COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE (Hon. Phillip J. Shepherd)
CASE NO. 20-CI-00538

MARGARET STERNE, et al. **PLAINTIFFS**

V.

MICHAEL ADAMS, et al. **DEFENDANTS**

MOTION FOR TEMPORARY INJUNCTION

Plaintiffs Margaret Sterne, Helen LeMaster, Fred Mozenter, Debra Graner, Michael Chaney, and MacArthur Darby move the Court to enter a Temporary Injunction pursuant to CR 65.04. This Motion seeks to (1) enjoin the requirement that voters satisfy a statutorily recognized excuse to vote by mail, pursuant to KRS 177.085(1)(a), during the pendency of the Covid-19 pandemic; (2) enjoin the requirement that voters satisfy a statutorily recognized excuse to vote absentee in person, pursuant to KRS 177.085(1)(d), during the pendency of the Covid-19 pandemic; (3) delay the effective date of SB 2 until after the Covid-19 pandemic ends; (4) compel the Defendants to extend Sections 3, 4, 5, 6, 9, and 10 of the emergency regulations (31 KAR 4:190E) during the pendency of the Covid-19 pandemic; and (5) compel the Defendants to electronically deliver Plaintiff Darby an absentee mail-in ballot using the ballot delivery system established pursuant to KRS 117A.030(4), and to make this delivery option available to other voters with documented visual disabilities who choose to vote by mail and select this method of transmission.

INTRODUCTION

Every minute, approximately 38 new cases of Covid-19 are confirmed in the United States.[1] About 47 people die of the disease each hour.[2] And the pandemic is not expected to subside in the coming months. During a hearing before the U.S. House of Representatives Committee on Energy and Commerce, Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases, testified: "There will certainly be coronavirus infections in the fall and winter because the virus is not going to disappear."[3] Dr. Robert Redfield, Director of the Centers for Disease Prevention and Control, agreed, stating: ". . . I want to make it clear we are going to experience significant coronavirus infection in the fall and winter of 2020."[4] Indeed, as explained below, recent statistics in the Commonwealth suggest that a troubling spike already is occurring. As a result, the Governor (at the recommendation of the White House) has encouraged schools to delay the start date of in-person classes for the fall, reinstituted a closure of all bars, and reduced permissible capacity for indoor, in-person dining at restaurants to 25%.[5]

This action seeks to compel Kentucky's election officials to exercise their authority to establish rules that will allow all eligible Kentuckians to vote safely in the upcoming general election, regardless of their risk of contracting the Covid-19 virus. These officials worked together to do just that in the June 23, 2020 primary, implementing successful and widely praised emergency election regulations that allowed no-excuse absentee voting for all Kentuckians during

[1] "New Cases by Day," *Cases in the U.S.*, CTRS. FOR DISEASE CONTROL & PREVENTION (CDC), https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html#accordion-1-collapse-3 (last updated July 28, 2020).
[2] *Id.*
[3] *Oversight of the Trump Administration's Response to the COVID-19 Pandemic Before the H. Comm. On Energy and Comm*, 116th Cong. at 3:53:21–3:54:24 (statement of Dr. Anthony Fauci, Director of Director of the National Institute of Allergy and Infectious Disease.
[4] *Id.* (statement of Dr. Robert Redfield, Director of Centers for Disease Prevention and Control).
[5] B. Tobin et al., *Andy Beshear orders Kentucky bars to close, restaurants to reduce capacity to combat COVID-19*, Courier Journal (July 27, 2020), https://www.courier-journal.com/story/news/2020/07/27/kentucky-gov-andy-beshear-order-bar-closures-covid-cases-spike/5517328002/

the pandemic. However, with less than 100 days before the General Election, Defendants have yet to announce similar rules for the November election. Those new rules cannot be set on the eve of the election. They must be compelled to act now, so that voters and election officials alike have clarity as to the opportunities and requirements to vote.

Kentucky's constitution demands nothing less. Section 6 of that Constitution guarantees citizens of the Commonwealth the right to "free and equal" elections. For over a century, Kentucky's courts have held that elections are not free and equal where a significant percentage of eligible voters face a legal—or practical—barrier to expressing their vote. That is plainly the case here: the ongoing pandemic threatens countless Kentuckians' (including Plaintiffs') ability to safely vote in person at the polls under the rules of a typical Election Day.

This is not a partisan issue; the novel coronavirus, SARS-CoV-2, does not discriminate by political affiliation. It has claimed the lives of Republicans, Democrats, Independents, and the apolitical alike. Without efforts to make voting safe this fall, the harms of this pandemic will be felt by voters of all persuasions. For these reasons, Section 6's guarantee of "free and equal" elections mandates that the June 23 emergency election regulations be extended to all elections held during the pendency of the Covid-19 pandemic and that implementation of the state's new voter ID law be delayed until the pandemic ends.

FACTUAL BACKGROUND

A. The Covid-19 Pandemic

On March 11, 2020, the World Health Organization declared that the novel coronavirus, SARS-CoV-2, which causes a disease known as Covid-19, had become a pandemic. Covid-19 has now spread throughout the world, including to every state in the United States and throughout Kentucky. The novel coronavirus that causes Covid-19 continues to spread at an unprecedented

pace around the world and within the United States. As of July 31, 2020, there were 4,405,932 confirmed cases and 150,283 deaths in the United States.[6] As of that same date, the Commonwealth of Kentucky had confirmed 29,386 positive cases of Covid-19 and 731 deaths in Kentucky.[7]

COVID-19 appears to be much more contagious than other respiratory illnesses, in significant part because of its capacity for presymptomatic and asymptomatic transmission, and highly lethal, particularly for people with underlying health conditions or comorbidities that put them at severe risk of complications or death. Murray Decl. ¶¶ 32-33, 43. According to the U.S. Centers for Disease Control and Prevention, ("CDC"), individuals are at higher risk of severe complications and death from Covid-19 if they are 65 years or older or have underlying health conditions and diseases, including cancer, chronic kidney disease, chronic obstructive pulmonary disease, serious heart conditions, obesity (body mass index ("BMI") of 30 or higher), Type 2 diabetes, sickle cell disease, and an immunocompromised state from a solid organ transplant.[8] It has noted that people with the following conditions *may* be at increased risk from Covid-19: moderate to severe asthma; cerebrovascular disease; cystic fibrosis; hypertension; immunocompromised state from blood or bone marrow transplant, immune deficiencies, HIV, use of corticosteroids, or use of other immune weakening medicines; neurological conditions; liver disease; pregnancy; pulmonary fibrosis; smoking; thalassemia; and Type 1 diabetes.[9]

Severe Covid-19 cases can cause a wide variety of secondary infections and pathologies, including but not limited to: pneumonia, acute respiratory distress syndrome, kidney failure, liver failure, strokes, heart attacks, cardiac inflammation, and gastrointestinal infections, among others.

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[6] *See* https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html
[7] *See* https://govstatus.egov.com/kycovid19.
[8] *See* https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fgroups-at-higher-risk.html.
[9] *Id.*

Furthermore, everyone is at some risk of severe complications and death from Covid-19, as health officials have recently associated Covid-19 with pulmonary embolism and stroke in younger patients without known risk factors and inflammatory disease in young children.

Though Covid-19 typically begins with "a flu-like illness that starts out with fever, cough, sore throat and shortness of breath," some people "develop much more serious illness, characterized by respiratory compromise due to pneumonia that can be gradual or sudden." Murray Decl. ¶¶ 6, 21, 22. The major complication in patients with severe disease is acute respiratory distress syndrome ("ARDS"), which commonly requires patients to be put on a ventilator. *Id*. ¶¶ 6-7, 23. People who develop severe complications and require mechanical ventilation to survive ARDS "are likely to develop lung scarring that may permanently impair their pulmonary function" or, in the case of stroke, "long term neurological deficits from these events." *Id*. ¶¶ 7, 26. In critical cases, Covid-19 can be fatal. Murray Decl. ¶¶ 27-31. Infections are more common in people younger than 50. Murray Decl. ¶ 31. Even young individuals, including children, are at risk of severe complications and death from COVID-19. Murray Decl. ¶¶ 24-25. In fact, because 66 percent of the U.S. population is under 50, Dr. Murray notes that "deaths among people under 50 will not be uncommon as the epidemic progresses over time." Murray Decl. ¶ 31.

The threat of airborne transmission of SARS-CoV-2, the virus that causes Covid-19, in indoor settings where people congregate, like a polling place, is real, substantial, and not meaningfully mitigated by any of the available protective measures. Murray Decl. ¶¶ 6-20, 32-43. There are two particularly concerning mechanisms by which the virus can spread. First, the virus spreads through respiratory droplets that can attach to the surfaces of objects or be suspended in air and transmitted via inhalation. These respiratory droplets are "emitted during coughs, sneezes or even talking." *Id*. ¶ 8; *see also id.* ¶¶ 9-13, 33-34. And because these droplets are somewhat

large, they can either attach to objects or travel short distances in the air (around 6 feet) to infect those who come into contact with them. *Id*. ¶ 33-34, 38. In other words, these large respiratory droplets create the risk of spread as a result of contact with inanimate objects such as a door-handle or from close quarters with infected individuals. *Id*. Although masks and hand hygiene can mitigate the spread of the respiratory droplets, they cannot completely prevent transmission, especially when masks are not constructed or worn properly[10] and where Kentucky law does not require voters to wear masks at polling places.

Second, there is also growing evidence that COVID-19 spreads as an aerosol – in other words, through direct inhalation even in settings where two individuals do not have contact with each other. Murray Decl. ¶¶ 34-41. Aerosol transmission is much harder to control via traditional control methods, such as handwashing or masks, than transmission through large droplets. *Id*. at ¶ 36. During aerosol transmission, small respiratory droplets "can dehydrate and linger as 'droplet nuclei' in the air." *Id*. at ¶ 37. Because of the particles' smaller size, they travel further distances – some evidence suggests up to 25 feet – and expand the range in which people can be infected. *Id*. at ¶¶ 38-39. As a result of this type of airborne spread, one's risk of infection increases in indoor, poorly ventilated areas where multiple people are congregated, even when individuals maintain social distance. It appears that aerosol spread may lead to mass infection events, such as one incident in which 45 people were infected, despite keeping distance from each other, after attending choir practice. *Id*. at ¶ 34.

Moreover, since COVID-19 can be transmitted "by symptomatic and asymptomatic people" alike, individuals can spread the disease before realizing they are infected and self-

[10] *See CDC on Homemade Cloth Face Coverings*, CDC, https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-make-cloth-face-covering.html (last updated July 6, 2020); *How to Wear Cloth Face Coverings*, CDC, https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-wear-cloth-face-coverings.html (last updated July 6, 2020).

quarantining. *Id.* ¶¶ 8-9, 32-33, 42. The CDC has also warned that asymptomatic COVID-19-positive individuals can transmit the disease to others.[11] As a result, voters can spread the disease at a polling place before they even realize they are infected.

There is also evidence that individuals of color are dying of Covid-19 at a higher rate than other demographic groups. As of July 31, 2020, the Commonwealth's Covid dashboard showed that 14.54 percent of all those who have died from the virus in Kentucky are Black,[12] even though Kentucky's population is only 8.5 percent Black.[13] These data reflect the broader pattern, as seen in both the United States and Britain, in which Black individuals have suffered from higher morbidity and mortality rates. Murray Decl. ¶ 29. So, too, have residents ages 60 or older suffered disproportionate impact, with over 90 percent of deaths in the state occurring in this age group.[14] These disparities could have serious implications for Kentucky elections and turnout, as voters age 65 or older comprised approximately 24 percent of Kentucky's electorate in the 2018 general election[15] and 18 percent in the 2016 general election.[16]

Additionally, Kentucky's population has specific epidemiological factors that place the state in a uniquely precarious position with respect to the virus. Murray Decl. ¶¶ 74-81. Kentucky has elevated rates of cancer, obesity, hypertension and other diseases and conditions that place its population at a higher risk of vulnerability or are suspected of placing individuals at higher risk.

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[11] *Coronavirus 2019 (COVID-19): How to Prepare*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/coronavirus/2019-ncov/prepare/transmission.html (last updated Mar. 4, 2020).
[12] *See* KDPH COVID-19 Dashboard, https://experience.arcgis.com/experience/647a7cae97c64091b63fee0bd55b140c.
[13] *See* Kentucky Quick Facts, US Census Bureau, https://www.census.gov/quickfacts/fact/table/KY/PST045219.
[14] KDPH Dashboard, *supra* note 12.
[15] Table 4c, *Voting and Registration in the Election of November 2018*, U.S. CENSUS BUREAU (Apr. 23, 2019), https://www.census.gov/data/tables/time-series/demo/voting-and-registration/p20-583.html.
[16] Table 4c, *Voting and Registration in the Election of November 2016*, U.S. CENSUS BUREAU (May 10, 2017), https://www.census.gov/data/tables/time-series/demo/voting-and-registration/p20-580.html.

Id. ¶ 76.[17] According to the Kaiser Family Foundation, 44 percent of adults in Kentucky are at risk of severe illness from Covid-19. *Id*. ¶ 79.[18] Moreover, a nationwide risk assessment of community vulnerability ranked Kentucky as the 13th most vulnerable state in the country with respect to the virus, in large part due the prevalence of recognized and suspected epidemiologic risk factors. Murray Decl. ¶ 81. Cumulatively, these existing health challenges make Kentucky particularly vulnerable to COVID-19: "These data suggest that in the event of further spread of Covid-19, Kentucky may experience higher levels of disease, disability and death than other states experiencing the same amount of transmission." Murray Decl. ¶ 81.

Nor is there an end in sight. "An effective vaccine is extremely unlikely to have been developed, tested and widely distributed before November." *Id*. ¶ 83. And while some drugs have shown efficacy in reducing the duration of the illness, pharmaceutical treatments are unlikely "to have a major impact on the transmission of the virus and the risk of severe disease or death by November 2020." *Id*. ¶¶ 56, 85. Leading epidemiology experts, supported by both the data and the "principles of infectious disease dynamics," anticipate that the pandemic will continue into November 2020 and could well grow worse by that time. *Id*. at ¶¶ 67-73.

The implications of COVID-19 for voters in Kentucky are severely troubling. According to Dr. Murray's report, "There is a substantial risk that an infection with Covid-19 acquired during voting at a poll place in Kentucky in the fall of 2020 could result in symptomatic disease, hospitalization or death." *Id.* at ¶ 11. That is because "[t]o the extent that polling places are crowded, require people to wait in lines, involve interacting with polling staff or other voters at a

[17] https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fgroups-at-higher-risk.html.

[18] "Adults at Higher Risk of Serious Illness if Infected with Coronavirus," *State Data and Policy Actions to Address Coronavirus*, Kaiser Family Fdn. (July 14, 2020), https://www.kff.org/coronavirus-covid-19/issue-brief/state-data-and-policy-actions-to-address-coronavirus/.

close distance, move people through the process slowly, are poorly ventilated and/or involve people touching objects like pens, paper, or surfaces within the voting booth, they constitute a risk to voters." *Id.* at ¶¶ 11, 48. Precautions may help reduce this risk to some extent, but the threat of transmission is grave and immediate.

B. Kentucky's response to Covid-19 and the June 23, 2020 Primary

Governor Beshear declared a State of Emergency ("State of Emergency") on March 6, 2020, which remains in effect as of the date of this filing. *See* Exec. Order 2020-215. Shortly thereafter the Governor issued a series of executive orders and recommendations, known informally as the "Healthy at Home" initiative, designed to combat the spread of Covid-19.

Recognizing that Covid-19 presents unique challenges to Kentucky's electoral process, the Defendants in this case took decisive and sensible action to ensure that Kentuckians would have a meaningful chance to vote in the 2020 primary elections despite the Covid outbreak. In his public comments, Secretary Adams acknowledged that expanded absentee voting is necessary during the Covid-19 pandemic to ensure a "free and fair" election as required by Kentucky's Constitution: "[Elections] must be fair, which is why I'm ensuring valid integrity in this plan, but they must also be free, meaning we have to make it possible for people to freely vote without unnecessarily risking their personal safety or that of others."[19]

On March 16, 2020, Secretary Adams sent a letter to Governor Beshear recommending that he "declare by executive order that all Kentucky elections scheduled for May 19, 2020—including the Democratic and Republican primary elections, special elections and local option elections—shall be delayed by thirty-five (35) days, and that such elections shall take place on

[19] *See* Ky Secretary of State, *This is not a mail-only election* (June 6, 2020 filmed presentation), https://www.sos.ky.gov/elections/Pages/2020-Primary-Updates.aspx.

