is an example of UK excellence in Clinical Trials. With over 38 thousand participants in 177 research sites, RECOVERY is the largest clinical trial in the world. The RECOVERY Trial is currently testing some of these suggested treatments like Low-dose Dexamethasone, Colchicine (commonly used anti-inflammatory), Tocilizumab (an anti-inflammatory treatment given by injection and also used to treat arthritis), Regeneron's antibody cocktail (a combination of monoclonal antibodies directed against coronavirus) and Aspirin (commonly used to thin the blood). The use of dexamethasone was supported by findings of the trial and was shown to reduce hospital deaths by up to one third. Conversely the trial showed no clinical benefit of using lopinavir-ritonavir or azithromycin¹³. Recent analysis has shown that Tocilizumab reduces risk of death, shortens length of stay and reduces need for mechanical ventilation for hospitalised patients.¹⁴

The Post-hospitalisation COVID-19 study (PHOSP-COVID) is a consortium of leading researchers and clinicians from across the UK working together to understand and improve long-term health outcomes for patients who have been in hospital with confirmed or suspected COVID-19. Improving our ability to identify the vulnerable will reduce harm. Whilst we know the main risk factors (age, sex, co-morbidities, obesity etc.) we do not know why some low-risk individuals develop severe disease, why some get "long COVID" and why a small number of children develop a serious immune condition. Identification would allow bespoke protection advice and/or potential prophylactic intervention. Research focussing on non-hospitalised people with long Covid has recently been funded, including studies aiming to further characterise, define and develop therapies for Long COVID, including for children and young people.¹⁵

Wales has shown the ability to rapidly engage with national vaccination studies, including the Oxford/AstraZeneca and Moderna vaccines, using a more community-based model, and creating new partnerships for research. This infrastructure could become the core of a national vaccine evaluation capacity, which is likely to be needed to assess changing

¹³ <https://www.recoverytrial.net/news>

¹⁴ <https://www.medrxiv.org/content/10.1101/2021.02.11.21249258v1>

¹⁵ <https://www.nihr.ac.uk/news/185-million-awarded-to-new-research-projects-to-understand-and-treat-long-covid/26895>

vaccines in response to new variants, and also has the opportunity to integrate with post-marketing population safety and efficacy monitoring.

Wales' investment in the creation of the Secure Anonymised Information Linkage (SAIL) system since 2006 created one of the most respected and used Trusted Research Environments in the world¹⁶. SAIL functionality was leveraged early in the pandemic to create a system to provide research intelligence on the spread of the pandemic in Wales and the effectiveness of control measures, supported by grants from the Medical Research Council, National Institute of Health Research and Health and Care Research Wales¹⁷. A One Wales analytical team was established including individuals from Welsh Government, NHS Wales Informatics Service, Public Health Wales, NHS clinical groups, Administrative Data Research UK, Health Data Research UK, the Office of National Statistics and academics from Swansea, Cardiff and Bangor universities. These analyses have been of tremendous help in understanding and responding to the spread of infection across Wales through real time mapping, in care homes and the school population^{18 1920}. Work is ongoing assessing the impact of the vaccine roll out, the impact of shielding, the indirect effects of COVID on population health and wellbeing and the effectiveness of new models of care to respond to the legacy of COVID on the health and care system.

SAIL have made direct contributions to Welsh Government Technical Advisory Group on topics including care homes, health service impact of Covid, mental health and health inequalities. SAIL has also been an active partner in the UK research response to Covid-19, working as part of Health Data Research UK to provide expertise and data platforms to support wider research analysis of ZOE symptom study data and other cross-national research programmes.

There are currently more than 90 active covid-19 related studies utilising SAIL data, and continuing to draw on this effective resource will be a key part of our recovery and renewal plans. SAIL will be working in collaboration with the Covid Evidence Centre to support research into Long Covid, evaluation of vaccine and specific therapies on COVID-19 outcomes and impact of health and care service changes as a result of COVID-19.

