England physical distancing policies and epidemiology from January - September 2020: A case report

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Conflicts of Interest

No conflicts of interest were reported.

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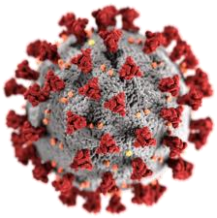
I. Introduction and project description

A new disease that spread around the world

On December 31, 2019, the World Health Organization (WHO) was notified of a cluster of individuals with pneumonia of unknown cause in Wuhan, China. (1) On January 12, 2020, China shared the genetic sequence of the novel coronavirus with other countries to help develop diagnostic tests. (1) Thailand reported the first known case of the novel coronavirus outside of China on January 13, 2020. WHO declared the novel coronavirus (2019-nCoV) outbreak a Public Health Emergency of International Concern on January 30, 2020 with 7,711 confirmed cases, 12,167 suspected cases, and 170 deaths in China and 83 cases in 18 countries outside of China. (1,2) The disease was later named COVID-19 for coronavirus disease 2019 and the virus referred to as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). (1) WHO declared COVID-19 a pandemic on March 11, 2020. (1)



Physical distancing policies and knowledge gaps

As an emerging infectious disease, there initially were no effective vaccines or preventive treatments for SARS-CoV-2. Therefore, governments have had to rely on the use of public policies to combat the spread of the virus. (1-4) Creating policies has been difficult due to the large amount of information and ongoing uncertainty around the characteristics of the virus and whom it affects. (4) One of the most commonly used policies to mitigate (slow) the spread of the virus that causes COVID-19 centres on physical or social distancing, which relies on separating people to reduce the transmission of the virus. (5) However, it is still unclear when is the best time to institute such policies and what happens when distancing policies are eased. There are many aspects of distancing, such as recommendations for maintaining a physical distance in public, banning group gatherings, or complete lockdowns, that complicate their assessment. (5) There are also many factors that have been attributed to people acquiring or having a worse outcome from COVID-19. (6-11) However, there is no harmonized database available with all the policies, epidemiology and contextual information that is needed in order to perform comparative analyses useful to informing policy making.

About this project

The Policy Frameworks and Epidemiology of COVID-19 Working Group was developed after a "CONVERGE Virtual Forum: COVID-19 Working Groups for Public Health and Social Sciences Research." A group of international researchers convened to explore what physical distancing policies countries implemented and their effects on the epidemiology of COVID-19. The Working Group was further supported through an award from CONVERGE and the Social Science Extreme Events Research (SSEER) Network. CONVERGE is a National Science Foundation funded initiative headquartered at the Natural Hazards Center at the University of Colorado Boulder.

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II. Methods

Research design

A qualitative embedded multiple case study research design was used to compare countries (or subnational jurisdictions, such as provinces, states or territories). The suite of public policies and resulting changes in the epidemiology of COVID-19 are examined within their specific country setting. Our cases start in January 2020 and end in or around August 2020. (Please see full study proposal). Research ethics approval was obtained by the Hamilton Integrated Research Ethics Board (HIREB) (Project # 11243).

Data collection

For each country, the setting, such as health systems, political systems and demographics were described to help with interpretation of findings and potential transferability, or the degree to which findings are applicable to other sites or future research.

Publicly available data was first collected on the jurisdiction following a standardized data collection form. Epidemiological data was drawn from publicly available data. WHO, World Bank, Central Intelligence Agency and other publicly available sources were used for timelines and country characteristics, where possible. Other sources of information included governmental and non-governmental websites, news articles, government reports, and peer-reviewed journals.

Next, key informant interviews were conducted to fill in gaps, verify information found through the documentary searches, and identify further participants and documentary sources of relevant information. (See informed consent and interview guide) Key informant interviews were conducted with policymakers, health workers, researchers and other stakeholders as appropriate to fill in knowledge gaps.

Data analysis and presentation

Our COVID-19 policies and epidemiology databases harmonize data on setting characteristics, policies, demographic characteristics and epidemiological risk factors and outcome metrics. These will further be described in single country or jurisdiction case reports. Comparisons will be selected based on both literal and theoretical replication. Countries that have similarities in either policies or epidemiological trends can be considered literal comparisons, whereas countries that differ will be used as theoretical comparisons. These comparisons will be submitted to peer-reviewed journals for publication.

III. Findings

A. Setting characteristics

Geographic, environmental, social and economic contextual factors

England is a Nation within the United Kingdom of Great Britain and Northern Ireland (UK). England is in the WHO Region of Europe. (12) England has a population of 56,286,961 and a population density of 432 people/km^2. (13) The population is most tightly clustered in the Southeast around London, Northwest around Manchester, and Northeast near the Scottish border. Approximately 83% of English residents live in urban centers. (14)

Figure 1. Heat map of UK with total per capita COVID infections: 29 November 2020 (15)

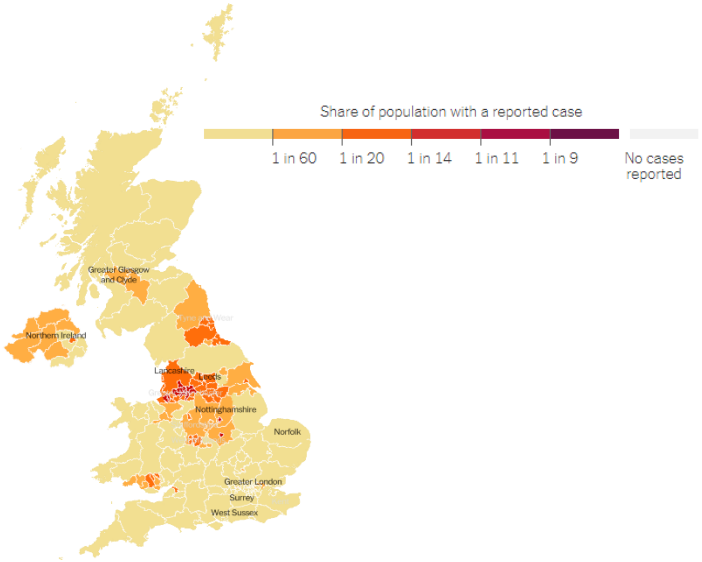


Figure 2. Global Health Security Index Epidemic Preparedness Rank Category (16)

