Institution: University of Oxford		
Unit of Assessment: 21 Sociology		
Title of case study: Demographic and Sociological interventions during COVID-19		
Period when the underpinning research was undertaken: Jan 2016 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Melinda Mills	Nuffield Professor of Sociology	01.06.14 - Present
Jennifer Dowd	Associate Professor	05.11.19 - Present
Per Block	Departmental Research Lecturer	01.01.20 - Present
Richard (Charles) Rahal	Departmental Research Lecturer	01.01.18 - Present
Valentina Rotondi	Postdoctoral Researcher	01.10.19 - Present
Period when the claimed impact occurred: March 2020 – December 31 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact (indicative maximum 100 words)

The Leverhulme Centre for Demographic Science (LCDS) has been at the forefront of COVID-19-related research into age-specific patterns of COVID-19 mortality and excess mortality, 'hotspots' of infection and healthcare supply, support bubble formation, face coverings, and vaccine deployment. This research has shaped policy-making at the highest level in response to the pandemic, both in the UK and abroad. In particular, the research led directly to the adoption of mandatory face coverings in indoor public spaces in England from July 2020 and government communication initiatives regarding vaccine deployment. Research by the LCDS on social bubbles influenced domestic policy and international practice. The research has also garnered international press attention and helped frame public discourse on COVID-19 policies, action and protective measures.

2. Underpinning research *(indicative maximum 500 words)*

The work of the LCDS, launched in October 2019 for a period of 10 years under the leadership of Professor Melinda Mills, applies empirical approaches to providing evidence-based policy. This positioned it perfectly to provide rapid scientific evidence and policy advice as COVID-19 spread.

The methodology and approach developed in **R1**, a scientometric review of genome-wide association studies from 2005 to 2018 (3,639 studies; 3,508 traits), was adopted and evolved in two major studies examining socio-behavioural aspects related to face-coverings **[R2]** and vaccine deployment **[R3]**. Whereas **R1** engaged with a single Application Programming Interface (API), it was expanded for **R2** and **R3** to include multiple APIs (Scopus, PubMed, Web of Science), thereby encompassing not just medical literature, but also relevant socio-behavioural, policy, engineering and other academic articles to give a broad-base empirical foundation for policy recommendations.

Royal Society and British Academy evidence reviews on Face-Coverings and Vaccine Deployment

Professor Mills led both of these major studies as a member of the Royal Society's Science in Emergencies Tasking: COVID-19 (SET-C) Group which provides rapid reviews of scientific evidence for the Government Office for Science. The first investigated the effectiveness of different types of face coverings and isolated behavioural factors that have limited adherence, such as public understanding of the virus transmission, risk perception, trust, effectiveness of public messages and perceived barriers **[R2]**. Its key messages to policy makers were: (i) Cloth face coverings are effective in reducing source virus transmission, i.e. outward protection of others, when they are of optimal material and construction (high grade cotton, hybrid and multilayer) and worn properly; (ii) Socio-behavioural and cultural factors are vital to understanding public adherence to wearing face coverings, and therefore, consistent and effective public messaging is vital to public compliance; and (iii) Face coverings should not be

seen in isolation, but as part of a 'policy package' of measures, including hand hygiene, social-distancing and bubbles.

The second report **[R3]** focused on the historical, ethical, and socio-behavioural factors related to vaccine uptake in order to aid policy makers in the UK, and globally, to plan effective and equitable vaccine deployment. Its focus on communication through dialogue, and on understanding rumours and misinformation, led to the conclusion that risk, trust and rumour underpin vaccine anxieties and resistance. This systematic review contained a series of recommendations for vaccine roll-out, including suggested prioritisation cohorts for phases one and two, particularly that in phase two the roll-out should move beyond mortality and age-based cohorts to prioritise non-health care occupations experiencing the highest levels of infection and death. It also stressed the importance of communicating a clear and transparent rationale, filling knowledge voids, and communication at the local level.

Social bubbles

Per Block led a social-network study, together with multiple members of the LCDS, including Dowd, Mills and Rahal **[R4]**. This paper evaluated the effectiveness of three targeted distancing strategies designed to 'keep the curve flat' and aid compliance during lockdown: limiting interaction to a few repeated contacts (bubbles), seeking similarity across contacts and strengthening communities via triadic strategies. The conclusions provided scientific evidence to underpin the formation of social bubbles by individuals, schools and workplaces.

Corona hotspots dashboard

Mills, Dowd and other LCDS researchers published an article **[R5]** and interactive online 'Corona Hotspots Dashboard' in March 2020 which combined census estimates and hospital capacity data from the ONS and NHS at various levels for England and Wales. The interactive dashboard offered the ability to examine more granular levels of risk, including estimates of expected hospitalisation and hospital burden and likely hospitalisation and COVID-19 deaths linked to localised demographic and socioeconomic variation.