June 23, 2020." *See* Letter from Sec. Adams to Gov. Beshear (Mar. 16, 2020).[20] Governor Beshear agreed and issued Executive Order 2020-236 that same day. That executive order noted that Covid-19 "continues to endanger public health and safety and, if not contained, threatens to overwhelm the Commonwealth's resources." It also recognized that "state and local governments share responsibility for the protection of public health, safety, and security and for taking appropriate actions to ensure the provision of essential public services." In light of these—and other—concerns, the Governor ordered that (1) "[a]ll Kentucky elections scheduled for May 19, 2020 . . . are delayed until Tuesday, June 23, 2020" and (2) "[t]he Kentucky State Board of Elections shall establish procedures for election officials to follow pursuant to this Order."

The following month, the Secretary of State sent the Governor another letter, this time recommending a modification to the manner in which the primary would be conducted. *See* Letter from Sec. Adams to Gov. Beshear (Apr. 23, 2020). Once again, Governor Beshear agreed with the recommendation. On April 24, 2020, he issued Executive Order No. 2020-296,[21] which provided, among other things, that: (a) "All Kentuckians should utilize absentee voting by mail for the June 23, 2020 primary election if they are able to do so"; (b) "The State Board of Elections shall promulgate emergency regulations to provide for such expanded absentee voting by mail" and to "create a secure online portal that will allow voters to request that the absentee ballot be mailed to them"; (c) "The State Board of Elections shall take all reasonable steps to ensure the safety of county clerks and poll workers when direct voting (not by mail) is necessary"; and (d) "The State Board of Elections shall promulgate such additional emergency regulations as are necessary to ensure that Kentuckians can safely exercise their right to vote in the June 23, 2020 primary election, while protecting the safety of Kentucky's county clerks and poll workers. The additional

[20] *See* https://twitter.com/KYSecState/status/1239654331487576065.
[21] *See* https://governor.ky.gov/attachments/20200424_Executive-Order_2020-296_SOE-Relating-to-Elections.pdf

regulations shall be consistent with the April 23, 2020 recommendations of Secretary of State Adams, which are incorporated by reference herein."

The State Board of Elections subsequently issued these emergency regulations. *See* 31 KAR 4:190E, Procedures for June 23, 2020 Elections.[22] Of the new regulations:

- Section 3 provided that, "[n]otwithstanding KRS 117.077, an application for an absentee ballot due to medical emergency a) shall not require the applicant to state that the emergency condition occurred within 14 days of the election, b) need not be notarized, and c) shall entitle the applicant, upon verification of the application, to vote by absentee, by mail or in person by appointment, as advised, if otherwise a lawful voter." 31 KAR 4:190E, § 3.

- Section 4 required the State Board of Elections to "send a non-forwarding postcard to every registered voter of the Commonwealth to inform them of the changes being made to the June 23, 2020 elections as a result of the COVID-19 pandemic, as well as the steps the voter must take to request an absentee ballot through the SBE secure online portal or by calling their County Clerk." 31 KAR 4:190E, § 4. That postcard must "advise voters that, if they will vote in person absentee or in person on election day, they are advised to make an appointment with their County Clerk." *Id.*

- Section 5 required the Board to develop an online portal through which voters could request an absentee ballot, which must "transmit the request to the County Clerk of the county in which the requester is registered to vote," who must in turn "transmit to the voter an absentee ballot within seven (7) days." *Id.* The State Board of Elections was also required to provide "to County Clerks a unique barcode for each voter's ballot envelope, providing the ability to track the ballot as it [is] mailed out and received back, in order to certify the movement of the ballot through the postal system and to issue voter credit." *Id.*

- Section 6 established a deadline for county clerks to mail absentee ballots that "have the return postage paid for by the State Board of Elections." 31 KAR 4:190E, § 6. The regulation also requires county clerks to count any ballot "delivered by the United States Postal Service and bearing a postmark of [the primary election date] or earlier" if received by a specified date. *Id.*

- Section 9 created a cure process for ballots returned with disqualifying deficiencies. Under this process, "[i]f a signature match cannot be made, the County Board of Elections, absentee ballot processing committee, or the County Clerk shall make a reasonable effort to contact the voter using the contact information provided by the voter's absentee ballot application, and provide the voter with a timeframe and manner in which the voter may cure the discrepancy." 31 KAR 4:190E, § 9.

[22] *See* https://content.govdelivery.com/attachments/KYSOS/2020/05/01/file_attachments/1441085/SBE%20Covid19%20Emergency%20Regulation.pdf.

- Section 10 required county clerks to "make their offices and telephone lines available for the purpose of allowing registered voters of their respective counties to schedule appointments to vote absentee in-person by appointment . . . no fewer than 5 days per week in the two weeks before the week of election day." 31 KAR 4:190E, § 10. "Appointments shall be consistent with public health and social-distancing standards and every reasonable effort shall be undertaken by County Clerks to see that in-person absentee voting is implemented in a manner that limits direct contact between voters, other voters, and election officials, and shall be conducted throughout the Clerk's business hours." *Id.*

The emergency regulations worked just as intended. As Secretary Adams noted in a June 30 press conference,[23] turnout under the emergency voting rules was "pretty amazing," with numbers last seen in 2008 during the competitive primary between Barack Obama and Hillary Clinton.[24] Of these votes, "approximately 80-85% of votes were cast absentee."[25] Secretary Adams confidently stated that Kentucky "pulled this off successfully, letting people vote safely at home and that we did so with no reported incidents of fraud . . . We had a clean election. I'm very proud of that."[26] Summarizing this process, Secretary Adams stated: "I think I've shown that we can make absentee ballots work without fraud. I have shown that we can make early voting [work] without fraud."[27]

However, Secretary Adams also noted that "[t]urnout in November is going to be twice as high as it was for June—or higher."[28] Thus, he acknowledged that modifications to the regular election rules likely are needed because of Covid-19, and he stated he wants to have those rules in place by Labor Day, if not sooner.[29] Without further action by Defendants to extend the rules in

[23] *See* WKYT, *Secretary of State Michael Adams Speaks About Primary Election Results*, https://www.facebook.com/ WKYTTV/videos/653442258585954/.
[24] *Id.* at 1:00.
[25] *Id.* at 1:50.
[26] *Id.* at 6:25.
[27] *Id.* at 13:10.
[28] *Id.* at 10:30.
[29] *Id.* at 8:00.

place for the June 23 primary, expanded absentee voting will not be available to voters in the November 3, 2020 General Election.

C. Existing Law

Absent an extension of the emergency election regulations, existing statutory requirements will govern the 2020 General Election. Critically, those requirements restrict vote by mail and early in-person voting to voters who can meet a narrow set of excuses. Beginning with the 2020 General Election, voters will also be required to produce photographic ID in order to cast their ballots, even if voting absentee.

1. Excuse Requirement

Kentucky law limits the availability of voting by mail to specific categories of voters with qualifying excuses. Pursuant to KRS 117.085(1)(a), the eight categories of voters with qualifying excuses are:

- Eligible uniformed-service voters or overseas voters registered to vote in Kentucky;
- Students temporarily residing outside their county of residence;
- Incarcerated voters charged with a crime who have not yet been convicted;
- Voters who have changed their place of residence to a state other than Kentucky after the deadline to register to vote in their new state of residence has passed;
- Kentuckians temporarily outside the state but still eligible to vote;
- Voters whose employment requires the voter to be outside the county of residence during all hours and all days of in-person absentee voting and on Election Day;
- Participants in the Secretary of State's crime victim address confidentiality protection program; and
- Those who are "[n]ot able to appear at the polls on election day on the account of age, disability, or illness," and have not been declared mentally disabled by a court of competent jurisdiction.

A qualified voter may request an application for an absentee ballot by telephone, facsimile machine, mail, electronic mail, or in person. Additionally, it permits voters experiencing a "medical emergency" within "fourteen (14) days or less of an election" and their spouses to "apply for an absentee ballot." The application "shall be notarized" and "shall state that the emergency condition occurred within the fourteen (14) day period." KRS 117.077. Defendants have already demonstrated that they have the power to construe the "medical emergency" excuse to include valid concerns regarding the risk of contracting Covid-19 and to waive the requirement that this emergency condition occur within 14 days of the upcoming general election.

An excuse is also required to vote early in person. KRS 117.085(1)(d). A voter may cast the voter's ballot early in person if the voter:

- Is an eligible uniformed-service voter or overseas voter registered to vote in Kentucky, who will be absent from the voter's county of residence on Election Day;
- Is a student who temporarily resides outside the voter's county of residence;
- Has surgery, or whose spouse has surgery, scheduled that will require hospitalization on Election Day;
- Temporarily resides outside the state, but is still eligible to vote in the state and will be absent from the voter's county of residence on Election Day;
- Is a resident of Kentucky who is a uniformed-service voter confined to a military base on Election Day, learns of that confinement within seven (7) days or less of an election, and is not eligible for a mail-in absentee ballot;
- Is in the voter's last trimester of pregnancy at the time the voter wishes to vote;
- Has not been declared mentally disabled by a court of competent jurisdiction and, on account of age, disability, or illness, is not able to appear at the polls on Election Day; or
- Is not permitted to vote by a mail-in absentee ballot but who will be absent from voter's county of residence on Election Day.

KRS 117.085(1)(d)(1)–(8).

As it concerns absentee ballot delivery, Kentucky law requires the State Board of Elections to "establish an electronic transmission system through which a covered voter may apply for and receive voter registration materials, military-overseas ballots, and other information authorized under this chapter." KRS 117A.030(4). "Covered" voters include certain categories of uniformed-service members and U.S. citizens living overseas. KRS 117A.010(1). County clerks may electronically transmit ballots to covered voters using the system required under KRS 117A.030(4). Once the voter has completed the ballot, the voter "shall transmit the voted ballot to the county clerk by mail only . . .". KRS 117.086(1)(b).

On information and belief, the State Board of Elections utilizes a system called Scytl Electronic Ballot Delivery to provide the electronic transmission system mandated by KRS 117A.030(4). According to Scytl, the company that produces this system, ballots are sent to voters over encrypted channels.[30] "Ballots can be marked on-screen via a secure marking utility that prevents common errors such as over-voting and under-voting. Voters also have the option to print their ballots and mark them by hand."[31] Scytl's delivery system allows voters to submit ballots by mail, fax, or online,[32] though as discussed above, Kentucky law requires voters who receive their ballots electronically to return them by mail.

2. New Voter ID Law ("SB 2")

While Gov. Beshear and Secretary Adams developed the emergency election regulations, and Kentuckians sheltered at home pursuant to the Governor's "Healthy at Home" initiative,[33] the General Assembly enacted SB 2, which will require Kentuckians to produce photographic ID to

[30] *Electronic Ballot Delivery*, SCYTL 1, available at https://www.scytl.com/en/resource/electronic-ballot-delivery-scytl-solution-sheet/.
[31] *Id.*
[32] *Id.*
[33] A list of the actions taken by the Governor may be found at https://governor.ky.gov/covid19.

vote, beginning with the November 3, 2020 General Election. It will apply to voting by mail as well as in-person voting. Valid identification, as defined by Section 23 of SB 2, means a document with the voter's name and photograph issued by: the United States; the Commonwealth of Kentucky; the United States Department of Defense; a branch of the uniformed services; the Merchant Marines; the Kentucky National Guard; a public or private college, university, or postgraduate technical or professional school located within the United States; or any city government, county government, urban-county government, charter county government, consolidated local government, or unified local government, which is located within Kentucky. KRS 117.375(12).

SB 2 provides an alternative for those without a recognized form of voter ID, but this alternative requires a voter to execute an affirmation on a form furnished by the Kentucky Board of Elections. *See* KRS 117.228(1). The law is unclear but appears to require that affirmation to be executed in front of an election official even when a vote is cast by mail-in ballot. KRS 117.228(1)(c); KRS 117.085(2). To execute the voter affirmation required by SB 2, the voter must affirm, under penalty of perjury, various aspects of their identity and qualifications to vote, as well as confirm that one of eight possible "impediments" prevents them from procuring a photo ID. The eight impediments enumerated in SB 2 are: (a) lack of transportation; (b) inability to obtain their birth certificate or other documents needed to show proof of identification; (c) work schedule; (d) lost or stolen identification; (e) disability or illness; (f) family responsibilities; (g) the proof of identification has been applied for, but not yet received; or (h) the voter has a religious objection to being photographed. KRS 117.228(1)(c). Neither the risk of contracting or transmitting Covid-19, nor state or local agency closures due to the pandemic, are recognized as impediments.

For voters who cast an absentee mail-in ballot, SB 2 requires that "the voter shall provide a copy of his or her proof of identification, as defined in KRS 117.375, or the executed voter affirmation as described in KRS 117.228(1)(c)." KRS 117.085(2). The latter statute—KRS 117.228(1)(c)—contemplates a signature witnessed by an election official.

However, many of the places where Kentuckians would normally obtain an ID are closed or have restricted in-person traffic to avoid the spread of Covid-19, or have very limited appointment-only hours as the pandemic continues to spread. Indeed, that was one of the reasons articulated by Governor Beshear for his veto of SB 2: "The provisions of Senate Bill 2 would also likely threaten the health and safety of Kentuckians by requiring them to obtain an identification during the novel coronavirus (Covid-19) pandemic, a public health emergency. During this time, the offices that would provide this identification are not open to in-person traffic, which would be necessary to create the actual identification." *Veto Message from Gov. Beshear regarding SB 2*.[34] For example, applicants who wish to apply to a Kentucky driver's license in Fayette County are offered a website to book an appointment that, as of July 31, 2020, offered as its next available slot an appointment time on September 10, 2020.[35] In Calloway County, the next available appointment was September 15, 2020.[36]

For voters without access to copy machines and printers, it is equally unclear whether businesses that provide such access and services will be open in the autumn, when most voters will submit their applications to vote by mail. Moreover, it also is unclear whether or how the website set up to allow Kentuckians to request absentee ballots—govoteky.com—will be able to

[34] *See* https://apps.legislature.ky.gov/record/20rs/sb2/veto.pdf.
[35] *See* Driver's License Servs., https://secure.kentucky.gov/booking.web/Event/Book/217 (last visited July 31, 2020)
[36] *See* Calloway County Driver's License Servs., https://secure.kentucky.gov/booking.web/Event/Book/212 (last visited July 31, 2020).

verify that a voter has the necessary ID to satisfy SB 2, to the extent that voters will continue to be able to request their ballots using this system.

By Defendant Secretary Adams's own admission, SB 2 is not necessary to protect election integrity. For example, in a May interview, he stated: "There's no one who's tougher on election fraud than I am. I believe in [ballot integrity] which is why I built so many safeguards into this system. . . . As a whole, it's a very safe system."[37] He also said that he was "much more concerned about voter confusion than I am about people trying to steal an election."[38] In an interview on June 30, he asserted, "I think I've shown that we can make absentee ballots work without fraud. I have shown that we can make early voting [work] without fraud."[39]

D. Plaintiffs

Plaintiffs are registered voters in Calloway County, Franklin County, Fayette County, and Jefferson County.

Plaintiff Margaret Sterne is a 65-year-old U.S. citizen registered to vote in Calloway County, where she resides with her brother and mother. Sterne Decl. ¶¶ 1-2. She had her right to vote restored in 2018. *Id.* ¶ 1. Plaintiff Sterne has been diagnosed with chronic obstructive pulmonary disease (COPD) and high blood pressure (hypertension). *Id.* ¶ 3. In March, her doctor's office contacted her to inform her that she was at high risk of severe illness from Covid-19 and that she could not visit the office in person for appointments. *Id.* Any appointments she needs to make are conducted remotely by video. *Id.* Plaintiff Sterne has been self-isolating at the family's

[37] Kentucky Bottom Line Interview, *available at*: https://kychamberbottomline.com/2020/05/12/kentucky-secretary-of-state-adams-says-changes-to-voting-for-primary-elections-will-keep-people-safe-and-make-needed-improvements-to-system/

[38] *See* M. Ye Hee Lee, *Kentucky braces for possible voting problems in Tuesday's primary amid signs of high turnout*, WashingtonPost.com (June 19, 2020), *available at*: https://www.washingtonpost.com/politics/kentucky-braces-for-possible-voting-problems-in-tuesdays-primary-amid-signs-of-high-turnout/2020/06/19/b7b960ce-b199-11ea-8f56-63f38c990077_story.html

[39] *See* WKYT, *supra* note 23, at 13:10.

home, which is located in a rural area with no nearby neighbors. *Id.* ¶ 5. She has not left the property since March. *Id.* In addition to her own health, Plaintiff Sterne is worried about the health of her mother and brother, the latter of whom who lives with several health conditions, including AIDS and heart disease, and who relies on an oxygen tank. *Id.* ¶ 4. For these reasons, Plaintiff Sterne must vote by absentee ballot in the November general election in order to safeguard her health and that of her mother and brother.