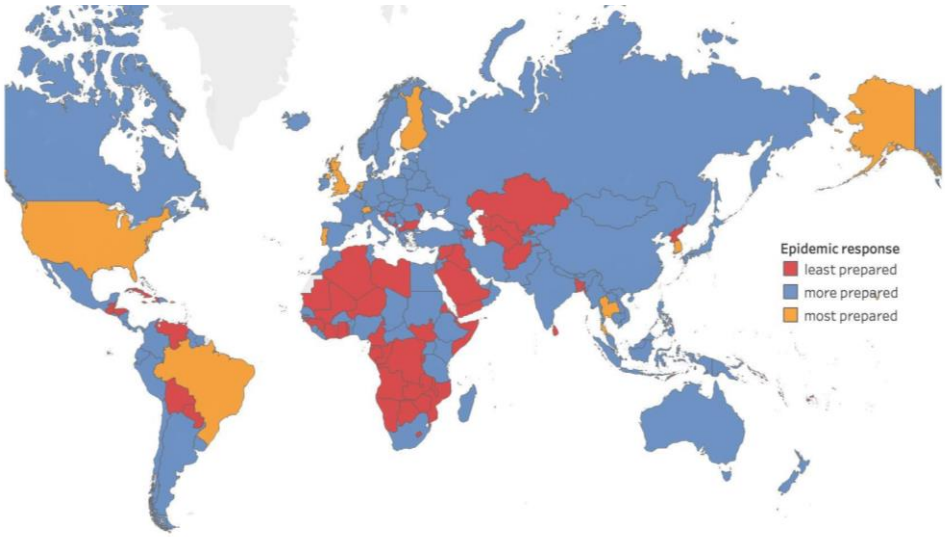


Table 1. COVID-19 relevant contextual factors for the United Kingdom

Global Health Security Index, 2019 (Overall Index Score out of 100 and category) (16)	77.9 - Most prepared (United Kingdom)
Global Health Security, 2019 (Epidemic Preparedness Index Score out of 100 and category) (16)	91.9 - Most prepared (United Kingdom)
Particulate matter (PM2.5) air pollution, mean annual exposure, 2016 (micrograms per cubic meter) (17)	10.47 (United Kingdom)
PM2.5 air pollution, population exposed to levels exceeding WHO guideline value, 2015 (% of total) (17)	66.53 (United Kingdom)
International migrant stock, 2015 (% of population) (18)	13.2 (United Kingdom)
Trust in national government, 2018 (% of population) (19)	51.02 (United Kingdom)
Mobile cellular subscriptions, 2018 (per 100 people) (20)	118.37 (United Kingdom)
Individuals using the internet, 2019 (% of population) (21)	92.52 (United Kingdom)
Index of economic freedom, 2020 (Rank and category) (22)	79.3 - Mostly free (United Kingdom)
World Bank classification, 2020 (23)	High income (United Kingdom)
Gini Index, 2016 (24)	34.8 (United Kingdom)
GDP per capita, PPP, 2019 (Current international $) (25)	48,709.70 (United Kingdom)
GNI per capita, PPP, 2019 (Current international $) (26)	48,040 (United Kingdom)
Current health expenditure, 2017 (%) (27)	9.6 (United Kingdom)
Vulnerable employment, total, 2020 (% of total employment) (28)	12.94 (United Kingdom)
Vulnerable employment, female, 2020 (% of female employment) (29)	9.59 (United Kingdom)
Vulnerable employment, male, 2020 (% of male employment) (30)	15.91 (United Kingdom)
Homelessness, 2017 (%) (31)	0.26 (United Kingdom)
Adult literacy rate, 2018 (%) (32)	-- (United Kingdom)
Literacy rate, adult female, 2003 (% of females 15 and above) (33)	99 (United Kingdom)
Literacy rate, adult male, 2003 (% of males 15 and above) (34)	99 (United Kingdom)
Primary school enrolment, 2017 (% net) (35)	99.49 (United Kingdom)

GDP - gross domestic product; **GNI** - gross national income; **PPP** - purchasing power parity

Population health characteristics

Life expectancy at birth in the United Kingdom was 81.26 years in 2018. (36) For males, life expectancy at birth was 79.50 years, and for females it was 83.1 yrs. (37,38) Non-communicable diseases are believed to play a role in who develops severe symptoms of COVID-19. In the United Kingdom, the proportional mortality from cardiovascular diseases was 25%, cancers 28%, chronic respiratory diseases 8%, and diabetes 1%. (39) (See Figure 3.) The probability of dying between ages 30-70 from cardiovascular disease, cancer, diabetes, or chronic respiratory disease was 10.9% for all adults, and 12.9% and 9.0% for males and females, respectively. (40)

Figure 3. Proportional mortality from non-communicable diseases (NCDs) - UK, 2016 (39)

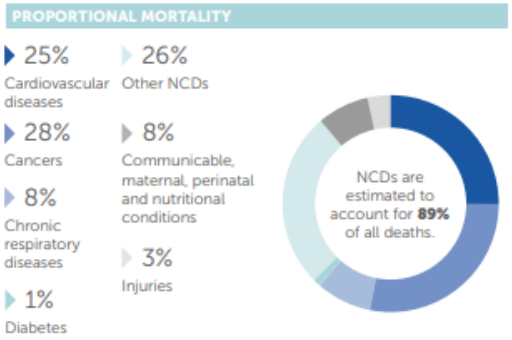


Table 2. Age and health characteristics for England (United Kingdom where labeled)

	Male	Female	Total
Population ages 0-14, total, 2019 (% of total population) (England) (41)	5,225,139 (9.28)	4,966,950 (8.82)	10,192,089 (18.11)
Population ages 15-64, total (% of total population) (England) (42)	17,866,491 (31.74)	17,874,665 (31.76)	35,741,156 (63.50)
Population ages 65 and above, total (% of total population) (England) (43)	4,736,201 (8.41)	5,617,515 (9.98)	10,353,716 (18.39)
Current tobacco use prevalence, total, 2018 (%) (UK) (44)	21.1	17.3	19.2
Raised blood pressure, adults ages 18+, 2015 (%) (UK) (45)	21.9	18.8	20.3
(Diabetes) Raised blood glucose, adults ages 18+, 2014 (%) (UK) (46)	8.4	6.9	7.7
Prevalence of obesity among adults (Body Mass Index ≥30), 2016 (%) (UK) (47)	28.6	30.4	29.5
Prevalence of Human Immunodeficiency Virus (HIV), 2019 (% of population ages 15-49) (UK) (48)			--
Bacillus Calmette-Guérin (BCG) Immunization coverage estimates (%) (UK) (49)			--
Prevalence of undernourishment, 2018 (% of population) (UK) (50)			2.5

Governance and health systems

England is one of four Nations located within the United Kingdom and is a devolved democratic jurisdiction. (51) The powers of each Nation are asymmetrically apportioned by statute and can be repealed by the central government located in Westminster. Health policy is generally delegated to the various nations under their respective Devolution Act(s). (51) In England, the UK's parliament directly rules the nation, with the Prime Minister and Minister of Health and Social Care determining health and public health policy for England. The current Conservative government has been in place since December 12, 2019. (52)