Demographics of COVID-19 Mortality

Dowd, with multiple LCDS researchers **[R6]**, led an early examination (first published April 2020) of COVID-19 fatality rates. This paper found that COVID-19 mortality risk is concentrated in older age groups, with population age composition a key predictor of case fatality rates. Consequently, they predicted that countries with older populations, (e.g. Italy) would experience more deaths than those with younger populations (e.g. Korea). Therefore, intergenerational interactions and policies that bring different age groups together (e.g. closing schools) could have inadvertent negative consequences.

3. References to the research (indicative maximum of six references)

R1. Mills, M. C., R. C. Rahal, 'A Scientometric Review of Genome-wide Association Studies', *Communications Biology*, 2 (2019) https://doi.org/10.1038/s42003-018-0261-x [output type: D]

R2. Mills, M. C., R. C. Rahal, E. T. Akimova, 'Face Masks and Coverings for the General Public: Behavioural Knowledge, Effectiveness of Cloth Coverings and Public Messaging.' SET-C Report, The Royal Society and British Academy. 26 June 2020. https://royalsociety.org/-/media/policy/projects/set-c/set-c-facemasks.pdf?la=en-GB&hash=A22A87CB28F7D6AD9BD93BBCBFC2BB24 [output type: N]

R3. Mills, M. C., R. C. Rahal, D. M. Brazel, 'COVID-19 Vaccine Deployment: Behaviour, ethics, misinformation and policy strategies,' SET-C Report, The Royal Society and British Academy. 21 October 2020. https://royalsociety.org/-/media/policy/projects/set-c/set-c-vaccine-deployment.pdf?la=en-GB&hash=43073E5429C87FD2674201CA19280A8E [output type: N]

R4. Block, P., M. Hoffman, I. J. Raabe, J. B. Dowd, R. Rahal, R. Kashyap,and M. C. Mills, 'Social Network-based Distancing Strategies to Flatten the COVID-19 Curve in a Post-lockdown World.' *Nature Human Behaviour* 4 (2020), 588-596. https://doi.org/10.1038/s41562-020-0898-6 [output type: D]

R5. Verhagen, M., D. M. Brazel, J. B. Dowd, I. Kashnitsky, and M. C. Mills, 'Forecasting Spatial, Socioeconomic and Demographic Variation in COVID-19 Health Care Demand in England and

Wales.' *BMC Medicine* 18, no. 1 (2020), 1-11. https://doi.org/10.1186/s12916-020-01646-2 [output type: D]

R6. Dowd, J., L. Andriano, D. M. Brazel, V. Rotondi, P. Block, X. Ding, Yan Liu, and M. C. Mills, 'Demographic Science Aids in Understanding the Spread and Fatality Rates of COVID-19.' *Proceedings of the National Academy of Sciences of the United States of America,* 117: 18 (2020), 9696-698. https://doi.org/10.1073/pnas.2004911117 [output type: D]

All pieces listed have been peer-reviewed. The research is part of a body of work funded by the ERC (SOCIOGENOME: EUR2,000,000, 2014-2017; CHRONO: EUR2,500,000, 2019-2024), and the Leverhulme Trust (Leverhulme centre for Demographic Science:GBP10,000,000, 2019-2029). Mills was the PI in all cases.

4. Details of the impact (indicative maximum 750 words)

Research into COVID-19 by the Leverhulme Centre for Demographic Science (LCDS), led by Professor Melinda Mills, has helped produce a range of evidence-based scientific advice to shape policy-making at the highest level, as well as raising public awareness of measures to stop the spread of the virus. Impacts resulted in a range of COVID-19 responses and prevention measures.

Face-Coverings: Policy and subsequent public practice change

The Royal Society and British Academy face coverings study, led by Mills **[R2]**, highlighted the effectiveness of face coverings in controlling the virus and called for consistent public messaging. **R2** was published on 26 June 2020 and presented to the Scientific Pandemic Influenza Group on Behaviours (SPI-B) on 3 July 2020 **[E1]**. The role of the SPI-B, of which Mills is a member of the coordination team, is to provide expert behavioural advice to the Scientific Advisory Group for Emergencies (SAGE), which is chaired by the UK Government Chief Scientific Adviser, Sir Patrick Vallance. [Text removed for publication]