Plaintiff Helen LeMaster is Plaintiff Sterne's mother and resides with Plaintiff Sterne in Calloway County. LeMaster Decl. ¶ 3. She is a U.S. citizen and has not lost her right to vote by reason of a felony conviction. *Id.* ¶ 1. Plaintiff LeMaster is 84 years old and has been diagnosed with COPD, high blood pressure (hypertension), atrial fibrillation, and a thyroid condition. *Id.* ¶¶ 1–2. She is also a breast cancer survivor and had several lymph nodes removed from her arms as part of her cancer treatment. *Id.* ¶ 2. Since moving in with Plaintiff Sterne in March, she has not left the property. *Id.* ¶ 4. Plaintiff LeMaster is registered to vote in Calloway County, but she will not vote in November if required to vote in person because of the significant threat posed to her life by Covid-19. *Id.* ¶ 5.

Plaintiff Fred Mozenter is a 72-year-old U.S. citizen who is registered to vote in Franklin County. Mozenter Decl. ¶ 1. He is a bladder cancer survivor who has been in remission since November 2018. *Id.* ¶ 2. Nonetheless, he still requires treatment every six months. *Id.* Treatment consists of a three-week course of instillations that can only be administered in-person by his medical provider. *Id.* Plaintiff Mozenter also lives with Type 2 Diabetes, reduced kidney function, and hypothyroidism. *Id.* Since March, he and his wife, Plaintiff Debra Graner, have limited their public outings. *Id.* ¶ 3. When they do leave their home, they wear masks, maintain at least 6 feet of distance from others, and use options that provide for less contact, like the pharmacy's drive

through. *Id*. Plaintiff Mozenter has had to go to his doctor's office in person to receive cancer treatments, as well as to his local emergency room to address an unanticipated health issue. *Id.* ¶¶ 2–3. Plaintiff Mozenter seeks to vote by mail to protect his and his spouse's health against Covid-19; he does not want to take the risk of voting in person at a polling place. *Id.* ¶ 4.

Plaintiff Debra Graner is a 69-year-old registered voter in Franklin County and the spouse of Plaintiff Mozenter. Graner Decl. ¶ 1. She has been diagnosed with hypertension. *Id.* ¶ 2. Like her husband, she has left their home on a limited basis. *Id.* ¶ 3. She always wears a mask and follows recommended social distancing standards. *Id.* She and Plaintiff Mozenter have not gone to church or had guests over to their home since March. *Id.* Plaintiff Graner requested a mail-in absentee ballot for the June 23, 2020 primary election prior to Gov. Beshear's executive order allowing all registered Kentucky voters to cast their ballots by mail in the primary, and received an application by mail. *Id.* ¶ 4. However, believing she could submit her request online after the order's issuance, she did not return the physical form mailed to her by her clerk's office and she was never sent an absentee ballot. *Id.* Despite multiple phone calls to her clerk's office, it was not until June 21 that she was informed that her request had not been processed. As a result, she voted absentee in-person on June 22. *Id.* Because Plaintiff Graner's age puts her at increased risk of severe illness from Covid-19, and because her husband's multiple health conditions place him at increased risk, voting in person on Election Day will endanger her health and that of her husband due to crowding, long lines, other voters' failure to wear masks, and inadequate safety measures. The safest option is for Plaintiff Graner to cast a ballot by mail, but if she experiences issues in receiving her ballot again, she needs the option to vote in-person absentee before Election Day, which, under the emergency procedures in place for the June 23 election, encouraged voters to

make an appointment with their county clerk's office so that election workers could maintain safe voting conditions. *See* 31 KAR 4:190E(10).

Plaintiff Michael Chaney is 49 years old and registered to vote in Fayette County. Chaney Decl. ¶ 1. He is a U.S. citizen and has never lost his right to vote due to felony conviction. *Id.* ¶¶ 1-2. Plaintiff Chaney has been diagnosed with congestive heart failure and is therefore at increased risk of severe illness from Covid-19. *Id.* ¶ 3. Since March, he has followed his doctor's recommendation to wear a respirator when he has to go into public as an added protection against contracting novel coronavirus. *Id.* ¶ 4. Plaintiff Chaney leaves his home approximately every two weeks to go to doctor's appointments and the grocery store. *Id.* His household is taking extensive precautions against contracting Covid-19. *Id.* ¶ 5. Only one of his household members works outside of the home, and follows a "decontamination" procedure upon his return from work to protect the other household members. *Id.* All of the household members restrict their outings. *Id.* Plaintiff Chaney needs to vote by mail because his doctor has recommended he vote by mail due to the risk posed to his health by Covid-19 and because a member of his household is immunocompromised. *Id.* ¶¶ 5–6.

Plaintiff MacArthur Darby is a 74-year-old registered voter in Jefferson County. Darby Decl. ¶¶ 1–2. He is totally blind and has been diagnosed with cancer. *Id.* ¶ 3. He lives on his own. *Id.* In general, since March, he has only left his home to go to doctor's appointments and to pick up prescription medication, though on a few occasions has gone to Kroger, Costco, the T-Mobile Store, and a clothing store. *Id.* ¶ 4. He receives his meals through a meal delivery plan and Instacart. *Id.* A limited number of people have regularly been in his home since March, including someone who comes once a week to mow his lawn and make necessary repairs; two housekeepers, who come every other week; and a pest control employee who comes every three months. *Id.* ¶ 5. His

computer technician comes on an as-needed basis. *Id.* To the best of his knowledge, they each wear masks and maintain appropriate distance. *Id.* Typically, Plaintiff Darby votes in person on Election Day at his polling place using a machine that reads his ballot to him and allows him to make his selections without assistance. *Id.* ¶ 6. Usually, it takes him about two to three hours to vote on Election Day, including travel to and from his polling place and time spent casting his ballot. *Id.* ¶ 7. During one election, he had to wait for two hours to cast his ballot because a poll worker had difficulty operating the machine and providing him with instructions. *Id.* He ultimately had to ask someone to read his ballot to him so that he would not miss his paratransit bus. *Id.* In the June 23, 2020 primary election, he cast his ballot by mail with the assistance of his daughter, who was visiting from Atlanta. *Id.* ¶ 6. Because his age and cancer diagnosis put him at increased risk from Covid-19, Plaintiff Darby needs to vote by mail. *Id.* Additionally, Plaintiff Darby seeks to invoke his right to a secret ballot under Section 147 of the Kentucky Constitution. The only way he can cast a secret ballot by mail is for his county clerk to transmit his ballot to him electronically, using the system promulgated pursuant to KRS 117A.030(4), so that he can use his computer's reader technology to review and mark his ballot without assistance. Under current law, only military and overseas voters may have their ballots electronically transmitted to them. KRS 117.085(3)(b); KRS 117.086(1)(b); KRS 117A.030(4).

Currently, Plaintiffs do not qualify to vote absentee under any of the excuses provided by law. Although Plaintiffs Sterne, LeMaster, Mozenter, Graner, and Darby are 65 years or older, Kentucky law does not create a per se rule allowing voters in their age group to vote absentee. Rather, a voter may vote absentee if she is "[n]ot *able* to appear at the polls on election day *on the account* of age, disability, or illness, and who has not been declared mentally disabled by a court of competent jurisdiction." KRS 117.085(1)(a)(8) (emphasis added); *see also* KRS

117.085(1)(d)(7). The term "age" remains undefined under law. Plaintiffs are all physically able to appear at the polls on November 3 but doing so would pose severe risks to their health due to the Covid-19 pandemic. Even if these circumstances rendered them unable to appear at the polls on Election Day within the meaning of KRS 117.085(1), their inability to appear would be the result of the *threat* of severe illness—not disability, age, or actual illness. Notably, in expanding the ability to vote by mail for the June 23 primary, Defendants did not look to KRS 117.085(1) or the terms disability, age, or illness for authority, but the term "medical emergency" in KRS 117.077. *See* 31 KAR 4:190E(2).

LEGAL STANDARD FOR GRANTING TEMPORARY INJUNCTIVE RELIEF

A party is entitled to a temporary injunction by clearly showing that its rights will be violated by an adverse party and that it will suffer immediate and irreparable injury pending a final judgment. CR 65.04(1). In determining whether temporary injunctive relief is awarded, the circuit court follows a three-step inquiry:

> First, the trial court should determine whether plaintiff has complied with CR 65.04 by showing irreparable injury. This is a mandatory prerequisite to the issuance of any injunction. Secondly, the trial court should weigh the various equities involved. Although not an exclusive list, the court should consider such things as possible detriment to the public interest, harm to the defendant, and whether the injunction will merely preserve the status quo. Finally, the complaint should be evaluated to see whether a substantial question has been presented. If the party requesting relief has shown a probability of irreparable injury, presented a substantial question as to the merits, and the equities are in favor of issuance, the temporary injunction should be awarded.

Maupin v. Stansbury, 575 S.W.2d 695, 699 (Ky. Ct. App. 1978); *Boone Creek Properties, LLC v. Lexington-Fayette Urban Cty. Bd. of Adjustment*, 442 S.W.3d 36, 38 (Ky. 2014) (accord); *Price v. Paintsville Tourism Commission*, 261 S.W.3d 482, 484 (Ky. 2008) (accord).

ARGUMENT

A. Plaintiffs have raised at least a substantial question on the merits of their claims.

A party moving for a temporary injunction presents a "substantial question" when it shows that "there is a substantial possibility that the movant will ultimately prevail." *Price*, 261 S.W.3d at 484. However, "the actual overall merits of the case are not to be addressed in CR 65.04 motions." *Maupin*, 575 S.W.2d at 699. Here, Plaintiffs easily meet this standard.

1. Plaintiffs' Section 6 Claim

Section 6 of the Kentucky Constitution mandates that "[a]ll elections shall be free and equal." Ky. Const. § 6. For claims brought under Section 6, the controlling question remains: "Was the election free and equal, in the sense that no substantial number of persons entitled to vote and who offered to vote were denied the privilege?" *Wallbrecht v. Ingram*, 175 S.W. 1022, 1027 (Ky. 1915).

As the Court of Appeals (then the highest court of the Commonwealth) reiterated decades later: "[A]n election is free and equal within the meaning of the Constitution only when it is public and open to all qualified electors alike; when every voter has the same right as any other voter; when each voter under the law has the right to cast his ballot and have it honestly counted; when the regulation of the right to exercise the franchise does not deny the franchise itself or make it so difficult as to amount to a denial; and when no constitutional right of the qualified elector is subverted or denied him." *Queenan v. Russell*, 339 S.W.2d 475, 477 (Ky. 1960) (internal citations omitted). After all, "[t]he very purpose of elections is to obtain a full, fair, and free expression of the popular will upon the matter, whatever it may be, submitted to the people for their approval or rejection; and when any substantial number of legal voters are, from any cause, denied the right to

vote, the election is not free and equal, in the meaning of the Constitution." *Wallbrecht*, 175 S.W. at 1026.

Thus, it is not sufficient "[t]hat a majority of the legal voters were given an opportunity to register and vote"; that "is obviously not a free and fair election." *Early v. Raines*, 121 Ky. 439, 89 S.W. 289, 292 (Ky. 1905). Rather, "[w]here it is denied to any substantial extent, it is an invasion of the highest rights of the citizens, and tends to substitute other means of determining the popular will, for elections held by the people. Such course, however innocent its motive, cannot be too severely discountenanced." *Id.*

Section 6's guarantee means that "the legislature, under its authority to make reasonable regulations for the exercise of the voting franchise, cannot so frame the regulations as to deny the voting privilege, either directly or by rendering its exercise so difficult and inconvenient as to amount to a denial." *Queenan*, 339 S.W.2d at 477 (internal citations omitted). Even an "honesty of purpose in the enactment of a law intended to permit free and equal elections" cannot "save it from condemnation, if in its practical application it prevented a free and equal election." *Wallbrecht*, 175 S.W. at 1027; *see also Raines*, 89 S.W. at 292.

Section 6 also imposes an affirmative duty on legislatures and election officials to take steps to ensure that no significant percentage of Kentuckians is disenfranchised, in a practical sense. "It necessarily follows that a failure of the Legislature to make provision whereby the voter may have an opportunity to exercise his right of suffrage . . . would likewise be a violation of the same constitutional provision." *Smith v. Kelly*, 58 S.W.2d 621, 622 (Ky. 1933).

Here, Plaintiffs' constitutional rights will be "subverted or denied" if they are not granted the ability to vote absentee. *Wallbrecht*, 175 S.W. at 102. Plaintiffs Sterne and LeMaster have already decided that they cannot vote in person in November due to the risk it poses to their health

and that of their household. Sterne Decl. ¶ 6; LeMaster Decl. ¶ 5. The remaining Plaintiffs must weigh whether to sacrifice their right to vote, or their health and lives. Thus, a failure to grant them the ability to vote by mail would constitute a denial of their right to vote, protected by Section 6 of the Kentucky constitution. *Queenan*, 339 S.W.2d at 477; *Wallbrecht*, 175 S.W. at 1026 ("Strictly speaking, a free and equal election is an election at which every person entitled to vote may do so if he desires . . ."); *Raines*, 89 S.W. at 292 ("That a majority of the legal voters were given an opportunity to register and vote is obviously not a free and fair election. All legal voters should have the privilege and right."); *Chrisman v. Bruce*, 62 Ky. 63, 67 (1863) ("Here, [suffrage] is the fundamental right; all other rights, civil and political, depend on the free exercise of this one, and any material impairment of it is, to that extent, a subversion of our political system."); *Akers v. City of Mayfield*, No. 2018-CA-000101-MR, 2020 WL 115790, at *4 (Ky. Ct. App. Jan. 10, 2020) (recognizing the right to vote as "fundamental").

Plaintiffs are not alone in their threatened injuries. A substantial number of legal voters will be unable to cast their ballots if the emergency election regulations are not extended to the November General Election and any other elections held during the pandemic. The hardships imposed on voters by enforcing the excuse requirement during the Covid-19 pandemic will render voting "so difficult as to amount to a denial" for a large proportion of voters. *Queenan,* 339 S.W.2d at 477. As discussed above, some 44 percent of the state's adult population is at increased risk of severe illness from Covid-19. Elderly voters, who constituted nearly a quarter of Kentucky's electorate in the 2018 General Election, are especially vulnerable to the disease. Many of these voters are physically capable of getting to the polls and do not have a "disability" or "illness" within the meaning of KRS 117.085(1), and therefore do not qualify to vote by mail. Even voters who do not have conditions that put them at increased risk will face potential disenfranchisement,

as they will be forced to choose between exposing themselves to the virus and bringing it home to at-risk loved ones through in-person voting, or protecting their loved ones and foregoing their right to vote.

To make matters worse, the implementation of SB 2 during the pandemic will make it impossible for a substantial number of Kentucky voters to comply with the state's new voter ID law. Voters who do not currently hold a Kentucky issued driver's license or ID must schedule an in-person appointment at their local Office of Circuit Court Clerk to apply[40]—a process that many at-risk voters may eschew, especially as Covid-19 cases increase in the state. It is unclear whether college and university students will have access to student ID cards, as many schools have switched to online courses for the 2020-2021 academic year. At-risk voters who lack an acceptable form of ID may also have to execute an affirmation in person at their clerks' offices even if they vote by mail, thus forcing them to confront the same untenable choice as in-person voting. Similarly, at-risk voters who already have compliant ID but do not have access to a copier will potentially face disenfranchisement, as they will either have to risk contracting the virus by going into public to obtain a copy of their ID or forego voting altogether.