Public Health England oversees five regions (London, North of England, Midlands, East of England, and South of England), each of which is further subdivided into local authorities which are responsible for implementing public health policy, monitoring public health concerns, and engaging in public health research. (53) Major restructuring of the agency has been ongoing since 2012, with financial responsibility transferred from federal to local control, and with ongoing funding cuts since 2015, where talented and high-level employees have been lost. (54-55) Plans to shutter the agency amid the COVID-19 pandemic were announced on August 18, 2020. (56)

Health care is universally covered by the government in England by the National Health Service (NHS). (53) Funding for the agency is mainly drawn from taxes (79.4%) and National Insurance: a payroll tax (20%). (57) Approximately 11% of individuals carry supplementary insurance either for speedier care or to access additional amenities in hospital. Healthcare is free at point of service for residents of the UK or European Union; non-resident travellers and undocumented immigrants may be required to pay, but hospital care and communicable diseases are treated without charge. The price of prescription drugs is capped or free for individuals who are low-income, elderly, those under 15 or in school from 16-18, chronically ill/disabled, and expectant or recent mothers. Vision care is free of charge and dentistry costs are regulated. (57) English policy has differed in recent years from the rest of the United Kingdom, following a quasi-private approach where healthcare is fully government funded, but often operates by principles drawn from the for-profit business world. (51)

Table 3. Political and health system indicators for the United Kingdom

Fragile States Index score, 2020 (maximum 120, higher is worse) (58)	38.3
Fragile States Index rank, 2020 (out of 178 countries, higher is better) (58)	149
Global Freedom score and status, 2020 (59)	94 - Free
Internet Freedom score and status, 2020 (60)	78 - Free
World press freedom index, 2020, global score (0-100, lower is better) and rank (out of 180 countries, lower is better) (61)	17.41 - 35
Physician density, 2018 (physician/1,000 pop) (62)	2.81
Hospital bed density, 2013 (beds/1,000 pop) (63)	2.8

Pandemic experience and preparedness

In the United Kingdom, recent interest in the spread and control of infectious disease was prompted by the spread of two significant agricultural pathogens. The first major inquiry on communicable disease was released in 2000 regarding the spread of Bovine Spongiform Encephalopathy (BSE) in the 1980s and 1990s and recommended a slate of pathogen control and food safety measures. (64) These measures quickly proved to be ineffective in 2001 when Foot and Mouth Disease (FMD) uncontrollably spread through British farm animals. (65) Inspired by these twin disasters in responding to communicable disease and rising public pressure, the lead doctor in the United Kingdom subsequently published a paper in 2002 on the detection and treatment of microbiological diseases in humans. (66)

In 2009, England experienced an H1N1 influenza outbreak where 342 people died. (67) There has been a total of five cases of Middle East Respiratory Syndrome (MERS) detected in the United Kingdom. Four were diagnosed in 2012/2013 and one in August 2018. (68) Three UK healthcare workers tested positive for Ebola virus after having been deployed to West Africa as part of efforts to combat the 2014/2015 epidemic. (69-72)

The Civil Contingencies Act 2004 has provided much of the framework for the United Kingdom's emergency management planning and authority. (73) The most recent Hazard Identification Report was created in 2015 for the United Kingdom. (74) The report considers all possible threats to the UK from terrorism, crime, state-based actors, global health, etc. An additional review was completed in 2019, but details remain classified. (75)

To comply with the Civil Contingencies 2004 Act, the National Health Service (NHS) developed a series of operational emergency plans to deal with various eventualities, including responding to pandemic influenza that was last updated in 2017. (76,77)

England has predominantly used publicly operated laboratory systems, including public health, hospital, and academic centres. (78) At the beginning of the COVID-19 pandemic, testing was heavily limited to frontline healthcare workers, those working with vulnerable persons, or those engaged in critical work, while testing capacity was increased. (79,80) Testing was opened to all those with symptoms of COVID-19 on May 28, 2020. To keep pace with COVID-19 testing, private laboratories were recruited to begin testing on July 31, 2020. (80)