¹⁶ <http://www.biomedcentral.com/1472-6947/9/3>

¹⁷ <https://bmjopen.bmj.com/content/bmjopen/10/10/e043010.full.pdf>

¹⁸ <https://www.sciencedirect.com/science/article/pii/S1386505621000265>

¹⁹ <https://academic.oup.com/ageing/article/50/1/25/5908996>

²⁰ <https://www.medrxiv.org/content/10.1101/2021.02.04.21251087v1>

Wales COVID-19 Evidence Centre

The creation of the COVID-19 Evidence Centre, through Health and Care Research Wales, will be an important part of the armament going forward to ensure greater participation in programmes like the National Core Studies, RECOVERY and PHOSP-COVID and that new knowledge from these studies is mobilised effectively across health and care organisations across Wales..

But what happens next is vitally important – after the acute phase of the pandemic, as COVID19 becomes an endemic infection, and as our health and care system starts to recover from the extraordinary stresses and demands of the pandemic and to address the longstanding challenges such as underlying health inequalities which have been accentuated and made highly visible during the pandemic.

There is now an important opportunity to put research and evidence to work alongside service development and evaluation to support the processes of reconstruction, renewal and learning from the pandemic. We plan for a new and iterative programme of collaborative research involving health and care organisations and academic partners working together in four key areas:

- **Service recovery and reconstruction** – how best should existing services in areas as diverse as elective surgery, mental health, dementia, and primary care be supported to recover and rebuild their capacity and capability to pre-pandemic levels and to respond effectively and flexibly to a backlog of service need that may have built up? How can new service needs, such as those developed for long-COVID, be successfully incorporated into service delivery and recovery? What are the evidence needs particularly related to improving service efficiency and productivity and prioritising need?
- **Understanding and addressing health inequalities** – the pandemic started out as a health crisis but has become a crisis of inequalities. How have existing health inequalities changed during the pandemic and what are the most promising opportunities to intervene to address and reduce those inequalities? How can community-led initiatives to support resilience and recovery make a practical difference to health inequalities? How can interventions be best targeted on individuals, families and communities with the maximum capability to benefit through improved health?
- **Service innovation and learning** – the pandemic has driven a host of changes to the way that health and care services are delivered, and to the organisation of care processes. Much attention has been focused on areas like the use of digital/remote

interactions and technologies, but there are equally important changes to professional roles and functions, to care pathways and service delivery modalities, and to the use of data and analytics. How can service innovations be evaluated robustly and rapidly so that value enhancing changes can be recognised and spread elsewhere?

- Understanding human behaviour** – The pandemic has demonstrated a critical need to invest in infrastructure and research around behavioural insights and risk communication. Whilst various interventions have worked through influencing population behaviour (e.g. individuals staying at home during lockdowns), there have also been unintended consequences (e.g. ‘Protect the NHS’ and help-seeking behaviours for non-COVID related illnesses). We do not have a full enough understanding of the drivers of human behaviour in times of pandemic and endemic, nor of how best to frame and deliver behavioural and risk communications, hence learning the behavioural lessons worldwide from 2020 and 2021 will be important. Teams in public services across Wales have been motivated to use behavioural insights (in their communications and in their interventions) but there has not been sufficient critical infrastructure to support this when needed.

With expertise and capacity in evidence synthesis and knowledge mobilisation, and the ability to conduct some primary (new) research, the COVID-19 Evidence Centre provides an opportunity to work collectively and collaboratively across sectors with an agreed set of shared priorities to help support policy makers and ministers in using evidence to support decision making for recovery and renewal.

Recommendation 7: Welsh Government should support a coordinated national research and knowledge mobilisation programmes for reconstruction, renewal and learning from the pandemic in Wales. Welsh Government should work collectively to agree important strategic areas for further evidence synthesis and review and knowledge mobilisation via the COVID-19 Evidence Centre.

4. Addressing wider harms

Socioeconomic Harms

Wales, in line with the UK as a whole, has experienced a wholly unprecedented fall in economic output, with UK GDP down around 10% in 2020. Economic prospects for the coming year are highly uncertain, and depend on the continuing successful roll out of

effective vaccines - not just in the UK, but across the world. The decrease in output has not been reflected in reductions in household income of similar scale. Official data is not yet available, but it is clear that the average decrease in household incomes has been modest, perhaps a couple of percent.