Defendants' motives for enforcing the excuse requirement during the pandemic are immaterial. "This constitutional provision admits of no evasions or exceptions." *Wallbrecht*, 175 S.W. at 1027. Secretary Adams himself admitted that the emergency election regulations were necessary for ensuring that the June 23 primary—held during the pandemic—conformed to Section 6's requirement that elections be "free and equal." According to Secretary Adams, "[Elections] must be fair, which is why I'm ensuring valid integrity in this plan, but they must also be free, meaning we have to make it possible for people to freely vote without unnecessarily risking

[40] *See* https://kycourts.gov/Pages/DLreopeningplan.aspx.

their personal safety or that of others."[41] It follows that the emergency election regulations are equally necessary for ensuring that other elections held during the pandemic are "free and equal," including and especially the November General Election, when healthcare experts expect "significant coronavirus infection"[42] and for which Secretary Adams anticipates at least double the turnout seen in the June 23 primary.[43] For these reasons, Plaintiffs have demonstrated *at least* a substantial question with respect to their Section 6 claim and are entitled to relief.

2. Plaintiff Darby's Section 147 Claim

Plaintiff Darby is also likely to prevail on his Section 147 claim. Section 147 of the Kentucky Constitution provides in part: "In all elections by persons in a representative capacity, the voting shall be viva voce and made a matter of record; but all elections by the people shall be by secret official ballot, furnished by public authority to the voters at the polls, and marked by each voter in private at the polls, and then and there deposited, or any person absent from the county of his legal residence, or from the state, may be permitted to vote in a manner provided by law. . . . The General Assembly shall pass all necessary laws to enforce this section, and shall provide that persons illiterate, blind, or in any way disabled may have their ballots marked or voted as herein required." Ky. Const., § 147. Like Section 6's guarantee of "free and fair" elections, Section 147's secret ballot provision is "mandatory," *Cole v. Nunnelley*, 130 S.W. 972, 974 (Ky. 1910), and a voter's right to cast a secret ballot is "inviolable." *Major v. Barker*, 35 S.W. 543, 544 (Ky. 1896); *see also Banks v. Sergent*, 48 S.W. 149, 151 (Ky. 1898), *rev'd on other grounds, Widick v. Ralston*, 197 S.W. 2d 261 (Ky. 1946) ("The secrecy of the ballot is the fundamental idea of all elections, and this is required by the constitution as well as by statute."). It also works in

[41] *See* Ky Secretary of State, *This is not a mail-only election* (June 6, 2020 filmed presentation), https://www.sos.ky.gov/elections/Pages/2020-Primary-Updates.aspx.
[42] *Id.* (statement of Dr. Robert Redfield, Director of Centers for Disease Prevention and Control).
[43] *Id.* at 10:30.

tandem with Section 6's guarantee of "free and fair" elections, as the Kentucky Supreme Court has recognized that "the use of any except the secret official ballots affects the merits of the election, inasmuch as it is not a fair election, for that the law essentially requires." *Nall v. Tinsley*, 54 S.W. 187, 189 (Ky. 1899).

The purpose of this constitutional provision is to prevent coercion and protect voter independence. "By compelling the honest man to vote in secrecy, it relieves him, not merely from the grosser forms of intimidation, but from more subtle and perhaps more pernicious coercion of every sort. By thus tending to eradicate corruption, and by giving effect to each man's innermost belief, it secures to the republic what at such a juncture is the thing vitally necessary to its health—a free and honest expression of the convictions of every citizen." *Tinsley*, 54 S.W. at 188 (quoting John Henry Wigmore, THE AUSTRALIAN BALLOT SYSTEM 52 (2d ed. 1889)). In this regard, "[t]he primary purpose of the secret ballot may therefore be taken to be the protection of the voter." *Gardner v. Ray*, 157 S.W. 1147, 1153 (Ky. 1913).

As it concerns voters with vision impairments, Congress has recognized that the independence of these voters may be undermined at the ballot box. A Senate Report accompanying the 1982 amendments to the Voting Rights Act stated:

> Certain discrete groups of citizens are unable to exercise their rights to vote without obtaining assistance in voting including aid within the voting booth. These groups include the blind, the disabled, and those who either do not have a written language or who are unable to read or write sufficiently well to understand the election material and the ballot. Because of their need for assistance, members of these groups are more susceptible than the ordinary voter to having their vote unduly influenced or manipulated. As a result, members of such groups run the risk that they will be discriminated against at the polls and that their right to vote in state and federal elections will not be protected.[44]

[44] S. Rep. 97-417, at 62 (1982).

Nonetheless, modern technology has made it possible for blind voters to cast their ballots without assistance. Indeed, Plaintiff Darby has used such technology in the past when voting in person. And Kentucky already has a system in place for electronically transmitting ballots to military and overseas voters, meaning that Plaintiff Darby can vote safely from home without assuming the risk of contracting Covid-19 *and* vote his conscience with the same privacy afforded to other Kentuckians, using his computer's reader technology to review and mark his ballot.

Here, because Plaintiff Darby's age and health require him to vote by mail for all elections held during the pandemic, electronic transmission of his ballot under the system required by KRS 117A.030(4) remains the only means for ensuring his right to vote by secret ballot pursuant to Section 147 and for guaranteeing his confidence that the selections made on his ballot are truly his own. If he cannot get his absentee mail-in ballot electronically transmitted to him, he will have to seek assistance from another person, forego his right to a secret ballot, and place in that person full trust that he or she has faithfully made his desired selections on his ballot. This situation presents the type of interference with free expression that Section 147 is intended to prevent, and is wholly unnecessary and avoidable in light of the State's existing electronic ballot delivery capabilities under KRS 117A.030(4). As such, Plaintiff Darby has shown *at least* a substantial question and is entitled to relief.

B. Plaintiffs will suffer irreparable injury if the June 23 emergency election regulations are not extended for the duration of the Covid-19 pandemic.

Plaintiffs' threatened injury is irreparable because the loss of one's right to vote cannot be compensated. An injury is irreparable if "there exists no certain pecuniary standard for the measurement of the damages." *United Carbon Company v. Ramsey*, 350 S.W.2d 454, 456 (Ky. 1961). If calculations for those damages are "readily available," then the injury is not irreparable. *Cyprus Mountain Coal Corp. v. Brewer*, 8289 S.W.2d 642, 645 (Ky. 1992). Here,

there is no such calculation or standard; Defendants cannot place a monetary value on Plaintiffs' right to vote, which the U.S. Supreme Court has called "preservative of all rights." *Reynolds v. Sims*, 377 U.S. 533, 562 (1964) (quoting *Yick Wo v. Hopkins*, 118 U.S. 356 (1886)).

Federal law offers a helpful point of comparison on the question of irreparable harm and loss of the right to vote. Federal courts have long found that the harm caused by the loss of one's vote is irreparable because it cannot be redressed after the election. *See Elrod v. Burns*, 427 U.S. 347, 373-74 & n.29 (1976) (plurality opinion); *Sims*, 377 U.S. at 555 (1964); *Common Cause Ind. V. Lawson*, 327 F. Supp. 3d 1139, 1155 (S.D. Ind. 2018), *aff'd*, 937 F.3d 944 (7th Cir. 2019) ("A violation of the right to vote is presumptively an irreparable harm.") (citing *McCutcheon v. Fed. Election Comm'n*, 572 U.S. 185, 1440–41 (2014); *Obama for Am. V. Husted*, 697 F.3d 423, 436 (6th Cir. 2012) ("When constitutional rights are threatened or impaired, irreparable injury is presumed. A restriction on the fundamental right to vote therefore constitutes irreparable injury."); *Dillard v. Crenshaw,* 640 F. Supp. 1347, 1363 (M.D. Ala. 1986) ("Abridgement or dilution of a right so fundamental as the right to vote constitutes irreparable injury.").

In this case, Plaintiffs cannot vote in person because it will jeopardize their health and lives, as well as those of their household members. Thus, the failure to allow them to vote by mail will constitute a constructive denial of their right to vote, for which they will have no recourse. Similarly, voters who cannot comply with SB 2 during the pandemic will also be denied their right to vote. There is no pecuniary standard for this type of loss. Additionally, Plaintiff Darby will suffer irreparable harm if he cannot receive an absentee mail-in ballot electronically, because there is no adequate remedy at law if his right to a secret ballot is violated. He cannot be compensated for this type of loss. As such, Plaintiffs and a substantial portion of the Kentucky electorate are certain to suffer irreparable harm without relief from this Court.

C. The equities favor granting Plaintiffs' requested relief.

Plaintiffs' requested relief will maintain the status quo, while serving the public interest. For the foreseeable future, the Covid-19 pandemic *is* the status quo, with transmission rates expected to stay the same or increase this upcoming autumn and winter. Murray Decl. ¶ 10. To this end, extending the emergency election regulations promulgated for the June primary—as the most recent governing election rules and the only rules to have been applied during the current pandemic—is necessary to preserve the status quo. Delaying the implementation of SB 2 until after the pandemic is equally necessary, as the law has never been implemented, much less during a general election anticipated to have high voter turnout or during a deadly global pandemic.

A temporary injunction would also benefit the public interest. Section 6 of the Kentucky Constitution recognizes and codifies the public's interest in ensuring that registered voters can cast their ballots and have them count, by prohibiting laws and practices that have the effect of disenfranchising a "substantial number" of voters. *Wallbrecht*, 175 S.W. at 1026. Similarly, and by way of comparison, federal courts have found that "[t]here is a strong public interest in allowing every registered voter to vote freely." *Summit Cty Democratic Cen. & Exec. Comm v. Blackwell*, 388 F.3d 547, 551 (6th Cir. 2004); *see also Hunter v. Hamilton Cty Bd. of Elections*, 635 F.3d 219, 244 (6th Cir. 2006) ("Members of the public, however, have a 'strong interest in exercising the fundamental political right to vote.' That interest is best served by favoring enfranchisement and ensuring that qualified voters' exercise of their right to vote is successful." (internal citation omitted)); *G & V Lounge, Inc. v. Mich. Liquor Control Comm'n*, 23 F.3d 1071, 1079 (6th Cir. 1994) ("[I]t is always in the public interest to prevent the violation of a party's constitutional rights." (citing *Garnett Co., Inc. v. DePasquale*, 443 U.S. 368 (1979)). The public would also

surely benefit from election measures that will help mitigate the spread of Covid-19, at a time when infections are forecast to be "significant."[45]

Nor will a temporary injunction requiring Defendants to extend the emergency election regulations harm Defendants. If anything, allowing more voters to cast their ballots by mail would benefit Defendants by easing the administrative strain caused by poll worker shortages that have plagued multiple states, including Kentucky, since March.[46] *Cf. Carey v. Population Servs. Int'l*, 431 U.S. 678, 691 (1977) ("The prospect of additional administrative inconvenience has not been thought to justify invasion of fundamental constitutional rights."); *see also Tashjian v. Republican Party*, 479 U.S. 208, 218 (1986). According to the Election Assistance Commission, in 2018, 58 percent of U.S. poll workers were age 61 or older[47]—placing many of them at increased risk of severe illness from Covid-19. Finally, an extension of the emergency election regulations would advance Defendants' interest in protecting public health, as the CDC has recommended that states use alternatives to in-person voting during the pandemic.[48]

As to enjoining SB 2 during the pandemic, Secretary Adams has already conceded that the emergency election regulations sufficiently safeguarded election integrity. He observed: "I think I've shown that we can make absentee ballots work without fraud. I have shown that we can make early voting [work] without fraud."[49] He confirmed that Kentucky election officials successfully

[45] *Id.* (statement of Dr. Robert Redfield, Director of Centers for Disease Prevention and Control).
[46] *SOS Issues SOS Call for Poll Workers*, KY. SEC'Y OF STATE (July 15, 2020), *available at* https://kentucky.gov/Pages/Activity-stream.aspx?n=SOS&prId=328) ("The primary reason June's primary offered so few voting locations is that so few Kentuckians volunteered to be poll workers."); Michael Wines, *From 47 Primaries, 4 Warning Signs About the 2020 Vote*, New York Times (Jun. 27, 2020), https://www.nytimes.com/2020/06/27/us/2020-primary-election-voting.html.
[47] Figure 4, *Election Administration and Voting Survey 2018 Comprehensive Report*, ELECTION ASSISTANCE COMM'N 10 (June 2019), *available at* https://www.eac.gov/sites/default/files/eac_assets/1/6/2018_EAVS_Report.pdf.
[48] *Considerations for Election Polling Locations and Voters*, CDC (Jun. 22, 2020), https://www.cdc.gov/coronavirus/2019-ncov/community/election-polling-locations.html.
[49] *Id.* at 13:10.

administered the June primary "with no reported incidents of fraud."[50] As such, whatever anti-fraud interest Defendants may have in implementing SB 2 during the pandemic will not be harmed by a temporary injunction, if coupled with an extension of the emergency election regulations.

With respect to Plaintiff Darby's Section 147 claim, his requested relief would also preserve the status quo, because for him, the status quo is voting a secret ballot using assistive technology. And because the State Board of Elections already makes electronic transmission of absentee ballots available to military and overseas voters, Defendants will not be burdened if required to make the same delivery system available to Plaintiff Darby and similarly situated voters, so that they can read and complete their ballots using assistive technology at home.

For these reasons, the public interest far outweighs any interest Defendants may have in enforcing the excuse requirement and SB 2 during the pandemic, and in not electronically transmitting absentee ballots to voters with visual impairments. The equities therefore favor granting Plaintiffs' requested relief.

CONCLUSION

Kentucky's response to Covid-19 for the June 23 primary was a success story and a model for other states as the Covid-19 pandemic continues and, in all likelihood, worsens this fall. But if Defendants fail to offer the same protections for other elections held during the pandemic, including November's General Election, Kentucky's elections will instead become a cautionary tale. Having shown a substantial question, the threat of irreparable harm in the form of disenfranchisement, and that the public interest all militate in favor of preserving the status quo and extending the emergency election regulations to the November General Election and enjoining

[50] *Id.* at 6:25.

enforcement of SB 2 for the duration of the Covid-19 pandemic, Plaintiffs are entitled to a temporary injunction.

Respectfully submitted,

/s/ Michael P. Abate

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CERTIFICATE OF SERVICE

I hereby certify that on July 31, 2020, I filed the foregoing Motion for Temporary Injunction and served it on the following counsel by submitting it through the court's electronic filing system. All parties are represented by counsel who are registered electronic filers.

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COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE (Hon. Phillip J. Shepherd)
CASE NO. 20-CI-00538

MARGARET STERNE, et al. **PLAINTIFFS**

V.

MICHAEL ADAMS, et al. **DEFENDANTS**

DECLARATION OF DR. MEGAN MURRAY

---

1. I am the Ronda Stryker and William Johnston Professor of Global Health in the Department of Global Health and Social Medicine at the Harvard Medical School, a Professor of Epidemiology at the Harvard Chan School of Public Health, a faculty member of the Center for Communicable Disease Dynamics at the Harvard Chan School of Public Health and an associate Professor of Medicine at the Harvard Medical School and the Brigham and Women's Hospital. I obtained my BA from Dartmouth College in 1980, after which I worked for the Intergovernmental Committee for Migration (now IOM) heading up a public health screening program for refugees being resettled from refugee camps in Thailand. I obtained my MD from Harvard Medical School in 1990 and my ScD (doctorate in science) in Epidemiology from the Harvard School of Public Health in 2001. I completed a residency in internal medicine in 1993 and a fellowship in the subspecialty of Infectious Diseases in 1995, both at the Massachusetts General Hospital in Boston.

2. Over the past 20 years, I have worked in the field of infectious disease dynamics and epidemiology, teaching and conducting research in emerging infectious diseases and in tuberculosis epidemiology and control. At the Harvard Chan SPH, I taught the basic epidemiology

course *Infectious Disease Dynamics* between 2000 and 2016, and I have directly supervised the research of over 40 graduate students and post-doctoral fellows in these fields. Attached here as Exhibit A and incorporated by reference to this declaration is a copy of my curriculum vitae.

3. I have conducted research and have published on the transmission dynamics of SARS-CoV-1 in 2003, the 2010 cholera epidemic in Haiti, and on the 2015 Ebola outbreak, although most of my research is in the field of tuberculosis. I have published over 200 research articles. My work includes dynamic modeling of epidemics (TB, Cholera, Ebola, SARS-CoV-1, SARS-CoV-2); cohort studies on host and pathogen specific determinants of disease transmission and the development of novel diagnostic tools for the diagnosis of infectious diseases. I have been funded by the National Institute of Infectious Disease and Allergy since 1995 and have led, and currently lead, several major consortium projects on tuberculosis funded by this agency.