B. Policies and epidemiology

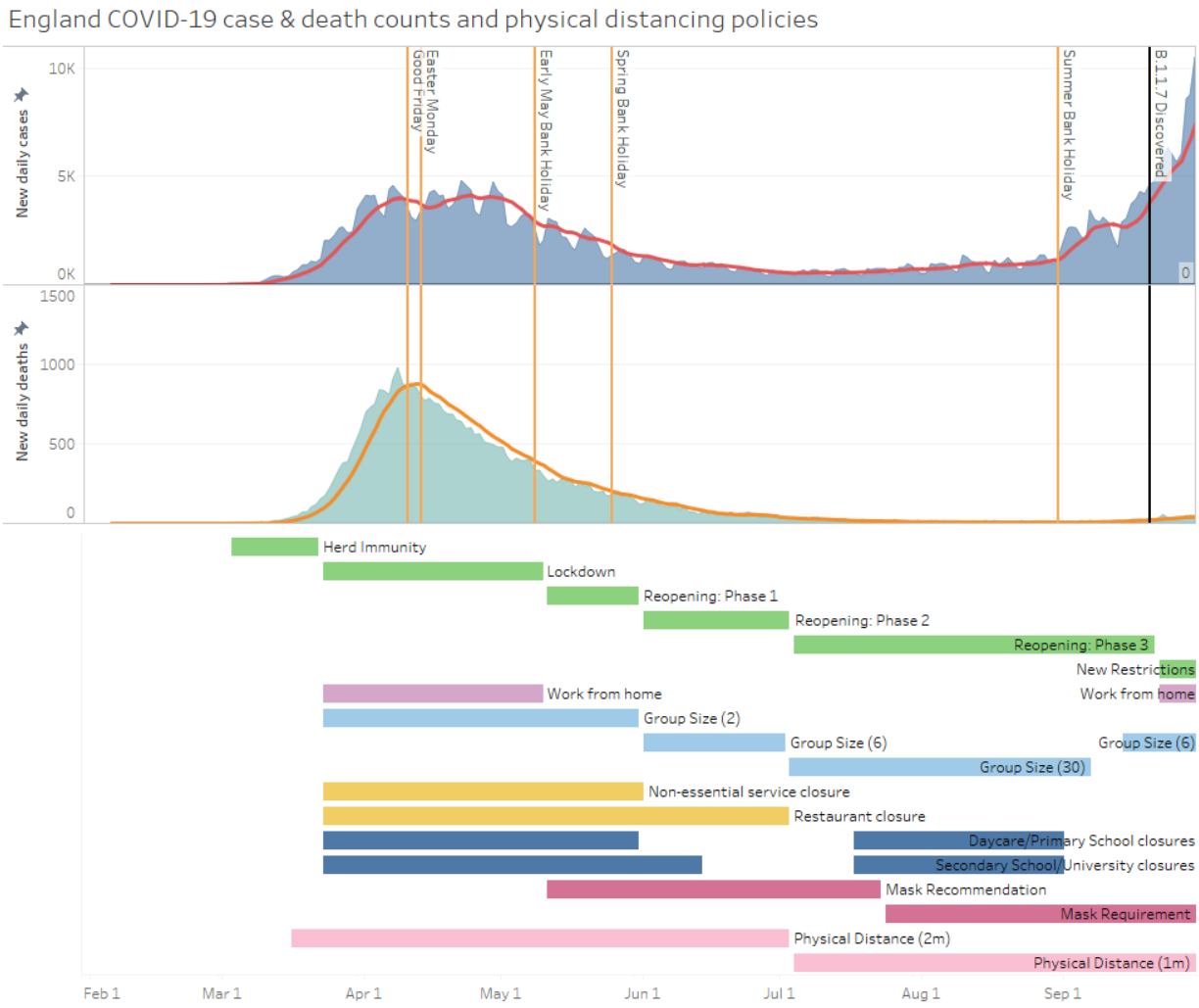
Cases and physical distancing policies

England's first case of COVID-19 was recorded on January 30, 2020 and reported 100 cases by March 2, 2020. (81) The Coronavirus 2020 Act was passed into law on March 25, 2020, and instituted emergency measures. (82) At that time, there were 15,389 cases and 15 deaths. (81) As of September 30, 2020, there were 420,987 cases and 37,555 deaths in England. (81) Figure 4 shows the number of daily cases and deaths in England and dates for selected policies from January to September 30, 2020.

England published its first COVID-19 response strategy on March 3, 2020. (83) The described strategy was one of mitigation; public health officials and medical officers would be tasked to suppress the spread of COVID-19 and empowered to quarantine, test and trace all suspected cases of the disease. Large scale or disruptive interventions needed to fully contain the spread of COVID-19 were not deployed. A number of interviews provided by government officials indicated that over those next two weeks, a subtle change in thinking had been executed and the United Kingdom did not plan to intervene to slow the spread of COVID-19, instead allowing the population to be infected so they could quickly reach herd immunity. (84-86) This triggered immediate backlash from health care workers, public health professionals, and the general public, forcing the UK government to change course and establish an official lockdown beginning March 25, 2020. (88-90)

Schools closed on March 23, 2020, with primary schools partially reopening for some face-to-face classes on June 1, 2020 and secondary schools similarily reopening on June 15, 2020. (91-92) Schools closed for the summer on July 17, 2020 and did not reopen until their regularly scheduled date in September. (93) In September, most schools in England reopened on the 1st or 2nd, but exact dates could vary as education term dates are controlled by local governments. (94-95) Once schools reopened for the autumn term, full in-person attendance became mandatory. (93)

Figure 4. England COVID-19 case counts & death counts and select physical distancing polices — January 30, 2020 to September 30, 2020



Description of events in England

The main spokesperson for England's COVID-19 response has been Prime Minister Boris Johnson, though other Department Secretaries have released updates regarding COVID-19 matters in their sphere of influence. (96) The Chief Medical Officer of the United Kingdom is a critical advisor, providing technical advice in combating COVID-19, but acknowledges that he has limited influence on overall decision-making. (97) Local health directors have been tasked primarily with following centralized policy established by the Prime Minister in responding to COVID-19. (98)

Messaging around COVID-19 in England has been inconsistently communicated with both herd immunity and mitigation strategies suggested as the UK's initial strategies. Prior to the first lockdown on March 25, 2020, England's declared strategy was of delaying the spread of COVID-19 so that the virus would not overwhelm the NHS and lead to excess loss of life. (83) However, minimal action was taken to control the spread of COVID-19. (99) Prior pandemic planning in the United Kingdom is predicated on the idea that the outcome of pandemic disease would be infection saturation of the entire population. (100) Publicly, their strategy was seen to follow the doctrine of herd immunity, especially after an interview where Sir Patrick Vallence, Chief Scientific Officer, stated that herd immunity would likely be the inevitable outcome of the COVID-19 pandemic. (86) The messaging around the government's COVID-19 response subsequently changed with a response from Matt Hancock, Secretary for Health and Social Care, on March 14. All earlier statements were characterized as miscommunication and that preserving lives was the government's highest priority. (87) However, Information subsequently released due to a freedom of information request from the BBC in September 2020 suggests that Herd Immunity was likely the UK government's initial, underlying strategy to respond to the spread of COVID-19 cases. (89)

On March 23, 2020, the Prime Minister announced that the UK would be entering lockdown; all non-essential activities were closed, and people ordered to stay at home unless leaving for narrowly defined essential business. (98) The Coronavirus Act 2020 was passed on March 25, 2020, formalizing initial restrictions, mobilizing volunteers, and establishing emergency powers to deal with the pandemic. (82) Schools, restaurants and pubs, movie theatres, construction companies, offices, etc. were ordered closed or to operate exclusively online. These strategies were adopted in line with prior planning that foresaw a lockdown may be necessary to preserve the integrity of the NHS. (76,97) After entering lockdown, each Nation in the UK would follow a different route map to reopen and each has taken divergent actions in responding to COVID-19.

After the initial lockdown, two events significantly negatively affected public perception on how COVID-19 was being handled in the UK. On March 27, 2020, the Prime Minister publicized that he had been diagnosed with a mild case of COVID-19. (101) He would latter require intensive care from April 6 - 9 and be released from hospital on April 12, 2020, despite repeated reassurance of his mild illness. The second event involved Dominic Cummings — one of the Chief Aids of the Prime Minister and a person very influential in drafting COVID-19 restrictions — who was seen publicly flouting those regulations, once on March 31st and a second time on

April 12th; despite calls to resign or be fired by the Prime Minister, he retained his position. (102) Combined, these factors led to the decline of public trust in both the UK government and news media, with more people beginning to feel that they were sources of misinformation. (103)

The first case of COVID-19 was documented on January 30, 2020 and was related to travel. (104) Community spread was first suspected to be ongoing as of the beginning of March by executives with Public Health England. (105) In order to ensure hospital capacity remained available, all elective and routine medical procedures with the NHS were suspended for three months beginning on March 18, 2020. (106)