This decoupling of incomes from output reflects in large part the range of support measures put in place by government. The Job Retention Scheme (JRS), Self-Employment Income Support Scheme (SEISS) and the increase to Universal Credit (UC) have been particularly important. It is vital that the JRS and SEIS are kept in place until recovery is well underway, and are removed in phased manner. There is a strong case for maintaining the increase to UC on a permanent basis, as explained below. While the reduction in average income has – so far – been modest, evidence shows that outcomes have differed sharply across the income distribution, with many of those on low incomes suffering much larger income reductions - in many cases having to increase their levels of borrowing. This reflects the fact that people with low incomes are more likely to work in the sectors that have been hardest hit by the crisis.

In addition, cuts to the welfare system, imposed over the years immediately prior to the crisis, meant that the incomes of this group had fallen even further behind the average, before the effects of the crisis were felt. The JRS and SEISS, and other measures put in place by the UK and Welsh governments have also resulted in a much more moderate decrease in employment, and rise in unemployment, than would otherwise have been expected. The latest data indicates that employment in Wales may have fallen by 2-3 percent so far, a reduction of perhaps 30-40,000 jobs. This reduction is similar to that seen across most of the rest of the UK (London has experienced the largest reduction).

While job losses have been concentrated in some obvious sectors – hospitality, retail, leisure and the arts – few sectors have entirely escaped adverse effects. Job creation has stalled across most of the economy. Young people have been particularly badly affected.

Disruption to education is likely to have long lasting consequences, and to result in a widening of inequalities as the effects will have been felt particularly keenly by those from disadvantaged backgrounds. Young people have also suffered disproportionately in the labour market. This reflects both the fact that young people are more than likely than average to work in the most severely affected sectors and that the stalling of job creation poses particular challenges to new, and recent, entrants to the labour market. UK level data (which is certainly applicable to Wales) indicates that young people account for around half of the fall in employment while accounting for only around 10 percent of the labour force. Young men, and young Black and Asian people, have been particularly badly affected.

While much of the reduction in employment has been offset by increased participation in education, this has not been true for young men or young Black and Asian people.

As with GDP, and for similar reasons, prospects for unemployment are highly uncertain. A further large increase in unemployment seems quite a realistic prospect, particularly if UK government employment support schemes are removed prematurely. In a recovery, employment lags GDP, so even if there is a rapid recovery, it is likely that unemployment will remain elevated for several years. As with previous periods of economic crisis, in addition to the effects on the young, unemployment will be particularly concentrated amongst those who are already disadvantaged in the labour market. This will include people on low pay, with low qualifications, in “fragile” employment, with poor health, or who are at risk of discrimination.

Evidence shows that unemployment, particularly when experienced during a deep recession has “scarring” effects, particularly on the young. These effects result in worsened prospects for future employment, income, health, well-being and even life expectancy. Increased inequality over the long term is therefore a likely consequence. Over the shorter term future, analysis by the Resolution Foundation indicates that if the £20 increase to Universal Credit is removed, the incomes of those on low incomes will be further eroded relative to people on average and higher incomes.

Income reductions and unemployment both reduce wellbeing. However, there is of course also solid evidence that social distancing and reduced socialisation have adverse effects on well-being. Poor mental health is one of the strongest predictors of low well-being, and social isolation and loneliness is in turn very strongly associated with poor mental health. Taking account of the socio-economic effects of the pandemic and the associated restrictions, and making a judgement about the priority with which restrictions should be relaxed, requires the balancing of a wide range of factors and it is not possible to assess effects using a single metric.

The socioeconomic harms subgroup will continue to aim to monitor these harms and help to formulate well-evidenced policies to mitigate socioeconomic harms. The equity impacts of COVID and Government and community responses need to be considered for different groups, in terms of occupation, ethnic groups, whether individuals have a garden, a car, or money in the bank, as so far the pandemic and the response have exacerbated health and economic inequalities. The group will continue to input into Government decision making and look to commission or synthesise research where necessary. The group will continue to liaise with wider determinants experts in PHW and with the Welsh Health Equity Status Report initiative (WHESRi). The group can help to facilitate existing research into the

pandemic to consider dynamic relationships between health, human capital and productivity in their outcomes.