In announcing the measure, Prime Minister Boris Johnson, pointing to the *'scientific evaluation of face coverings and their importance in stopping aerosol droplets*', stated that face coverings offered '*a great deal of value'* in controlling the spread of the virus **[E3]**. Sadiq Khan, The Mayor of London, in response to the announcement, said, *'I am pleased the Government have finally listened – not just to me – but to the clear overwhelming scientific advice from the World Health Organisation, Royal Society* **[R2]***, British Medical Association and others, who have echoed my calls for face coverings to be mandatory in enclosed and busy places such as shops*' **[E2a&b]**. The report was also used as part of the Greater London Authority's (GLA) communications to residents and visitors to London **[E2a]**. These communications have, according to the Mayoral Health Adviser, *'impacted not only the population of those living in London (around 9 million), but also millions of visitors (estimated at around 11 million in 2020), and our face coverings page has had hundreds of thousands of unique views since March'* **[E2a]**. The Mayor of London also directly referenced the report **[R2]** in his social media, particularly on his Facebook page **[E2c]**.

Vaccine Deployment: Policy and Communication

In a House of Lords debate in November 2020, Lord Patel pointed to the challenges in delivering an effective national vaccination programme: '*as Professor Melinda Mills, in a report from the Royal Society and British Academy* **[R3]***, pointed out, not the least* [challenge] *is honest, transparent public communication free from hyperbole'.* In response, Lord Bethell, the Parliamentary Under-Secretary of the Department of Health and Social Care, agreed, stating that '*we take seriously our efforts to reach hard-to-reach communities – those who might not have confidence in the Government'* and consequently that Jonathan Van-Tam, the Deputy Chief Medical Officer, had been appointed '*the face of the vaccine, as it were'* **[E4]**.

A '*culturally tailored communication strategy'* and *'monitoring of vaccine status and vaccine-related beliefs and behaviours alongside existing monitoring of adherence'* were recommendations to come out of the 17 December 2020 SAGE meeting **[E6a]**. These recommendations featured in two separate documents that were presented at the meeting, one from the SPI-B group regarding the possible impact of the Covid vaccination programme **[E6b]** and another on factors influencing vaccine uptake **[E6c]**, both of which referenced **R3**. The UK

COVID-19 vaccines delivery plan **[E5]** consequently made provision for local, targeted communications, as *'local authorities know their communities best'*, citing Hertfordshire County Council as an example of a pro-active local authority, *'leading significant research in this area'*. Hertfordshire's research, published December 2020, contains a detailed precis of **R3** and directly quotes Mills' statement that local authorities need to *'generate an open dialogue that addresses misinformation and does not dismiss people's real vaccine concerns and hesitancy'* **[E6d]**. A national Community Champions Programme, which will work with 65 local authorities across England to reach out to ethnic minority and disabled communities, will support *'the sharing of this* [Hertfordshire's] *approach and other best practice examples'* **[E5]**.

Social Bubbles: Influence on UK policy and International Practice

The Parliamentary Office of Science and Technology (POST), in a parliamentary briefing paper (7 May 2020) extensively cited **R4** findings that a cluster of a few repeated contacts (bubble) was the most effective strategy for keeping infection risk low **[E7]**. On 13 June 2020, the UK government changed its guidance to allow people living alone to form a 'support bubble' with one other household **[E8]**.

The evidence provided to support social bubbles presented in **R4** was widely picked up by the worldwide media, including outlets such as the BBC, CNN and Euronews **[E10b]**. This wide dissemination of the research led to enquiries around the world from organisations regarding social bubble implementation. For example, the European Centre for Disease Prevention and Controls recommended employment of bubbles in their guidance on infection prevention and control of COVID-19 in migrant and refugee reception and detention centres **[E9a]**. In the US, Sullivan County School District, Pennsylvania, implemented a 'cohorting' protocol to minimise the risk of widespread contagion, a policy, according to one of their pandemic co-ordination team, *'based on the article* [Block] *published in Nature Human Behavior'* **[E9b]**.

Filling the Information Void: Informing the Public

R1-6 all received substantial media attention around the world and helped frame social discourse and public debate on matters concerning disease mitigation measures, demographic spread of the virus and likely hotspots of virus impact. Professor Mills was interviewed on a substantial variety of TV and radio channels, including the BBC World, CNN, Sky News, and multiple foreign national outlets regarding the findings in **R2 [E10a]**. LCDS's initial study on the demographics of COVID-19 mortality rates in Italy and England and Wales **[R6]** garnered attention from policy-makers and the media. Newspapers across the world covered the results of the study, including the New York Times, The Wall Street Journal, News18 India, Il Post, The Sydney Morning Herald and National Geographic España and The Economist **[E10c]**. The research **R1-6** has also been widely disseminated through the *Dear Pandemic* initiative, run by a group of female academics, of which Dowd is a co-founder. Through mainstream and social media outlets this group engages in public health outreach, and its Facebook page alone had over 60,000 followers at the end of 2020 with posts between 9 August and 15 September 2020 reaching a total audience of 1,022,226.