Beginning on February 2, 2020, the UK advised against — but did not prohibit — international travel to Wuhan, China and gradually expanded the advisory until March 17, where all international travel was advised against. (107) Travellers coming into the UK were required to quarantine for fourteen days beginning on June 8, 2020. (108). Starting on July 3, 2020, this quarantine requirement was waived for those who entered the United Kingdom from countries on the constantly updated list of travel corridors. (109)

Public Health England recommended that all individuals try to keep at least 2 meters distance from each other on March 16, 2020. (110) This was revised on June 26, 2020, to 1 meter where 2 meters was not feasible. (111) On March 21, 2020, the United Kingdom published guidelines around Shielding, a policy of enhanced social distance for people identified as clinically vulnerable to COVID-19; it applied to the elderly, transplant recipients, people with cancer, severe respiratory conditions, metabolic vulnerability to infection, those taking immunosuppressant therapies, and pregnant women with heart disease. (112) People advised to Shield were recommended to always stay home and avoid social contact, in-person shopping and travel where possible. All employers were required to make workplace accommodations for individuals advised to Shield. Masks were first recommended for use on May 11, 2020. (113) They became required for use on public transit beginning June 15, 2020. (114) Regulations extended this to all public places on July 24, 2020, except for employees at work, when eating or drinking, children under the age of eleven, those who could not for a medical reason, or when required to remove it by an officer of the law. (115)

Groups larger than two people were banned on March 26, 2020. (116) However, the size changed to six people outdoors or two indoors on June 1, 2020, except for funerals, elite athletics or where necessary for education, volunteering, childcare, safeguarding the vulnerable, to avoid illness or injury, or to continue established custody arrangements. (117) Group size increased to 30 on July 4, 2020. (118) This was reduced back to six individuals on September 14, 2020, unless they were meeting for the purpose of marriage; the limit then was 30. (119)

Beginning on May 11, 2020, England entered Step One of reopening of their Coronavirus response plan. (113). Step Two began on June 1 and Step Three on July 4, 2020. (120) Step Two was defined by a staggered return to education and employment, alongside the reopening of

non-essential retail. (113) Two households would be permitted to form an exclusive COVID-19 social support bubble. Step Three involved the reopening of restaurants and pubs, leisure facilities, public buildings, and close contact services. (113) Decisions on when to move between phases were made based on a combination of technical benchmarks as well as with consideration for the economic implications of prolonged shutdown. (113) After July 4, local lockdowns were permitted in England to control spread of COVID-19 in localized hotspots. (122) Councils were empowered to close local shops and facilities, order individuals to remain at home and restrict or prevent public gatherings. How this was used varied greatly in practice and over time with some local councils introducing only pre-emptive voluntary restrictions, limited store hours, closing shops, banning social gatherings between people of different households, or issuing stay-at-home orders. (122-127) This diversity in public health directives led to public confusion and eventually prompted the UK government to standardize three tiers of COVID-19 related restrictions in October 2020. (128-130)

Overall, England's response to COVID-19 has faced significant challenges when compared to Europe or the G7. (131-134) On the policy front, the initial response to COVID-19 was incredibly muddled and unclear with major differences in planning communicated to the public days apart. (86-87) Prior to the lockdown announced on March 23, 2020, little substantive policy was established to control the spread of COVID-19; it was assumed that such efforts would fail and that the general English public would not tolerate wide-spread intervention to combat the pandemic. (133) The Scientific Advisory Group for Emergencies (SAGE) was not able to act effectively or independently to provide advice; at least two political appointees were selected to influence the committee and the committee did not include public health experts. (134) SAGE was eventually replaced by an independently formed group of experts to advise the government. (135) The government began to change course after March 15, 2020, after an independent assessment predicted approximately 500,000 Britons would die without health policy changes. (88) England would not start to enforce social distancing or other policy changes until March 23, 2020. (100)

On March 12, 2020, while Italy, Spain and France entered lockdown, England terminated widespread COVID-19 testing due to inaccessibility of tests and belief that community testing would not matter due to COVID-19's unchecked spread. (133) In part due to an unwillingness to commit to a specific strategy, the UK government failed to take steps to set up testing infrastructure and to acquire personal protective equipment (PPE) in February and would take until the end of May for those resources to be put in place. (137-141)

As of March 19, 2020 the decision was made to begin to open additional capacity in the National Health System (NHS) by discharging non-critical patients and delaying surgeries that were not immediately necessary. (142) Elective procedures were scheduled to resume on April 29, 2020. (143) Dental services were closed on March 25, 2020 and would reopen on June 8, 2020. (144) The discharge of existing patients was executed poorly. All patients were required to receive COVID-19 testing before being discharged, but approximately one quarter did not — including those who were discharged to elderly care homes — leading to increased community spread. (145) A negative COVID-19 test was not required for admission to a long-term care

home until April 16, 2020, leading to extensive outbreaks. (146) Best practices of ensuring that workers were only at one site were recommended though not required if implementation was impractical for hospitals and care homes beginning on April 3 and April 2, respectively. (147-148) In hospital, patients with a positive or suspected case of COVID-19 were ordered to be segregated beginning on January 10, 2020. (149)

After the lockdown was announced on March 23, 2020, data indicates there were significant, geographically consistent reductions in mobility. (150) The proportion of the population following social distancing guidelines waned — particularly among young people — as England began the process of reopening. (151) The primary factor driving reduced compliance was loss of confidence in the government. Fines for violating social distancing regulations were disproportionately targeted at Black, Asian, and Minority Ethnicities (BAME) despite those groups demonstrating greater compliance with social distancing directives. (152-153)

England planned to engage in staged reopening with Three Steps. Step One (May 11, 2020): involved working from home, keeping schools closed, being able to go outdoors on non-essential business, recommendations to avoid public transit, recommendations to use masks in spaces where physical distancing was impossible, and continue to Shield the vulnerable. (113) Step Two (June 1, 2020): involved a return to childcare settings and primary school (secondary schools would open two weeks later), opening of non-essential retail, permitting the broadcast of cultural and sporting events, and beginning of two household social bubbles. Step Three (July 4, 2020) involved the opening of remaining businesses, public places, and leisure facilities. Local lockdowns started to be implemented on July 18, 2020, to control COVID-19 hotspots. (122) Primary schools began a phased in-person reopening on June 1 with secondary schools similarly following on June 15 and remained open until the end of the summer term on July 17, 2020. (93-95) When schools returned for the autumn term, full in-person attendance would become compulsory. (154-155)

Restrictions relaxed significantly in the month of July. Starting on July 3, 2020, travel corridors were established, allowing Britons to complete their summer vacations in specified foreign countries without needing to quarantine upon their return. (109) Also in July, the government announced a program, Eat Out to Help Out, where they planned to subsidize the cost of purchasing meals from restaurants in the month of August. (156) This program resulted in a transient increase in restaurant spending that terminated with the end of the program but may have led to an increase in COVID-19 transmission. (157)