Inequalities

One of the consequences of the COVID-19 pandemic has been to illuminate far-reaching health and socioeconomic inequalities. The pandemic's impact has fallen disproportionately on the most vulnerable individuals and along racial, ethnic, occupational, and socioeconomic lines. Inequalities in people's protection from, and ability to cope with, this pandemic and its tremendous societal costs stress the importance and urgency of the challenge and the changes needed to protect population health and wellbeing in the future'.²¹

The Institute for Fiscal Studies' Deaton Review²² explicitly sets out the role of inequality in many forms and the crisis the pandemic will leave behind i.e. legacies for inequality. Looking ahead, the review notes the light at the end of the tunnel is that the pandemic and the response required by government will also bring opportunities (e.g. allowing mother's careers to develop if able to work from home more and/or fathers able to spend more time with children, removing the dominance of London (and other cities) and perhaps new ways of looking at social security from the perspective of key workers. After decades of describing inequality (and well intentioned efforts to intervene) the pandemic may be the prompt to make the radical changes necessary.

The COVID-19 Marmot Review into health inequalities and the pandemic also²³ reinforces the need to build back fairer. Marmot and colleagues refer to the austerity measures introduced following the global financial crisis and how these undermined the UK's ability to respond to the pandemic, carrying on a tradition of research into health inequalities over many decades. The review also notes how the virus has reinforced the existing inequalities in place pre-COVID-19.

There are wider potential consequences of efforts to address COVID-19 that have perhaps not sufficiently considered inequalities, such as moving to online shopping with potentially more precarious delivery jobs, people working in warehouses where COVID-10 security may

²¹ [https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667\(21\)00011-6/fulltext#:~:text=England's%20inequalities%20are%20reflected%20in%20the%20COVID%2D19%20pandemic.&text=Unemployment%20could%20rise%20as%20high,recover%20economically%20from%20the%20pandemic.](https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(21)00011-6/fulltext#:~:text=England's%20inequalities%20are%20reflected%20in%20the%20COVID%2D19%20pandemic.&text=Unemployment%20could%20rise%20as%20high,recover%20economically%20from%20the%20pandemic.)

²² <https://www.ifs.org.uk/inequality/covid-19-and-inequalities/>

²³ <https://www.health.org.uk/publications/build-back-fairer-the-covid-19-marmot-review>

be an issue and the fact that home working will not be suitable for many in lower paid jobs, those in public facing jobs being more likely to be deprived or disproportionately represented by people of colour; or inequalities driven by digital exclusion and so on. Building back fairer means having a commitment to addressing these structural inequalities such that society is fairer and outcomes are not disproportionately poorer in certain groups next time there's a public health emergency.

In terms of the impact of the pandemic, a gender dimension has emerged and will require further examination. For example, recent ONS data²⁴ illustrate that while mortality has been higher among men, women have been harder hit in terms of wellbeing, as well as being more likely to be furloughed, spend less time working from home and more time on unpaid household work and childcare. Similarly, a 'gender health paradox' has been identified, where men may have shorter life expectancy and higher mortality rates, but women report higher morbidity²⁵.

While we can look at the impacts of ethnicity, gender, socio-economic status and so on, it is also critical the intersectionality of these determinants of inequality are recognised, highlighting the importance of being joined up in all of this.

We are well placed to address this challenge in Wales, with legislation already in place that requires us to integrate this thinking into all policies (Well-being of Future Generations (Wales) Act 2015²⁶, explicitly recognising the need for a healthier Wales, prosperous Wales and crucially, a more equal Wales. The focus on future generations also provides the basis on which to focus attention on younger people and the impacts of the pandemic thus far in terms of early development, education and future prospects. The legislation should already be shaping thinking on climate change, the future of work, the built environment and so on and the pandemic will no doubt accelerate this thinking.

Other work underway will also contribute to this agenda. For example, Public Health Wales announced an agreement last November with the WHO European Office to progress activity

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<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19andthedifferenteffectsonmenandwomenintheukmarch2020tofebruary2021/2021-03-10>

²⁵ <https://journals.sagepub.com/doi/full/10.1177/1403494820975604>

²⁶ <https://www.futuregenerations.wales/about-us/future-generations-act/>

on health equity²⁷. One component is placing health equity at the heart of the COVID-19 sustainable response and recovery – subtitled building prosperous lives for all in Wales²⁸.