Ongoing Impact

At the time of writing (early 2021), the LCDS research **[R1-6]** has been in the public sphere under a year and the above represents only the beginning of its impact, and as at the end of 2020 various impact pathways were in train. The LCDS team is working with NHSx to adapt and develop its online Corona Hotspots Dashboard **[R4]** to predict health and deprivation hotspots to allow the NHS and local authorities to manage resources at a local level. A Dutch version of the Corona Hotspots Dashboard using added microdata from *Statistics Netherlands* (CBS = Centraal Bureau voor de Statistiek) has already been developed as an app in partnership with the Amsterdam Health & Technology Institute **[E11]**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

E1. Letter from Sir Patrick Vallance, UK Government Chief Scientific Adviser (6 January 2021)

E2. Mayor of London's Office:

a) Letter from the Mayoral Health Advisor, Greater London Authority (26 November 2020)
b) Press Release, 'Mayor responds to government announcement on face coverings (14 July 2020)
c) London Mayor Social Media directly referencing R1, Facebook (3 October 2020)

E3. Boris Johnson, announcement on face coverings, 13 July 2020, https://news.sky.com/story/coronavirus-britons-should-be-wearing-face-masks-in-shops-says-boris-johnson-12027625

E4. House of Lords Debate (11 Nov 2020) vol. 807 col. 1036, https://hansard.parliament.uk/Lords/2020-11-11/debates/1A4CED44-2113-4B5B-BE93-6AF87328D38F/Covid-19Vaccine#contribution-0210E3EF-38B3-47F0-BD33-95E54C66CB9C and on *Today in Parliament*, (11 Nov 2020), BBC Radio 4, min.23:30 https://learningonscreen.ac.uk/ondemand/index.php/prog/1746FAAF?bcast=133206495

E5. HM Government – UK COVID-19 vaccines delivery plan https://www.gov.uk/government/publications/uk-covid-19-vaccines-delivery-plan/uk-covid-19-vaccines-delivery-plan

E6. Vaccine communication - https://www.gov.uk/government/collections/sage-meetings-december-2020#meeting-73,-17-december-2020

a) SAGE 73 minutes: Coronavirus response, 17 December 2020
b) SPI-B: Possible impact of the COVID-19 vaccination programme on adherence to rules and guidance about personal protective behaviours aimed at preventing spread of the virus, 17 December 2020
c) Factors influencing COVID-19 vaccine uptake among minority ethnic groups, 17 December 2020
d) Hertfordshire County Council Behavioural Change Unit: COVID-19 Vaccination: Reducing vaccine hesitancy (December 2020), pp.3, 6, 9-10, 17 & 22.

E7. Parliamentary Office of Science and Technology, "Light switches and clusters: social distancing strategies for COVID-19", 7 May 2020, https://post.parliament.uk/light-switches-and-clusters-social-distancing-strategies-for-covid-19/

E8. BBC News online (13 June 2020), 'Coronavirus lockdown: Support Bubbles begin in England and NI https://www.bbc.co.uk/news/uk-53031844

E9. Social Bubbles – International Impact examples:

a) European Centre for Disease Prevention and Control. Guidance on infection prevention and control of coronavirus disease (COVID-19) in migrant and refugee reception and detention centres in the EU/EEA and the United Kingdom – June 2020.
b) Sullivan Country School District Health and Safety Plan 2020-21 (p.17) and email from member of the pandemic coordination team.

E10. Collection of Media relating to R1-R6:

a) Selection of media and altmetrics re **R2** and **R3** including BBC News (7 July 2020), Huffington Post (15 July), The Guardian (7 July).
b) Selection regarding social bubbles **[R4]** including from CNN (29 & 30 Apr 2020), BBC News Mundo (2 May), Euronews (8 May), Bloomberg (4 June), MIT Technology Review (4 June), Smithsonian Magazine (28 May).
c) Selection regarding **R6** including Il Post (16 March 2020), National Geographic Espana (19 April), New York Times (8 April), News18 India (16 March), Sydney Morning Herald (4 April).

E11. Amsterdam Health and Technology Institute (AHTI) Press announcement re COVID-19 dashboard - https://ahti.nl/nieuws/nieuw-covid-19-dashboard-geeft-inzicht-in-risico-hotspots-op-hoge-zorgdruk-bij-tweede-golf/