In May, SAGE estimated that at least 80% of the contacts of a person diagnosed with COVID-19 would need to be traced to effectively limit the spread of the disease. (158) The COVID-19 Test and Trace system did not achieve this benchmark before the United Kingdom reopened, and the efficacy of the program began to seriously degrade as COVID-19 cases climbed in September. (159-163) A specialized cell phone-based contact tracing app was released in England and Wales to bolster contact tracing efforts on September 24 and quickly became popular, with more than ten million Britons downloading it within three days. (164) Poor contract tracing was identified as one of the primary faults behind the UK's rising second wave

by both SAGE as well as the physicians and medical students of the British Medical Association. (165-166)

All progress in controlling COVID-19 that was bought in March, April, and May, was rapidly lost in September and into October. Beginning on September 21, 2020, SAGE advocated for a second short-duration lockdown to control exponentially growing COVID-19 case numbers. (158) In response, the Prime Minister ordered new public health distancing measures including an expansion of where masking was required, reduced hours of operation for restaurants and leisure facilities and fewer permitted exemptions to the 'rule of six' group size limit. (167-168) It would only be on October 31, 2020, that the Prime Minister indicated the growing number of infections could not be ignored and ordered a lockdown to begin on November 5, 2020, until a to-be-determined time in December. (169)

It is important to understand the underlying principles on which planning for this pandemic was established to understand England's response. The earliest pandemic influenza plan was written in 2011 and assumed that the spread of a pandemic disease would be uncontrollable. (99) When the first plans for COVID-19 were unveiled on March 3, this belief underlined it. (83) Morbidity and mortality were expected, and the government's central focus was to ensure that the healthcare system did not collapse. Declared plans shifted substantially on March 23 with the implementation of a general lockdown, but the underlying logic expressed at the time was that these measures were necessary to prevent the destruction of the NHS. (100) When the NHS was no longer immediately threatened by COVID-19, the country reopened.

Physical distancing policies were supported through economic relief for individuals and businesses. Beginning on March 26, 2020, the UK government introduced an 80% wage replacement scheme for workers and self-employed traders who had been furloughed or lost income due to the COVID-19 pandemic. (170-171) The scheme was slated to end, but has been continuously extended until at least December 31, 2020. Additional funding was provided to cities to make up for budgetary shortfalls and to extend public health programs, but money was often not provided in adequate amounts. (172) Businesses were able to defer taxes, reclaim statutory sick pay, and acquire grants or loans among other sources of support. (173) Eviction courts were closed beginning on March 25, 2020, and would only reopen on September 20, 2020, and six months notice was required of landlords prior to seeking eviction. (174) An optional mortgage holiday of three months was extended to both homeowners and business owners beginning on March 17, 2020. (175)

Attempts were made to reach out to Public Health England, the National Health Service, Department of Health & Social Care, physicians associations, nurses unions, and social care worker unions, for interviews for this study, but no response was received.

Several suggestions are presented for future waves of the COVID-19 pandemic based on documentary evidence and research team discussions:

- For public trust, and therefore compliance of public health measures, it is important that government spokespeople are seen as a team and caring for the people. Enthusiasm and cooperation are otherwise likely to wane.

- Clear public messages are important.

- Clearly defined and consistent planning is necessary.

- Late start in testing, including incubation, testing, and obtaining results, led to increased community transmission.

- The delayed call to wear masks or mandate their use in public was also considered a failure in this pandemic. Some jurisdictions did not wait for evidence on the effectiveness of masks and moved forward with policy decisions. Preventive action may still be useful, even in the absence of certain efficacy.

- Public health agencies need the funding and power necessary to respond to local conditions. Health agencies in England were trapped between reforms over the last decade that went towards local control and funding, but policy remained dictated by the central government.

- Mobilization of volunteer resources can plug gaps within public health infrastructure, especially near the 'beginning' of the crisis when enthusiasm and compliance were high.

- Information technology (IT) was very important in scaling up response measures at the institutional level. However, IT was also important for remote work, remote learning and sharing of information about COVID-19. There are people who still do not have access to technologies, which could exacerbate inequities.

- Earlier planning for PPE needs to be included in any pandemic plan as there was a lack of PPE early in the response.

- Testing for mobility of patients within health or social care settings needs to be considered, for example, admissions to elderly care homes or discharge from hospitals.

- Mobile assessment centres can help meet the needs of the community, especially those with transportation or time constraints.

- COVID isolation centres could provide resources and shelter for those needing to quarantine or recover from COVID-19.

- A range of success measures is needed besides number of cases and deaths, including hospitalizations, human resource capacity, and time to contact cases. Also, understanding that success in public health means absence of cases and that success may be measured differently in different phases of the response.

Disproportionately affected populations

There are certain groups that have been affected disproportionately in England.

Black, Asian, and Minority Ethnicities (BAME)

Approximately 13% of England's population is BAME and they make up 34% of admissions to hospital for COVID-19 related conditions and are significantly more likely to die after being diagnosed. (176-178) Initial investigations confirmed these reports but failed to provide recommendations. These were issued in a subsequent report after public outcry arose. (178-179) Factors identified for why BAME populations are more vulnerable are: housing overcrowding; financial vulnerability, vulnerable employment and disproportionately working in furloughed businesses; occupational risk, as BAME are disproportionately found among key service workers and healthcare workers; and marginalization. (180) Fines for violating social distancing regulations were disproportionately targeted at BAME individuals. (152-153) Subsequent research has suggested that mortality is most strongly driven by demographic and socioeconomic differences. (179)

BAME healthcare workers, in particular, are at disproportionately higher risk compared to other healthcare worker demographics. (181)

Long-Term Care Residents

Between January 31, 2020 and September 4, 2020, Public Health England reported that there were 8084 incidents of COVID-19 infection in elderly care homes. (182) The Office of National Statistics reported 15,414 COVID-19 related deaths between April 11, 2020, and September 4, 2020, and that 30% of total COVID-19 deaths occurred in care homes. (183) This is likely an underestimate as individuals moved from care homes to hospitals prior to their death would be excluded from this statistic. Given the disparity in numbers, more information was desirable, but impossible to attain; the watchdog organization charged with overseeing care homes has ceased to publicly publish reports on care homes due to the damage it was doing to those businesses. (184) Requests for interviews were not returned.