4. At the Harvard Medical School, I lead the Global Health Research Core of the Harvard Medical School, which conducts research in more than ten countries on a range of topics including emerging infectious diseases. I head up research at the Division of Global Health Equity at the Brigham and Women's Hospital and also direct research at the non-governmental organization, Partners in Health. I have served as an associate editor of the European Journal of Epidemiology, the Journal of the International Union against TB and Lung Disease and of PLoS (Public Library of Science) Medicine. I am the co-lead of the Epidemiology working group of the Massachusetts Consortium for Pathogen Readiness.

5. I am currently collaborating on research concerning SARS-CoV-2 and its incidence, as well as serving on Covid-19 advisory groups for multiple organizations, including the State of Massachusetts and Harvard University. My research in this area includes, but is not limited to, modeling and estimating the number of hospital beds that will be required in the US

and elsewhere, developing methods on syndromic surveillance for Covid-19 for low and middle-income countries, identification of risk factors for poor outcomes and the use of the vaccine, BCG, to prevent Covid-19 disease. To date (May 11, 2020), I have published two papers in this area and have three others under review.

OVERVIEW

6. **SARS-CoV-2 is a newly identified coronavirus that is the causative agent involved in Coronavirus Disease 2019 (Covid-19). SARS-CoV-2 infection can result in an asymptomatic infection or in symptomatic disease which ranges from mild to severe.** Most people who develop symptomatic Covid-19 have a flu-like illness that starts out with fever, cough, sore throat and shortness of breath. A subset of people who are infected will go on to develop much more serious illness, characterized by respiratory compromise and acute respiratory distress syndrome (ARDS). Other serious manifestations of Covid-19 have included cardiac problems (arrhythmias, acute cardiac injury, and shock), neurological problems (thromboembolic stroke) and persistent and inflammatory processes (Kawasaki-like disease in children).

7. Because Covid-19 is a new disease, it is too early to know the full extent of long-term medical consequences of the infection. However, some information can be inferred from the courses of diseases with similar manifestations. Patients who develop ARDS and/or are mechanically ventilated are likely to develop lung scarring that may permanently impair their pulmonary function [1]. Patients who end up in ICUs or on mechanical ventilation for extended periods often develop post-ICU syndrome with prolonged physical debilitation, muscle atrophy, neurocognitive impairments and emotional/psychiatric responses that are similar to post-traumatic stress syndrome. Although Covid-19 has been reported in people of all ages, older people and those with co-morbidities (concurrent illnesses) are most likely to develop severe disease. The CDC specifies that the following conditions may be associated with an increased risk of severe

Covid-19 illness: Age 65 and older, residence in a nursing home or long-term care facility, chronic lung disease or moderate to severe asthma, serious heart conditions, immunocompromised states including cancer, smoking, bone marrow or organ transplantation or poorly controlled HIV or AIDS, prolonged use of corticosteroids, severe obesity (body mass index [BMI] of 40 or higher), diabetes, chronic kidney disease undergoing dialysis and liver disease. [2] As noted below, given the higher prevalence of many of these conditions in African-American populations, these populations are at higher risk of severe disease if infected.

8. **Covid-19 is a respiratory virus which is spread by symptomatic and asymptomatic people through respiratory droplets, meaning drops of fluid from the nose or mouth that are emitted during coughs, sneezes or even talking.** Some of the viral particles emitted this way end up on surfaces (door handles, coins, voting machines, credit cards and/or photo IDs) where they can remain viable. It has also been shown that Covid-19 can be transmitted as an aerosol – in other words, through the airborne route, i.e., direct inhalation of virus suspended in the air.

9. **Control of SARS-CoV-2 spread is particularly difficult relative to some other viral infections because people can transmit the infection even when they do not have symptoms of the disease.** This means that the practice of isolating patients with symptomatic disease will not be enough by itself to control epidemic spread. In contrast, infections like smallpox and SARS-CoV-1 were not infectious until symptoms had developed so isolation of ill people had a substantial impact on epidemic control. In the absence of a vaccine or pharmaceutical interventions that interrupt transmission, infection control can only be achieved by reducing the number of contacts between infectious individuals (including those who are asymptomatic) and susceptible people.

10. Infectious disease epidemiologists have developed projections of the future trajectory of Covid-19 incidence based on modeling the epidemic and possible interventions. Although these models differ in terms of specifics, they consistently show that it is highly likely that the relaxation of social distancing measures that will occur with the end of "lock-down" will increase the number of social contacts that people make and that the incidence of infection will increase accordingly In particular, these models predict that transmission of SARS-CoV-2 will continue or increase in the fall and winter, leading to further morbidity and mortality from this disease.

11. There is a substantial risk that an infection with Covid-19 acquired during voting at a polling place in Kentucky in the fall of 2020 could result in symptomatic disease, hospitalization or death. The risk of an individual being infected in fall 2020 depends on the number of infectious people in that community at that time point and the number of physical, fomite-mediated and near unprotected contacts one makes during that process. To the extent that polling places are crowded, require people to wait in lines, involve interacting with polling staff or other voters at a close distance, move people through the process slowly, are poorly ventilated and/or involve people touching objects like pens, paper, or surfaces within the voting booth, they constitute a risk to voters.

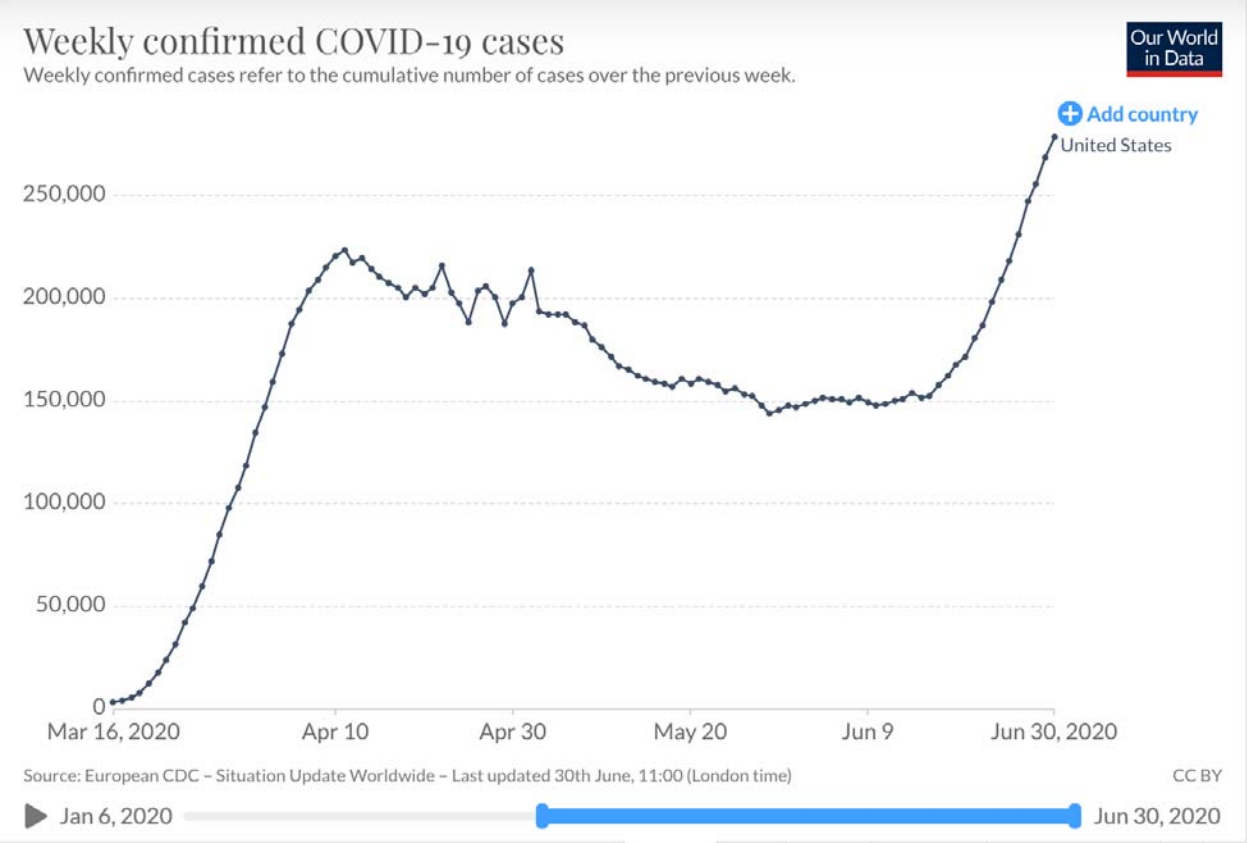
12. While measures such as careful cleaning, using hand sanitizer, and improving ventilation may reduce risk, their efficacy will vary based on how well they are implemented and even under optimal circumstances, they are unlikely to eliminate all transmission risk. For example, during the Wisconsin election held on April 7, a variety of protective methods were put into place to ensure voting safety for the approximately 440,000 people who voted in person.

13. Despite these precautions, the Wisconsin Department of Health Services detected 71 cases that they consider may have resulted from in-person voting, and a recent study found that counties with higher than average in person voting had twice the rate of Covid-19 positive tests in the weeks that followed the election. [3, 4]. (See detailed description of this study on page 25). These findings suggest that it may not be possible to eliminate the risk of transmission at polling booths through sanitization, keeping people apart, wearing of personal protective gear and other such measures.

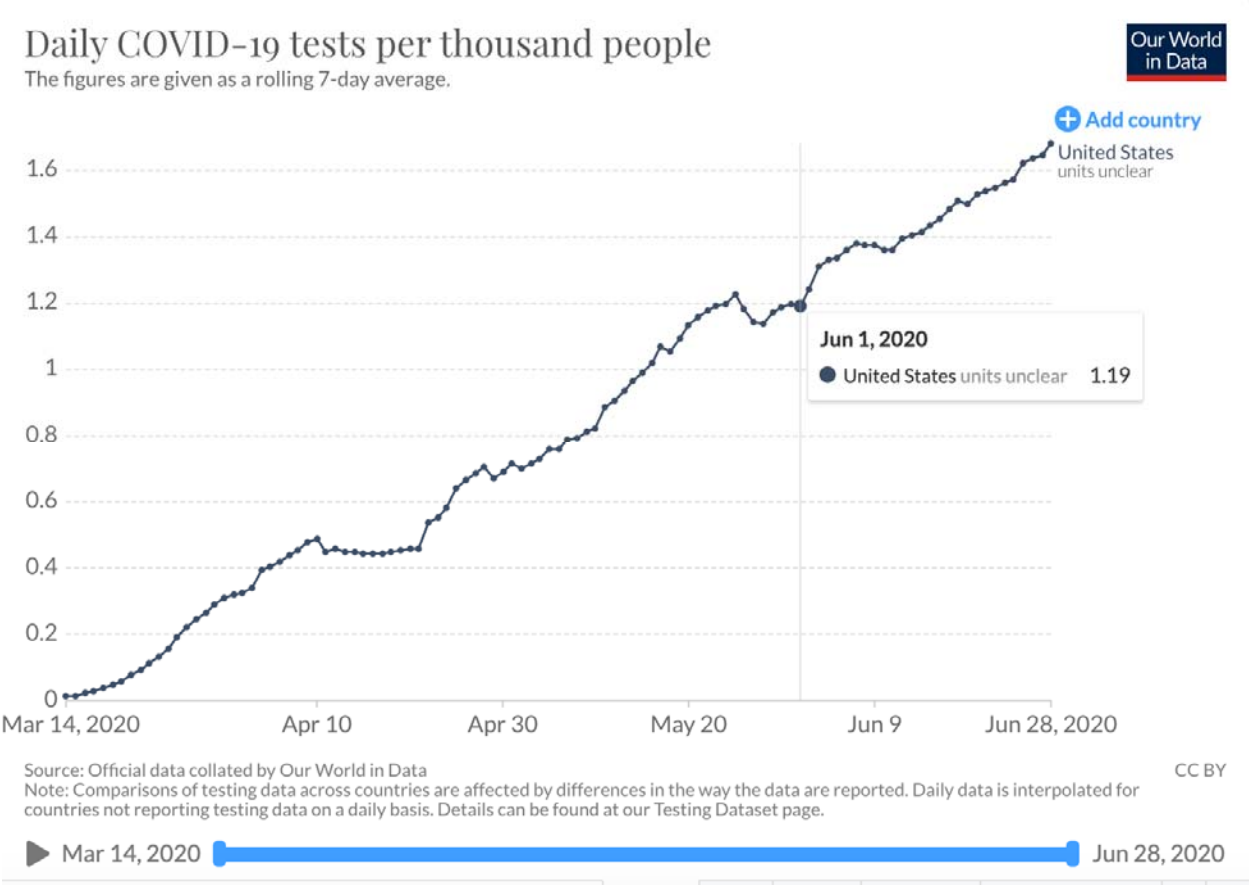
14. ***I was asked to describe the disease burden in the United States.*** As of June 30, the US had reported 2.59 million confirmed cases of Covid-19 and 126,140 deaths. A recent CDC study suggests that these case numbers are likely to underestimate the actual number of people who have been infected with Covid-19 by about ten-fold. In this work, the researchers compared reported case counts by a specific date in six US locations to the estimated number of people in those locations who were positive on antibody testing (which detects previous infection) and found that the estimated case count based on the seroprevalence survey was 6-24 fold higher than the case counts based on confirmed cases. This suggests that about 26 million cases have occurred in the US, affecting 7.8% of the total population. Notably (as explained below), this number is not high enough to suggest that the US population is protected by herd immunity. [5]

15. The figure below from the website https://ourworldindata.org/ shows the trajectory of confirmed cases since March 16th, demonstrating an initial decline in weekly confirmed cases that began in mid-April but which was reversed in early June. The weekly confirmed case load on June 30th was the highest it has been to date. [6]

Weekly confirmed Covid-19 cases in the US



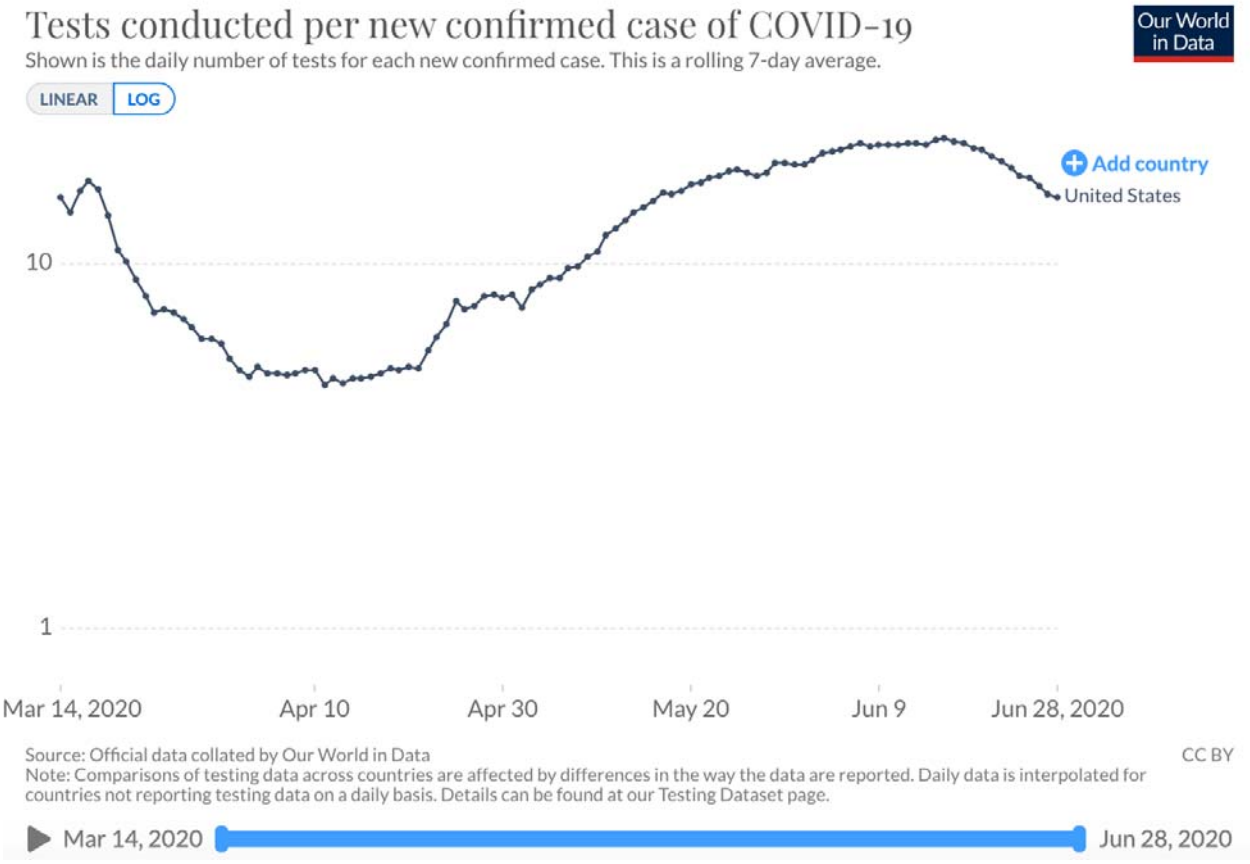
16. The next figure shows that the number of tests performed per thousand people has risen steadily since March. [7]



These two figures show that there has both been more testing capacity and an increased number of cases.