Inequality has recently been drawn into sharp focus with vaccine deployment. Vaccine refusals appear to be low, however survey data suggests greater vaccine hesitancy in younger adults, people with fewer qualifications, people living in more deprived areas and some ethnic minority groups. The reasons for refusals or hesitancy are complex and varied, including distrust in vaccines, potential side effects and perceived low benefits. In their enhanced surveillance report, Public Health Wales has reported emerging inequalities in COVID-19 vaccine coverage with lower coverage in groups at increased risk of severe COVID-19 outcomes, including minority ethnic groups and those living in more deprived areas. The reasons for these differences may relate to individual, community or service characteristics. Identifying areas of inequality present an opportunity to address the challenges for groups who may be otherwise disproportionately impacted as restrictions are relaxed.

Recommendation 8: Welsh Government should collect and use all appropriate evidence to formulate well-evidenced policies to mitigate socioeconomic harms across society and address long standing inequalities, especially where they have been exacerbated by COVID-19.

Children and Education

So far during the pandemic, children have been at lower risk of serious illness or death, but have been significantly impacted by the restrictions put in place to control the transmission of COVID-19. Their educations have been disrupted, which is likely to have long-term economic and social consequences. They have also seen a significant range of impacts on their physical and mental health and their wider well-being. As with the impacts of the pandemic on other age groups, these impacts will not be evenly distributed across children in Wales, but will almost certainly have exacerbated some existing inequalities while potentially also creating some new disadvantages for some children.

In the coming months it will be important to better understand the balance between the direct harms on children and indirect harms of schools closing on site provision for most pupils, and of other restrictions or consequences such as changes in the provision of childcare,

²⁷ <https://www.euro.who.int/en/health-topics/health-determinants/social-determinants/news/news/2020/11/new-agreement-between-whoeurope-and-welsh-government-launched-to-accelerate-action-on-health-equity>

access to health services, and social interaction outside children's households. The impact on education, wider physical and mental health and well-being will need to be considered alongside the direct COVID impacts of the pandemic (bearing in mind that a small proportion of children have suffered serious illness as a result of COVID, and that it is possible new variants could emerge which could have a more significant direct health impact on children). Where possible measures of these direct and indirect impacts will need to be identified to ensure these are understood.

It is not enough to understand these impacts, however. Actions can put in place to mitigate impacts and so it will be important to understand how effective mitigations can be. The effectiveness of mitigations in reducing transmission of COVID-19 (for example a move to remote learning, wearing of face coverings in schools, building understanding of infection risk into the curriculum and longer term structural adaptations of the school estate) and of mitigations in reducing the wider impacts of the pandemic (such as the potential for additional educational support or mental health support), will both need to be considered. As with impacts, where the effectiveness of these mitigations can be measured it will be important to identify how this will be done. In order to prepare for the likely ongoing impacts of COVID-19 in the coming years, a plan for ongoing deployment of mitigations will be needed before the end of the 2020/21 academic year. For example, planning on the basis that further restrictions may be required in late 2021 may require work to ensure blended learning can support good educational outcomes if and when needed.

In considering the impacts and the mitigations required, it will be important to take a population-based approach rather than considering each service accessed by children in isolation. This would involve adopting an explicit 'whole child' approach bringing together health, social services, education, housing, transport, leisure and other services. In putting in place mitigations to address the impacts of the pandemic on children there could also be opportunities to provide a system of support and services which works better for all children, especially those who are disadvantaged. This would require cross-Government working and decision-making.

Recommendation 9: Working with stakeholders Welsh Government should measure, understand and mitigate accrued educational and other harms to children and young people, as well as, improving approaches to respond to future waves will be important.

5. International

Since the appearance of the virus in China in early 2020, the virus has spread to every country in the world. However, the experiences of countries have differed widely with many western countries (Europe and north and south Americas) having been hit particularly badly where as some of the more socially conservative, restrictive or compliant countries have been able to control the virus more effectively. It seems that the freedoms enjoyed by the liberal democracies have allowed the virus to spread more effectively. This is not universal as both Australia and New Zealand and many island nations in the Pacific have been very effective at controlling the virus. Similarly, countries in Eastern Europe limited the spread of the first wave of the pandemic by early and effective border controls (closure or severe restrictions on travel). In the Pacific island nations, the spread of the virus has been controlled by almost complete closure of their borders – mainly airports as air travel is the main access transport mode to these countries. It is quite clear that controlling cross border travel is an effective measure so long as it is severe and rigorous (enforced quarantining on entry).