The decision to begin discharging patients from hospitals on March 19, 2020, to open capacity likely contributed to COVID-19 outbreaks in care homes. All patients were required to receive COVID-19 testing before being discharged, but approximately one quarter did not. (140-141) A negative COVID-19 was also not required for admission to a care home until April 16, 2020. (146) Best practices of ensuring that workers were only working at one site were recommended, but not required if implementation was impractical, for hospitals and care homes beginning on April 3 and April 2, respectively. (147-148)

Most Economically Deprived Quintile

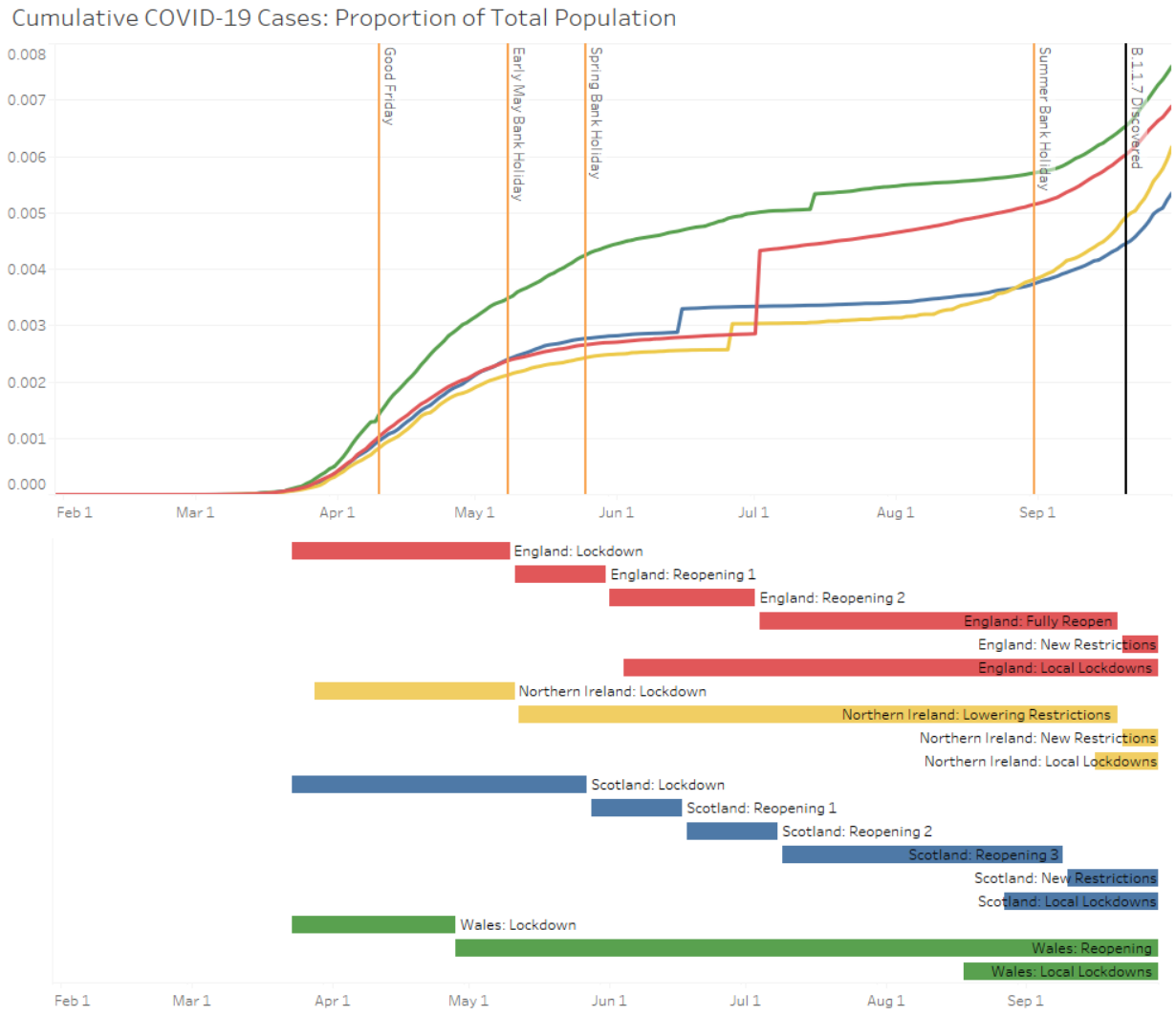
Individuals identified as economically deprived (bottom wealth quintile) are twice as likely to die compared to their least deprived peers. (185) For economically deprived women, the risk of mortality is comparable to economically deprived men and approximately six times higher than the least economically deprived women in the UK. (186)

Comparison with other Nations in the United Kingdom responses

There are many concerns in trying to compare countries' responses to COVID-19. This is shaped by limitations of the data itself and differences in contextual factors. A separate paper by this working group describes limitations of COVID-19 data. (Submitted) Table 4 presents a list of Nations within the United Kingdom and their use of different physical distancing policies. Polices are presented in a binary fashion and coloured in only if implemented.

Table 4. Comparative responses to COVID-19 by Nation in the UK — January 30 to September 30, 2020.

Figure 5. Cumulative Cases (adjusted as proportion of total population): By Nation in the UK – January 30 to September 30, 2020



In Figure 5, the abrupt jump in case counts from mid-June to mid-July in each nation are due to changes in case criteria including more cases and/or errors in reporting. (80) This figure illustrates the cumulative proportion of each nation's total population diagnosed with COVID-19 as well as highlights the general, overarching policy under which each nation in the UK was operating. During this period, most policy differences were small with the only difference being exact implementation dates within a four-to-six-week window.

Immense homogeneity exists between the nations of the United Kingdom with respect to COVID-19 responses. Policy was first implemented beginning on March 23, 2020, uniformly across the entirety of the country. (89) After that point, each nation charted its own, slightly different, course with respect to reopening from lockdown. England used a phased reopening strategy and reopened quickly. Northern Ireland selected a phased strategy to reopen but published no dates on when it would move between

phases. Most of its reopening was done piecemeal. Wales also adopted a piecemeal reopening strategy. Scotland adopted a four-phase reopening strategy, but repeatedly delayed moving to stage 4, instead remaining partially locked down as a mitigation strategy.