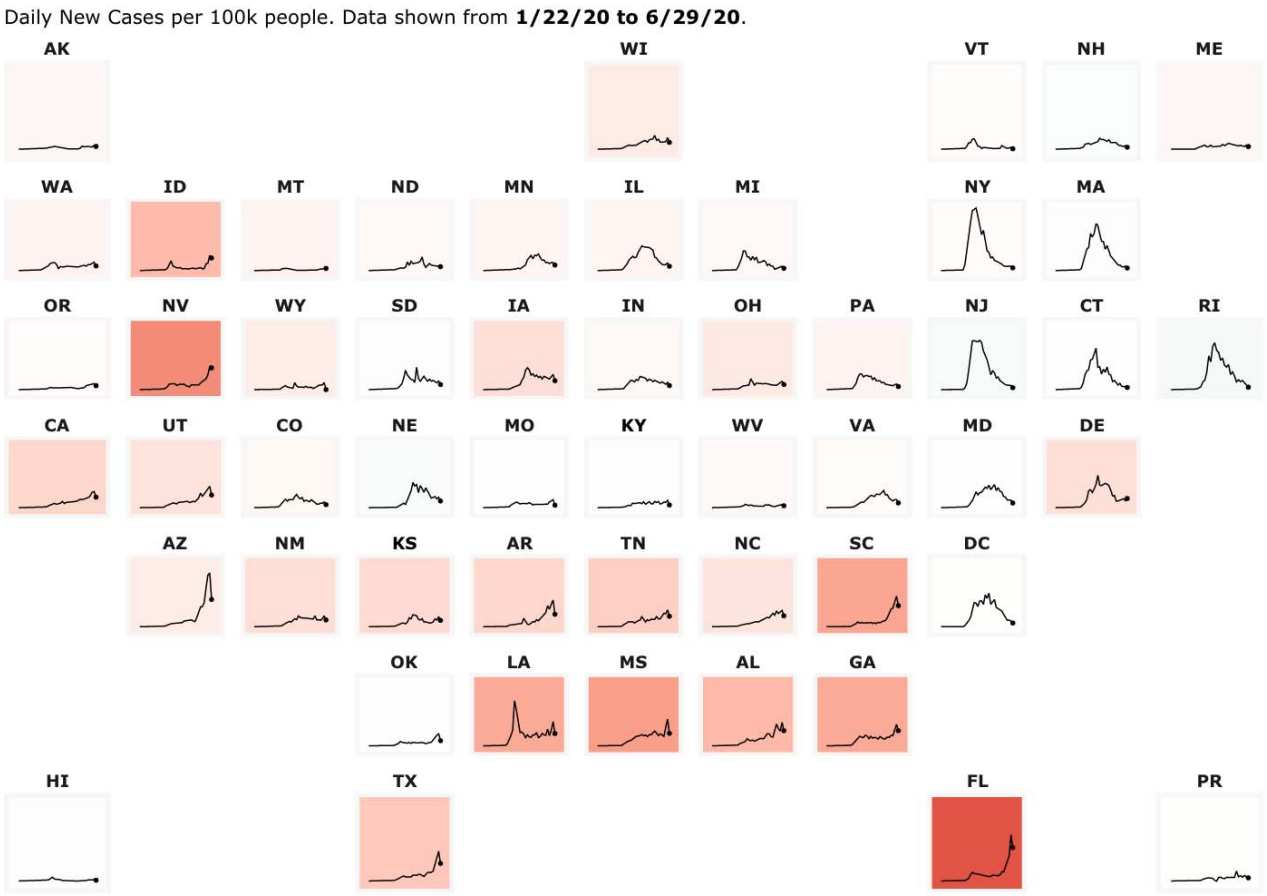
17. The next figure shows that the proportion of tests that are positive has risen since April and peaked in mid-June. This proportion should fall if testing increased without a true increase in the number of positive cases; the figure thus suggests that the increase in confirmed cases is not due solely to increased testing but to a true rise in incidence.

Tests conducted per new confirmed case of Covid-19 [8]



18. The figure below from Johns Hopkins University shows daily new cases per 100,000 people by state; the intensity of the red color indicates the extent of the upward trend in cases in the past two weeks:

Daily New Cases per100,000 people by state [9]



These figures show that many states are experiencing a rise in cases that temporally followed re-opening of businesses and institutions in May and early June.

19. ***I was asked to describe the novel coronavirus that causes Covid-19.*** SARS-CoV-2 is a newly identified coronavirus that is the causative agent involved in Coronavirus Disease 2019 (Covid-19) [1]. It is a single-stranded RNA virus of the Coronavirus family. Previously

identified coronaviruses are known to infect a wide range of hosts including wild and domestic animals and birds as well as humans. Six human coronaviruses have been identified over the past 60 years; four of them (OC43, 229E, NL63, and HKU1) cause mild cold-like symptoms and/or gastrointestinal tract infections. Two that have caused more serious illness include the severe acute respiratory syndrome coronavirus (SARS-CoV-1) that emerged in China in 2003 and the Middle East respiratory syndrome coronavirus (MERS-CoV) that was first identified in humans in Saudi Arabia in 2012. SARS- and MERS-CoVs are believed to have originated in bats and transferred to humans through intermediary hosts, possibly palm civets for SARS or dromedary camels for MERS. The coronaviruses that are most similar to SARS-CoV-2 are those identified in horseshoe bats – these share 96 percent of their genetic material with SARS-CoV-2 while the earlier SARS virus shared 80 percent and cold viruses mentioned above share about 50 percent [10].

20. Like SARS-CoV-1, SARS-CoV-2 infiltrates human cells by binding to the receptor for ACE2 (angiotensin converting enzyme) and then being taken up by these cells, where it directs the production of new virus particles (virions) using the host's genetic machinery [11]. Like other viruses, SARS-CoV-2 virions consist of a "core" which contains the genetic material, a "capsid" which is a protein coat and a lipid envelope. Upon assembly in the host cell, newly-produced virions are released from the host cell and go on to infect new host cells. To some extent, the clinical manifestations of the disease are related to the types of cells that have the receptor to which the virus binds and to the inflammatory responses that are induced by the host immune response to the infection. While ACE2 receptors were well-known to be present on vascular endothelial cells (blood vessels) and renal tubular cells (kidney), they have also been found to be abundant on alveolar epithelial cells (lung), enterocytes (gut), heart cells, brain cells and in cells in the inner

lining of the nose [12]. This diverse distribution helps explain the wide constellation of symptoms and syndromes that are increasingly being recognized as part of Covid-19 disease.

21. ***I was asked to characterize clinical features of Covid-19.*** SARS-CoV-2 infection can result in an asymptomatic infection or in symptomatic disease which ranges from mild to severe. The term Covid-19 refers to the illness that is caused by SARS-CoV-2. Most people who develop symptomatic Covid-19 have a flu-like illness that starts out with fever, cough, sore throat and shortness of breath. As clinicians have gained more experience with the disease, it is now becoming clear that the initial presentation of the disease can also include a variety of other symptoms including gastrointestinal issues such as nausea, vomiting and diarrhea, loss of a sense of taste and/or smell, headache and muscle pain and in some cases, particularly in the elderly, altered neurological states such as confusion, lethargy and reduced responsiveness. The Centers for Disease Control and Prevention (CDC) have recently expanded their list of symptoms associated with Covid-19 from fever, shortness of breath and cough to include chills, muscle pain, headache, sore throat and new loss of taste or smell [13]. On average, among those who present with these symptoms, fever persists for around 12 days, shortness of breath for 13 days and cough for about 19 days. According to the World Health Organization (WHO), recovery time appears to be around two weeks for mild infections and three to six weeks for severe disease [14].

22. A subset of people who are infected will go on to develop much more serious illness, characterized by respiratory compromise due to pneumonia that can be gradual or sudden. Some patients who initially reported only mild symptoms may progress to severe disease over the course of a week. In one study of 138 patients hospitalized in Wuhan, China for pneumonia due to SARS-CoV-2, dyspnea (severe shortness of breath) developed approximately five days after the

onset of symptoms, and hospital admission occurred after around seven days after the onset of symptoms [15].

23. Acute respiratory distress syndrome (ARDS) is the major complication in patients with severe disease. In the study cited above, ARDS developed in 20 percent of hospitalized patients around eight days after the onset of symptoms and 12.3 percent of this group required mechanical ventilation [16]. In another study of 201 hospitalized patients with Covid-19 in Wuhan, 41 percent developed ARDS [17]. Some patients with severe Covid-19 have an overactive inflammatory response, sometimes termed a "cytokine storm" – which is characterized by persistent fevers and laboratory abnormalities including high levels of inflammatory markers and elevated proinflammatory cytokines. People with these types of laboratory abnormalities are those most likely to have critical or fatal illness.

24. Other serious manifestations of Covid-19 have included cardiac problems: arrhythmias, acute cardiac injury, and shock [17-19] which occurred in 17, 7, and 9 percent of hospitalized patients, respectively [15]. In a case series of 21 severely ill patients admitted to a US ICU, one-third developed cardiomyopathy (injury to the heart muscle) [20]. An alarming recent finding has been the association of Covid-19 with thromboembolic complications (pulmonary embolism and stroke) that have been reported among patients in younger age groups and without known risk factors [21-23]. In one US-based case series, a single health facility reported on five Covid-19 patients with acute stroke who were seen over a two-week period, all of these people were under 50 years of age [22]. This incidence is more than seven times the rate reported in that age group prior to the pandemic. In one series of ICU patients, ischemic stroke was also observed in 3.7 percent of the patients [23].

25. Other rarer manifestations of Covid-19 include Guillain-Barré syndrome which can occur five to ten days after initial symptoms [24]. Guillain-Barré syndrome is a rare neurological syndrome characterized by an inflammation of nerve cells outside the brain. In serious cases, it can lead to paralysis which usually resolves after six months but which can be permanent in some cases. Another rare inflammatory syndrome that has been reported in Covid-19 occurs in children who have developed symptoms consistent with toxic shock syndrome and Kawasaki disease [25].

26. Because Covid-19 is a new disease, it is too early to know the full extent of long-term medical consequences of the infection. However, some information is already available, and some can be inferred from the courses of diseases with similar manifestations. Patients who develop ARDS and/or are mechanically ventilated are likely to develop lung scarring that may permanently impair their pulmonary function. [26]. In addition, patients who end up in ICUs or on mechanical ventilation for extended periods often develop post-ICU syndrome which includes a constellation of findings such as prolonged physical debilitation, muscle atrophy, neurocognitive impairments and emotional/psychiatric responses that are similar to post-traumatic stress syndrome [27]. Patients that suffer strokes in the context of Covid-19 are very likely to experience long-term neurological deficits from these events.

27. ***I was asked to describe known risk factors for serious Covid-19 disease.*** Although Covid-19 has been reported in people of all ages, older people and those with co-morbidities (concurrent illnesses) are most likely to develop severe disease. Accurate case fatality rates are hard to obtain in the context of limited testing since we do not always know who actually has the infection. However, a compilation of the death rates across countries shows that older people are consistently more likely to die if they have detectable Covid-19 disease than are younger people [28]. The table below shows that the risk of death rises with each additional decade after age 50.

Table 1. Case Fatality rate by age groups. From Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to Covid-19 in Italy. *JAMA*. 2020;323 [28]

Table. Case-Fatality Rate by Age Group in Italy and China[a]

	Italy as of March 17, 2020		China as of February 11, 2020	
	No. of deaths (% of total)	Case-fatality rate, %[b]	No. of deaths (% of total)	Case-fatality rate, %[b]
All	1625 (100)	7.2	1023 (100)	2.3
Age groups, y				
0-9	0	0	0	0
10-19	0	0	1 (0.1)	0.2
20-29	0	0	7 (0.7)	0.2
30-39	4 (0.3)	0.3	18 (1.8)	0.2
40-49	10 (0.6)	0.4	38 (3.7)	0.4
50-59	43 (2.7)	1.0	130 (12.7)	1.3
60-69	139 (8.6)	3.5	309 (30.2)	3.6
70-79	578 (35.6)	12.8	312 (30.5)	8.0
≥80	850 (52.3)	20.2	208 (20.3)	14.8

[a] Data from China are from Chinese Center for Disease Control and Prevention.[4] Age was not available for 1 patient.

[b] Case-fatality rate calculated as number of deaths/number of cases.

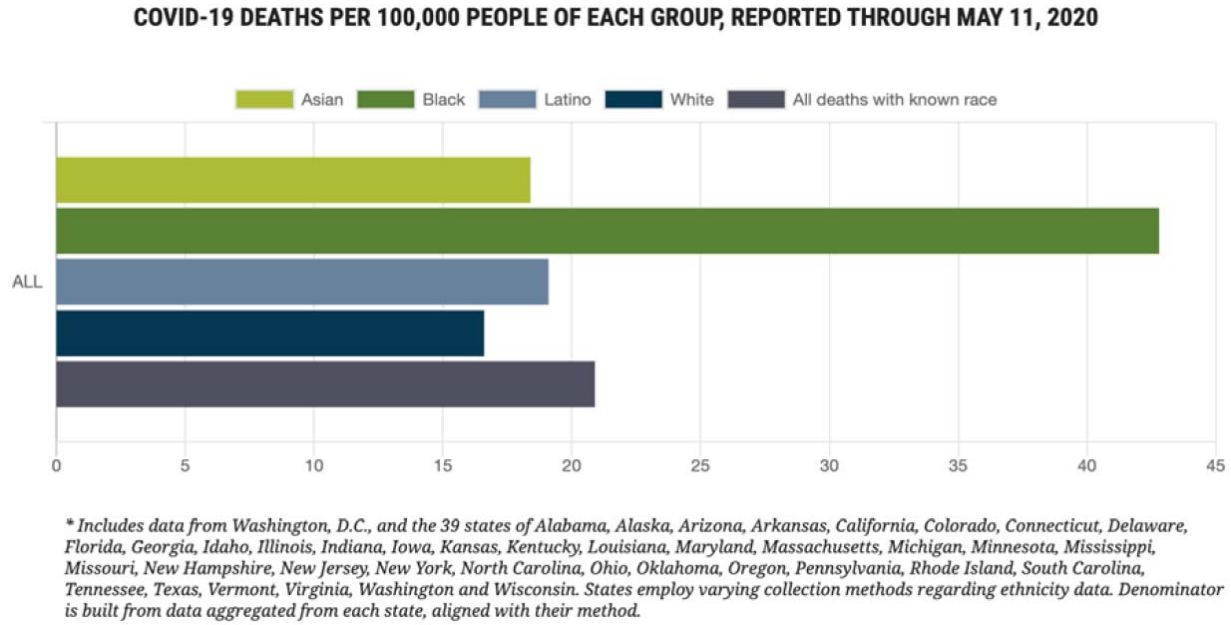
28. In addition to age, other risk factors for severe disease and death include hypertension, heart disease, lung diseases (e.g., asthma, chronic obstructive pulmonary disease (COPD)), diabetes mellitus, obesity, and chronic kidney disease. In one recent study of 5700 Covid-19 patients identified in New York City, 56.6 percent had pre-existing hypertension, 41.7 percent were obese (body mass index > 30) and 33.8 percent had diabetes mellitus in contrast to a national prevalence of hypertension of 30 percent, of diabetes mellitus of 10 percent and of obesity of 42.2 percent [31]. Risk factors for death among patients with Covid-19 were recently ascertained in another study of 5,683 Covid-19 deaths in the United Kingdom [32]. In this report, men were twice as likely to die as women; people with obesity 2.3 times as likely to die as those of normal weight; people with uncontrolled diabetes 2.36 times than non-diabetics, people with organ transplants 4.3 times than their healthy counterparts.