To some extent, countries in Eastern Europe not impacted heavily in the first wave (February through to May 2020) were lulled into a false sense of security and this was demonstrated when the post summer holiday season was over and returning to work, schools, etc. created the ideal conditions for severe second waves, more so than in the west European countries which had been hit harder in the first wave.

In South America and parts of Africa, the first wave did not materialise until much later and peaked initially in August, i.e. during the southern hemisphere winter. This was in sharp contrast to the European situation where infections levels fell to very low levels during the northern hemisphere summer. This was thought to be evidence of emerging seasonality but was just as likely to be due to the imposed lockdowns and the cycling in and out of lockdown in response to resurgences experienced in many countries supports this, i.e. imposition of NPI controls suppresses the infection rate.

As predicted, the western northern hemisphere experienced a wide resurgence of the virus during autumn months necessitating imposition of NPI controls and lockdowns, most of which were reasonably effective (but effectiveness differed in different countries). There was a lot of fear that the USA Thanksgiving celebrations would encourage a wide spread resurgence as people ignored NPI controls and travelled more widely but if there was an effect, it was not readily observable above the very rapid increase that the USA was

experiencing at the time. Nevertheless, the risks associated with national celebration events such as Christmas was real and this became apparent in several European countries, but not all, over the Christmas period and into January. However, in the UK, a big part of the Christmas 'rise' was caused by the appearance of the new 'Kent' Variant of Concern. About the same time, new Variants of Concern emerged in South Africa and Brazil and attention is now turning to the risk of these. The 'Kent' variant has spread very rapidly to many countries across the world and WHO expects that it will become the dominant world variant in the first part of 2021.

Additional to the Kent variant, the Brazil variant is spreading but not as widely yet as either the South Africa and Kent variants but it has the potential to do so because evidence is emerging from Manaus in northern Brazil that this P.1 variant is more easily transmissible and evades immune responses initiated by previous infections and, potentially, immunity from vaccines.

The capacity to undertake genomic testing is critical to detecting new variants but many countries have either very limited testing or no testing capability at all. There remains a real threat that new variants will emerge and not be detected until it is too late to control their spread. Such situations have profound implications when considering international travel, especially air travel for holidays and vacations as was demonstrated following the summer holiday season in 2020.

The UK, along with much of Europe and North America, is very fortunate in having well developed and resourced testing and health care systems, the financial resources to support people during lockdowns and imposition of NPI controls and the rollout of vaccines. Many countries in the world do not have these advantages and these countries pose a continuing risk for harbouring infection with many variants which raises the prospect of evolution of new variants or recombination events of existing variants. This is a global problem that is not going to go away.

The whole future likely situation demands continued great vigilance and monitoring of the international scene backed by the readiness/willingness to impose travel restrictions and controls of a severe and widespread nature (e.g. enforced quarantine hotel controls or complete travel bans).

Recommendation 10: Welsh Government must retain vigilance of the international scene and must be willing to maintain existing and impose new tight travel controls or travel bans swiftly upon emergence of variants of concern.

6. Conclusions

COVID-19 has caused significant harms in Wales, more harm will be accrued in the coming years. Identifying these harms and using evidence-based adaptive approaches will help us overcome them and prosper. Our understanding of this disease will grow and our experiences will also help us tackle other longer term and future public health challenges (e.g. climate change). Covid-19 has tested us all and it is important that we learn from these experiences and ensure that we, and future generations, are able to deal with the future challenges and health threats. Wales has a significant role that it can play at a UK and international level to lead by example and collaborate with others in using evidence to address its problems and act as an exemplar in this way of working.

Inevitably COVID-19 will present us with complex problems that require us to work with all of our partners and the public to find sensible solutions together. Identifying and calling out inequalities such that they can be addressed together, with evidence, should remain a priority. COVID-19 will also present us with opportunities for growth. By embracing the challenges and opportunities together Wales will prosper.