Figure 6. Cumulative Deaths (adjusted as proportion of total population): By Nation in the UK – January 30 to September 30, 2020

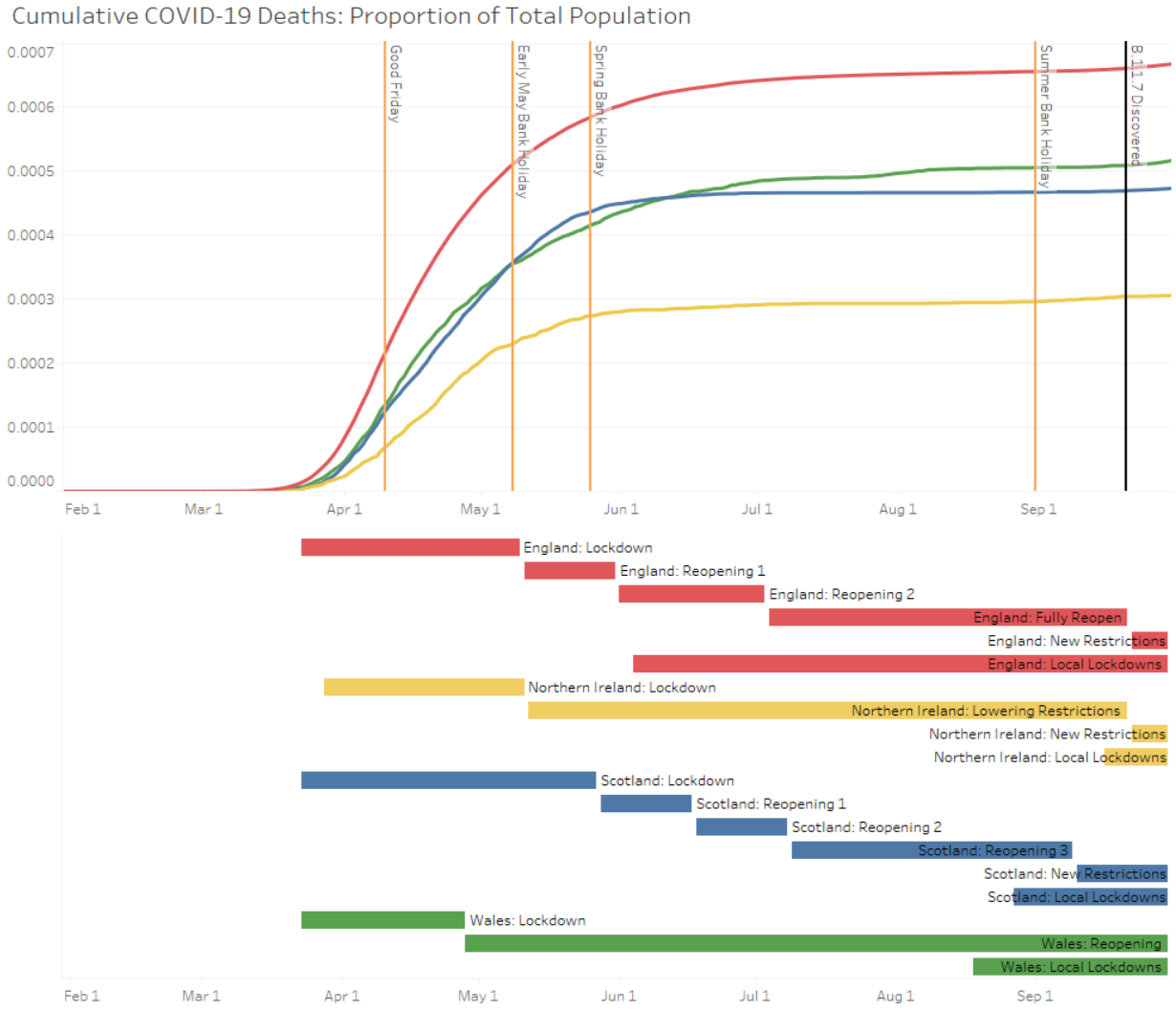


Figure 6 illustrates the population-adjusted cumulative rate death due to COVID-19 as a proportion of each nation's total population as well as the overarching policy under which each nation was operating.

Northern Ireland posted the fewest population-relative deaths during this period, significantly fewer than Scotland who reported a similar number of cases. Wales reported the highest number of cases while reporting population-relative deaths comparable to Scotland. These relationships may be partially explained by underlying population health characteristics and structural factors within the NHS in each nation due to the relative homogeneity in overall COVID-19 health policy.

IV. Discussion of main findings, limitations, and next steps

England has a population of 56,286,961, with 420,960 cases of COVID-19 and 37,556 COVID-19 related deaths as of September 30, 2020. This is no doubt an undercount of cases, as there was a delay in setting up testing at the beginning of the pandemic, and England dealt with a lack of testing supplies, lack of laboratory capacity, and strict criteria for testing at the outset. Additionally, deaths were only reported as being due to COVID-19 if the person died within 28 days of diagnosis. This was determined to likely be a significant undercount based on reports from the Office of National Statistics who tracked COVID-19 listed on death certificates issued weekly. Both measures have subsequently been posted as measures of mortality. (187-189) Even this may be an undercount due to restrictive testing criteria; epidemiologists may be best served by using measures of excess death.

During the first wave of COVID-19, schools were closed. No information has yet been published by the government on COVID-19 infections among school children; the Office of National Statistics is beginning to compile data. (190) News reports indicate that in September, before the second wave of COVID-19 cases, at least 5% of English pupils (approximately 400,000 individuals) were absent from school due to COVID-19 or self-isolation related reasons. (191-192) As of November 5, businesses have been ordered closed (schools remain open) as a second lockdown was ordered while the second wave of COVID-19 hits England. (193) People aged 20-29 are the fastest growing group infected by COVID-19 with overall rates of infection and hospitalization rising. (194) If or how this is related to the rise of the UK B.1.1.7 variant of COVID-19 — which is known to be more transmissible in children — is unknown. (195)

Many economic support programs that had previously been discontinued are being reinstated, though with less generous reimbursement. (196-197)

The UK's exit from the European Union (EU) is scheduled for December 31, 2020 and no deal has yet been reached. (198) Without a deal, goods, services, and people will no longer be able to enter the UK from the common trade area of the EU. How this will affect sources of PPE and medical equipment (including vaccines), and how it will affect EU citizens in the UK and UK citizens in the EU are unknown. (199-200) Peace in Northern Ireland was established by the Belfast/Good Friday agreement and the guarantee of an open border to Ireland. (201) With a no deal Brexit, a hard border would automatically be established and may lead to the destabilization of the region.

Inability to complete interviews with key informants in England may mean that data is incomplete or that nuance is missing.

Conclusions

It is without a doubt that COVID-19 has caused significant loss of life, economic hardship and social changes in England. Long-term effects have yet to be fully understood. There are already restrictive measures being put in place due to the increase in numbers, such as scaling back on the group sizes allowed in public. However, further contextualized research needs to be conducted to determine which social distancing policies are the most effective for specific settings. It is also imperative to improve surveillance and reporting systems internationally to deal with this and future pandemics. Comparative work is being conducted by this Working Group to understand what policies work, where and why.

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