29. In both Britain and the US, there are marked disparities in deaths by race: 33 to 42 percent of deaths in the US have reportedly occurred in African-Americans, while only 12 to 13 percent of the total US population is African-American [33]. This unequal distribution of

morbidity and mortality from Covid-19 is likely multi-factorial; African-Americans may be more likely to be infected with Covid-19 through workplace and transportation related exposures and more likely to have comorbidities that lead to poor outcomes if they are infected. The CDC reported that the prevalence of hypertension among non-Hispanic blacks is 40.3% compared to 27.8% in both non-Hispanic whites and Hispanics (data from 2015-6). [34]. Similarly, the prevalence of obesity among non-Hispanic blacks is 49.6% compared to 44.8% among Hispanics and 42.2% among non-Hispanic whites. [35]. Nonetheless, a recent report on risk factors for death from Covid-19 among 17,425,445 with health records in the British National Health Service found that even after controlling for other co-morbidities, being black increased the risk of death from Covid-19 by 70%. [36]. The mechanism by which ethnicity leads to worse outcomes has not yet been fully explained.

30. Figure 2 provides comparative death rates from Covid-19 from the APM research lab (https://www.apmresearchlab.org/).

Table 2. Covid-19 Death Rate by ethnic group. (From APM Research Lab)
https://www.apmresearchlab.org/



** Includes data from Washington, D.C., and the 39 states of Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington and Wisconsin. States employ varying collection methods regarding ethnicity data. Denominator is built from data aggregated from each state, aligned with their method.*

31. Although the Covid-19 case fatality rates are low in young individuals, it is important to note that multiple seroprevalence studies (studies that detect previous infection in people) in several countries show that infection (as distinct from severe disease) is more common in people younger than 50, probably because they have more frequent social contacts than older people. Furthermore, the proportion of people in the US population under 50 years of age is 66%, meaning that even though the absolute risk for a young person is lower than for someone over 50, deaths among people under 50 will not be uncommon as the epidemic progresses over time.

32. ***I was asked to explain how Covid-19 is transmitted and to describe interventions that could interrupt transmission.*** SARS-CoV-2 can be transmitted in multiple ways, through respiratory droplets emitted during talking, singing, sneezing and coughing, via objects on which viral particles have been deposited, and through air. Importantly, the virus can be transmitted by people who are asymptomatic as well as by those who are demonstrably ill.

33. Covid-19 is a respiratory virus which is spread through respiratory droplets, meaning drops of fluid from the nose or mouth that are emitted during coughs, sneezes or even talking. Some of the viral particles emitted this way end up on surfaces (door handles, coins) where they can remain viable. These objects then become "fomites," defined as inanimate objects that can transfer infection between people. A recent study documented the stability of SARS-CoV-2 on a series of different surfaces over time [37]. The virus was found to be more stable on plastic and stainless steel than on copper and cardboard with viable virus detectable for up to 72 hours after application to these surfaces although the virus titer was steadily reduced over those periods. On cardboard, viable SARS-CoV-2 was measured for 24 hours. Notably, this study also evaluated the stability of SARS-CoV-1 – the causative virus of the 2003 SARS epidemic – and found that it was very similar to SARS-CoV-2 despite the fact that SARS-CoV-2 has much more capacity to

spread widely than SARS-CoV-1. The authors conclude that the "differences in the epidemiologic characteristics of these viruses probably arise from other factors, including high viral loads in the upper respiratory tract and the potential for persons infected with SARS-CoV-2 to shed and transmit the virus while asymptomatic." [37] Notably, however, reports have suggested that the studies on the durability of fomites over-estimated the risk of fomite-mediated transmission because they assessed the viability of virus at much higher concentrations on surfaces than would occur in the community (rather than laboratory) setting. [38] On May 22, the CDC has revised its guidance on transmission to read: "The primary and most important mode of transmission for COVID-19 is through close contact from person-to-person. Based on data from lab studies on COVID-19 and what we know about similar respiratory diseases, it may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly their eyes, but this isn't thought to be the main way the virus spreads." [39]

34. There is also growing evidence that Covid-19 can be transmitted as an aerosol – in other words, through the airborne route, *i.e.*, direct inhalation of virus particles suspended in the air. The study cited above also assessed the stability of aerosolized SARS-CoV-2 over time [37]. To do this, they used a nebulizer to generate aerosols that would be similar to those observed in samples obtained from the upper and lower respiratory tract in humans. SARS-CoV-2 remained viable in aerosols throughout the duration of the three-hour experiment, suggesting that aerosol spread of SARSCoV-2 is indeed possible. These findings are consistent with case reports of Covid-19 patients who were infected in settings in which they did not have direct contact with others. In one case, 45 people were diagnosed with Covid-19 after attending a choir practice in Washington State in early March although they had no direct physical contact with each other [40].

35. Those findings are also consistent with a report in the journal, Nature, where researchers found viral RNA in aerosols sampled in February and March at two hospitals in Wuhan, China. The levels of airborne viral RNA in well-ventilated patient rooms were relatively low but there were higher levels in some of the patients' toilet areas, presumably aerosolized by the flushing mechanism. High levels of viral RNA were also found in areas where medical workers remove their protective equipment and in locations near the hospitals where people tended to congregate. The authors concluded: "Our study and several other studies proved the existence of SARS-CoV-2 aerosols and implied that SARS-CoV-2 aerosol transmission might be a non-negligible route from infected carriers to someone nearby. (74)"

36. This is an important point because airborne (or aerosol) transmission is less amenable to easily-implemented infection control measures than is transmission through large respiratory droplets, and this therefore makes polling booths and other closed spaces more dangerous than they might be otherwise.

37. To clarify, it is necessary to distinguish between airborne and droplet-based transmission of respiratory infections. When someone with a respiratory infection coughs, sneezes, talks or sings, they eject mucus and saliva droplets from their mouths. These virus-containing droplets are thought to measure between 5 and 10 micrometers. If ejected droplets are not blocked by a hand over the mouth or a mask, they may land on people or objects in the immediate vicinity. In general, droplets over 5 micrometers have been considered unable to travel more than 1-2 meters (3-6 feet) and this is the basis for the 6-foot rule recommended by the WHO and other health agencies [75]. Droplets larger than 5 micrometers are usually thought to fall quickly to the ground whereas small droplets can dehydrate and linger as "droplet nuclei" in the air, where they behave

like an aerosol and thereby expand the spatial extent of emitted infectious particles [76]. The WHO classifies particles of less than 5 μm as aerosol and those greater than 5 μm as droplets but there is significant variation in the literature regarding the classification of the lower size limit of droplets with some studies demonstrating that even particles with a diameter of more than 10 μm can remain airborne long enough so that it is not appropriate to consider them vehicles of transmission by the "droplet" route [77].

38. Bahl et al. recently conducted a systematic review of the evidence for the horizontal distance travelled by droplets and the guidelines based on these data [78]. They found that the evidence base for the 1-2 meter rule was sparse. Of ten studies on horizontal droplet distance, eight showed droplets travel more than 2 m (≈6 ft), in some cases more than 8 meters (≈26 ft). Several studies of SARS-CoV-2 support aerosol transmission, and one study documented the existence of viable virus at a distance of 4 meters (≈13 ft) from the patient. They also provide evidence that despite guidelines that suggest otherwise, infections cannot be neatly classified into the droplet versus airborne transmission routes and they argue that the weight of combined evidence supports airborne precautions against Covid-19.

39. Several other recent studies provide support for this theory. These are reviewed by David Helfgott in Infectious Disease Advisor and I cite from this article [79]: "In a study by van Doremalen et al, experimentally-generated aerosol particles with SARS-CoV-2 were found to have virus that was viable in cell culture throughout the 3 hours of aerosol testing [80]. Such laboratory-generated aerosols may not be exactly analogous to human-exhaled aerosols, and measurement of virus exhaled from patients with COVID-19 infection has been reported in several studies. In China, aerosol particles were isolated from air samples collected from various areas in 2 hospitals

and from outdoor spaces in Wuhan; virus genome was detectable in some aerosols but at very low concentrations [74]. A study at another hospital detected SARS-CoV-2 RNA in 35% of aerosol specimens from the intensive care unit and in 12.5% of specimens obtained from a COVID-19 ward [81]. An epidemiologic analysis from China concluded that cases of COVID-19 traced to possible shopping mall exposure may have occurred via aerosol [82]. In a study from Iran, air samples taken from a distance of 2 to 5 m from patient beds were negative for SARS-CoV-2 RNA [83]. However, a study from the University of Nebraska Medical Center demonstrated SARS-CoV-2 genome in 63.2% of air samples from rooms of 11 patients infected with COVID-19, with some samples obtained at distances >6 ft from the patient, and in 66.7% of 12 air samples obtained from hallways outside the patients' rooms [84]." More recently, Stadnytski and colleagues used highly sensitive laser light scattering to show that loud speech can emit thousands of oral fluid droplets per second; these were measured to have a diameter of approximately 4 μm diameter, leading the investigators to conclude that there is a substantial probability that normal speaking causes airborne virus transmission in confined environments [85].

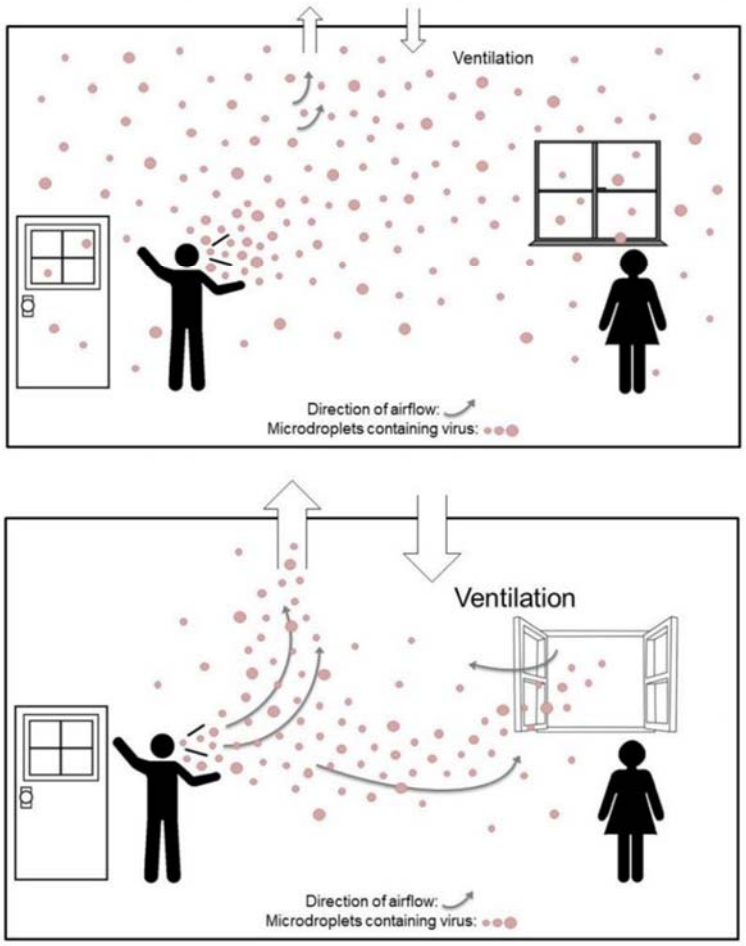
40. Most recently, a study of 2000 surveyed participants in the US and the UK found that increased height increases the risk of SARS-CoV2 infection with height greater than 6 feet associated with a 2-5 fold increase in the risk of infection. The authors of this study note that taller people might be at greater risk of infection in the event of aerosol transmission since they would be less exposed to downward falling droplets than shorter people. [102]

41. Although the mode of respiratory transmission of SARS-CoV2 is incompletely understood, but there is growing evidence that transmission can occur through both large droplets and by smaller particles (aerosols) with the relative contribution of each mode not yet clarified.

Given the possibility of aerosol-based spread, precautions against Covid-19 should include those designed to reduce airborne spread. This point is made emphatically in a letter from aerobiologists, Lidia Morowska and Don Milton that published in the journal, Clinical Infectious Diseases, and signed by 239 scientists. [103] In it, the authors state: "It is understood that there is not as yet universal acceptance of airborne transmission of SARS-CoV2; but in our collective assessment there is more than enough supporting evidence so that the precautionary principle should apply. In order to control the pandemic, pending the availability of a vaccine, all routes of transmission must be interrupted." Here the term, precautionary principle refers to the assertion "that the burden of proof for potentially harmful actions by industry or government rests on the assurance of safety and that when there are threats of serious damage, scientific uncertainty must be resolved in favor of prevention." [104] In this context, the precautionary principle prescribes that measures be put into place to reduce the possibility of infection through the aerosol route. Such measures would include use of N95 respirators that filter out small droplet nuclei and ensuring adequate ventilation within rooms. Figure 1, from the Clinical Infectious Diseases paper cited above, shows how

ventilation can help redistribute virus-containing microdroplets within a room.

Distribution of respiratory microdroplets in an indoor environment with (a) inadequate ventilation and (b) adequate ventilation



42. The transmissibility of any infectious agent depends on several things: the probability of an infection event given a contact between a susceptible person and an infectious person; the duration of infectiousness – or number of days that a person can transmit – and the number of contacts that an infectious person has per unit time. This means that the transmissibility can vary in different settings and will depend on things like crowding, which increases the number of contacts. Based on a summary of multiple studies, each infectious person with Covid-19 is

expected to infect between 2 and 3 people on average [34]. But this term – "on average" – obscures the substantial variability observed in different people. Some people are much more infectious than others and other people do not transmit at all. Like many other respiratory infections, SARS-CoV-2 follows the 20/80 rule – meaning that most transmission is associated with 20 percent of the infectious people while the other 80 percent infect relatively few people. The factors that lead to this kind of "super-spreading" are not clear and it is thus not possible to identify in advance those people who are likely to infect a large number of other people.

43. Control of SARS-CoV-2 spread is also made more difficult because people can transmit the infection even when they do not have symptoms of the disease. This can happen in two ways. Many people with SARS-CoV-2 infection have few if any symptoms – as more and more seroprevalence studies are being conducted to identify who has been infected, it is estimated that 50-60 percent of infected people never develop symptoms of the disease. (Seroprevalence surveys are studies that look for the presence of antibodies to an infection in a blood sample; these are only present in people who have been exposed to the infection and have mounted an immune response.) Secondly, people who develop Covid-19 disease experience a "pre-symptomatic" period during which they are infected but do not yet have symptoms. A study in the New England Journal of Medicine found that quantitative SARS-CoV-2 viral loads were similarly high in four different symptom groups: people with typical symptoms of Covid-19, people with atypical symptoms, people who were pre-symptomatic, and those who remained asymptomatic. Notably, 71 percent of the samples taken from pre-symptomatic persons had viable virus for one to six days before the development of symptoms. Because viral load is an accepted proxy for infectiousness, these data imply that a significant proportion of transmission events originate from persons who do not have detectable infection.

44. ***What kinds of interventions are currently available that could interrupt or reduce transmission of SARS-CoV-2?*** In the absence of a vaccine or pharmaceutical interventions that reduce the probability of transmission, there are a limited number of approaches that public health experts recommend to implement infection control, all of which involve restricting people's physical and social interactions. These fall into the broad categories of isolation, quarantine and social or physical distancing. Isolation refers to restricting all interactions with people with symptomatic disease to try to prevent them from infecting others; while this is an important strategy for Covid-19, it is unlikely to be sufficient to eliminate transmission since isolation will only be completely effective if people are diagnosed with the disease at or before the time that they become infectious. As noted above, in people who are infectious before they have symptoms or in infectious people who never develop symptoms at all, transmission can take place in the absence of symptoms. Quarantine refers to the separation and restriction of people without signs of illness who may have been exposed to an infectious case so that they do not infect others during a pre-symptomatic or asymptomatic period. Another approach is to implement social distancing – this can range from asking people to stay at home to avoiding any congregate settings such as schools, voting booths, workplaces, or large gatherings. The purpose of social distancing is to reduce the number of person-to-person contacts one makes so that one is less likely to encounter an infectious person and become infected with SARS-CoV2. Polls show that US adults practicing social distancing have 90% fewer contacts per day than those who are not social distancing. Those who completely or mostly isolate themselves generate about five contacts per day, compared with an average of 52 for those not attempting to isolate themselves [36]. Notably, during testimony to the Senate in May, Dr. Anthony Fauci, head of the National Institute for Allergy and Infectious Diseases, warned that Americans would experience "suffering and death that could be avoided,"

if states failed to delay reopening of businesses until they see dramatic declines in cases. Lastly, physical distancing can involve measures such as wearing masks or maintaining a distance of 6 feet from others which reduce the likelihood of close physical contact even when people are in contact with each other.

45. The question of the efficacy of quarantine, isolation and social distancing depends on when in the course of the infection most transmission is taking place. If most transmission occurs during the asymptomatic period – as it does, say, for HIV – isolation of patients with disease will have little impact. If on the other hand, most transmission takes place when people have identified themselves as ill (as it did for SARS-CoV-1 in 2002), isolation can be a very effective way to reduce spread. The benefits of quarantine – restricting the movements of people who are known to be in contact with an infectious case – depend on how effectively one can identify all contacts and prevent them from mixing with the general public. For obvious reasons, this can be very challenging and can have unintended consequences if quarantined people are housed together and become infected in that setting. Social distancing cannot prevent all transmission but could have a substantial impact on delaying transmission since contact rates are often much higher in congregate settings such as schools, prisons and other residential facilities. None of these measures is likely to lead to complete control of an epidemic since transmission is expected to resume once these are discontinued. But they may delay spread and give health systems time to develop better responses to the disease, whether those are new drugs, vaccines or simply improved efficiency of supportive care.

46. ***I was asked to review the evidence that policy measures such as lock-down or re-opening affected Covid-19 incidence rates.*** It is inherently challenging to measure the effects of large-scale policy changes on the incidence of a disease since it is frequently the case that many

interventions (lock-down, mask wearing) are implemented at the same time point and thus their individual impact cannot be disentangled from the impact of other measures. Several recent studies have addressed this problem by examining a large number of data sets from different geographical regions which implemented different sets of interventions. Two recent studies link cross-region data analysis with mathematical modeling techniques to estimate the impact of non-pharmaceutical interventions on the course of this epidemic. The first of these examined the impact of measures taken in 11 European countries on Covid-19 death rates [87]. and concluded that the combination of policies prevented more than 3 million deaths from the epidemic's start to early May, with stay-at-home orders and policies that restrict face-to-face contact being especially effective, reducing transmission by 81%. Another recent Nature paper analyzed how the epidemic evolved over time in China, the United States and four more countries that applied policies to prevent viral spread. [88]. This analysis also found that lockdowns — policies that require people to stay at home whether or not they are infected — were effective at stemming viral spread.

47. It is too early to conduct similar kinds of systematic analyses on the impact of the recent re-openings across the US on death rates. However, a Reuters analysis found that US Covid-19 cases rose 25% in the third week of June, up from a 1% rise in the second week of June and a 3% increase in the first week of June. [37] CIDRAP (Center for Infectious Diseases Research and Policy) reported that "twenty-five states reported an increase of 10% or more new cases, and 10 states noted a 50% increase. [38]. Texas reported an increase of 84%, Florida 87%, and Arizona 90%." In testimony to the Congressional House Energy and Commerce Committee on June 22, Dr. Anthony Fauci (head of the National Institute of Allergy and Infectious Diseases) noted that the increase in cases is due to community spread of the virus—and not just increased testing.

48. ***I was asked to address the likelihood that voting at polling stations could lead to SARS-CoV-2 transmission and Covid-19 disease.*** Because voting takes place in public buildings where people congregate, voting at a polling station in November entails a substantial risk of infection with Covid-19 that could result in symptomatic disease, hospitalization or death. The risk of an individual being infected during a community event in a public place depends on the number of infectious people in that community at any particular time point and the number of physical, fomite-mediated and near unprotected contacts one makes during that process. To the extent that polling places are crowded, require people to wait in lines, involve interacting with polling staff or other voters at a close distance, move people through the process slowly, are poorly ventilated and/or involve people touching objects like pens, paper, or surfaces within the voting booth, they constitute a risk to voters. While measures to reduce transmission (cleaning, wearing masks, hand-sanitizing, maintaining distance between people) can reduce risk, their efficacy will depend on how systematically they are implemented and how well voters comply with recommended procedures. Building-based measures such as upper room ultra-violet germicidal irradiation may also be effective in reducing transmission but are unlikely to be implemented at multiple polling booths by November, 2020. [39]. Similarly, if voters or poll workers use toilets that are also used by others, they can be put at risk. The data supporting some aerosol transmission of Covid-19 provides evidence that poorly ventilated areas where crowding may take place pose risk to those using these facilities. To the extent that an elderly or disabled voter might need assistance in the voting booth, that might also increase the risk of infection if it involves closer person-to-person contact than would otherwise occur. The probability that a person who is exposed to Covid-19 in this setting will go on to develop severe Covid-19 disease or to die depends on the age of that

person and his/her underlying health status. There is a measurable risk that an infection with Covid-19 in Kentucky could result in symptomatic disease, hospitalization or death.

49. ***I was asked whether measures such as careful cleaning, use of masks, hand-sanitizer and maintaining a 6-foot distance from others will eliminate the risk of transmission in voting booths.*** I consider each of these interventions and the evidence for their efficacy on preventing transmission.

50. Masks. The evidence on the efficacy of masks in preventing transmission of respiratory viruses is mixed and depends on the type of mask worn and the circumstances of an exposure. Face masks fall into several distinct categories: disposable N95 and equivalent respirators are test-fitted devices designed to filter small airborne particles, including aerosols. Surgical or medical masks are loose-fitting, fluid-resistant coverings that create a physical barrier, blocking larger particles. Cloth masks are non-medical face coverings that vary with regard to filtration and fluid resistance depending on the material used, the number of layers, and fit. Most studies of cloth masks have evaluated 12-16-layer cotton masks used in Asia but these are not standard in the US and to my knowledge, there have been no systematic trials of cloth masks with fewer layers published to date. Many US-based cloth masks are single layer.

51. There have been several systematic reviews on the efficacy of masks in preventing viral respiratory infections. Systematic reviews are compilations of previous studies that address a specific research question and which summarize all the evidence that fits pre-specified eligibility criteria. MacIntyre et al. reviewed 19 randomized controlled studies of face masks (i.e., studies which randomly assign people to wear face masks or not), 8 of which were among community residents, 6 among health care workers (HCWs) and 5 in people with infection (source control studies) to prevent infection of their contacts. For HCWs, the study reported "there is evidence of

efficacy of respirators (defined as N95 masks) if worn continually during a shift, but no evidence of efficacy of a (non-N95) mask." The studies in community members all looked at "medical" masks, and none of the 8 studies conducted found a statistically significant benefit to face mask wearing, although several demonstrated a trend for protection that did not meet the statistical criteria necessary to report an effect. Several studies showed that relatively few community members assigned to the mask intervention adhered to the established protocol for mask wearing. Wearing of medical/surgical masks by source cases did show a modest effect in reducing household infection in several of the studies summarized [89].

52. Liang and colleagues performed a meta-analysis which pooled the data from multiple studies and re-calculated the effect estimate based on the pooled sample size [90]. This study found an overall relative risk of .35 which suggested that the protective efficacy of mask wearing is 65%. However, the study included both randomized clinical trials (RCTs) (which reported a relative risk of .67, suggesting protective efficacy of 33%) and observational studies which reported a relative risk of .24 or 76% efficacy. RCTs are much more likely to be unbiased so this differential suggests that people who wear masks by choice are likely to have a lower risk of infection in general that cannot be attributed to the mask.

53. Furthermore, some of the studies used N95 masks, others medical/surgical masks and in others, the type of mask was not specified. Liang did not provide individual estimates for the efficacy of each type of mask so there is no additional information here on the amount of protection afforded by the type of cloth masks used in the US.

54. In another recent study published in the Lancet, Chu and colleagues reviewed data on preventive measures as reported in 172 observational studies on SARS, MERS and Covid-19 (91). This study found an overall relative risk of .33 in mask wearers compared to non-wearers but

notes that the effect for N95 masks was more extreme than for medical/surgical masks and even more extreme than for single layer cloth masks. However, they do not provide direct estimates of the efficacy of cloth masks. The study also found that maintaining at least one meter distance from an infected person reduced transmission by about 80% and that this protection increased two-fold with each further meter of separation. The authors conclude: "These data suggest that wearing face masks protects people (both health-care workers and the general public) against infection by these coronaviruses, and that eye protection could confer additional benefit. **However, none of these interventions afforded complete protection from infection, and their optimum role might need risk assessment and several contextual considerations**." (Emphasis added.) To conclude, I cite a recent statement from Michael Osterholm, the director of the Center for Infectious Disease Research and Policy at the University of Minnesota, and one of the world's leaders in the field of infectious disease threats and preparedness:

> "[The general public] should be made aware that [cloth] masks may provide some benefit in reducing the risk of virus transmission, but at best it can only be anticipated to be limited. Distancing remains the most important risk reduction action they can take. ... The messaging that dominates our COVID-19 discussions right now makes it seem that—if we are wearing cloth masks—you're not going to infect me and I'm not going to infect you. I worry that many people highly vulnerable to life-threatening COVID-19 will hear this message and make decisions that they otherwise wouldn't have made about distancing because of an unproven sense of cloth mask security." [105].

55. Hand Hygiene. There is less data available on hand sanitizers and the prevention of Covid-19. Hand sanitizers have been shown to effectively reduce viable virus on hands, but there have been no clinical trials to assess how this impacts transmission. Hand washing works if an uninfected person's hands are contaminated with Covid-19 either from touching another person or from contaminated objects. However, the CDC notes "transmission of coronavirus occurs much more commonly through respiratory droplets than through objects and surfaces, like doorknobs, countertops, keyboards, toys, etc (92)." Experts currently acknowledge that it is not yet possible

to know how much hand hygiene contributes to disease risk. As quoted by The New York Times, Dr. Osterholm of the University of Minnesota's Center for Infectious Disease Research and Policy said "he's spent his 40-year medical career trying to convince people to be more diligent about washing their hands to prevent disease — so he doesn't want to say it's not important. But he believes that social distancing will prevent the majority of Covid-19 infections."

56. Staying home when sick. The CDC guidance also recommends that people not come to polling stations if they are ill. This will certainly reduce the opportunity for transmission events from these people to other voters. However, if these people had not requested mail-in voting ballots before they developed symptoms or tested positive for Covid-19, they would then be unable to participate in the election. As above, since older people, people of color, and those with co-morbidities are more likely to be ill with Covid-19 at any specific time point, this means this group will be differentially affected by this stipulation. Furthermore, current estimates suggest that only one in ten people with Covid-19 is detected with the remainder having either mild or asymptomatic infection. These individuals would be physically able to vote in person and may unwittingly spread infection if they did show up at the polls. Thus, while this intervention of self-isolating when sick will disenfranchise some voters, it is unlikely to have a major impact on transmission at polling places.

57. In summary, the impact of these interventions depends entirely on what kinds of masks are worn, how compliant users are, whether other people rather than the wearer are complying with mask-wearing, how well polling booths can maintain distance between people, and how much transmission is mediated by aerosols versus large respiratory droplets.

CDC guidelines on accommodations for voting

58. Importantly, the CDC guidelines (93) also include recommendations about in person voting and note a "lower risk in election polling settings include those with:

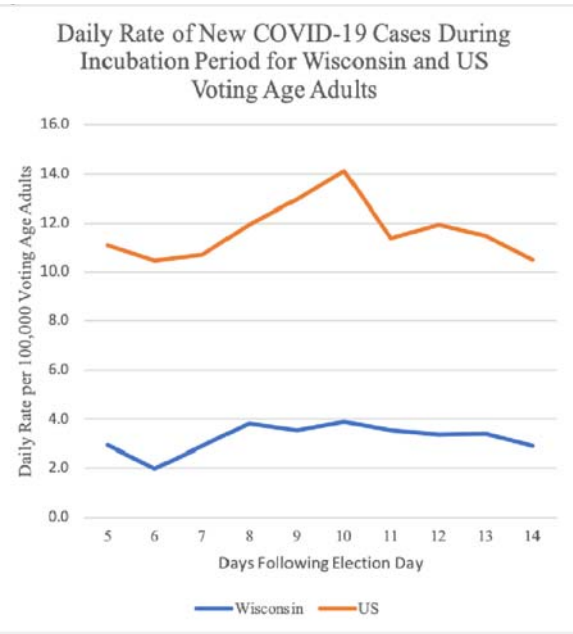
- a wide variety of voting options
- longer voting periods (more days and/or more hours)
- any other feasible options for reducing the number of voters who congregate indoors in polling locations at the same time."

59. Other recommended practices include ensuring adequate ventilation at each polling site, increasing the number of polling locations available for early voting and extending the hours of operation, maintaining or increasing the total number of polling places available to the public on election day to improve the ability to social distance, minimizing lines as much as possible, especially tightly-spaced queues in small indoor spaces and limiting the number of voters in the facility by moving lines outdoors if weather permits or using a ticket system for access to the facility. Suggested modified procedures include increasing the distance between polling booths to ensure that voters remain 6 feet apart, ensuring sufficient space for social distancing and other measures, identifying larger facilities for use as future polling places, modifying the polling location layout to ensure voters move in one direction while in voting locations and to avoid bottlenecks, such as single doors for entry and exit, notifying voters of changes to polling operations, including the availability of alternative voting options that minimize contact and ensuring that any changes to operations do not limit accessibility to voters with disabilities.

60. It is important to note that it may be difficult or even impossible for polling stations to accommodate all of these safeguards. At the recent state election in Kentucky, the state responded to constraints caused by Covid-19 by reducing the number of polling locations rather than increasing them - from a former average of around 3,700 locations to 170 locations, with the state's two most populous counties having just one in-person polling location each.

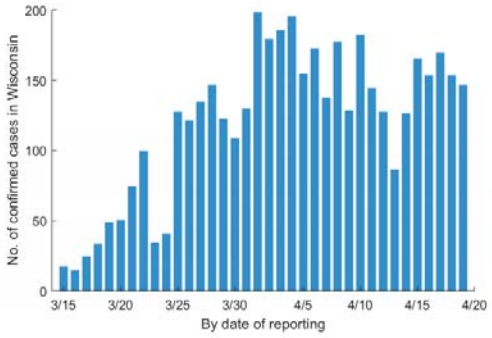
61. ***I was asked to evaluate the impact of the April 2020 Wisconsin primary election on Covid-19 risk.*** In addition to these studies and recommendations, there is some empirical evidence that in-person voting can increase Covid-19 risk. Wisconsin held an election for national primaries and state positions on April 7, 2020 in which mail-in voting was allowed and a large portion of the electorate chose that route with an estimated 1.1 of the 1.55 million total voters submitting mail-in absentee votes. In the aftermath of that election, the Wisconsin Department of Public Health conducted contact tracing that identified 71 confirmed cases of Covid-19 among people who may have been infected during the election. It is possible that these people may have been infected elsewhere although it is difficult to verify.

62. Two studies suggest that voting did not lead to a "surge" in Covid-19 cases after the election while a third more recent study found a significant association between in-person voting and the spread of Covid-19 two to three weeks after the election. I will briefly review and critique these studies. On April 28, Berry et al, posted a pre-print on the server, Medrxiv, that showed that the number of reported Covid-19 cases reported in Wisconsin in a fourteen-day period following the election did not exceed the rates reported prior to that period. This study did not consider infections that were detected more than 14 days after the election and thus only looked at infections that occurred on the day of polling and not the indirect effect of further transmission from people who were infected on election day. The report looks at temporal changes in Covid-19 in a single location without assessing other possible factors associated with changes in incidence over that time period [94].



Rate of new Covid-19 Cases following April 7 Wisconsin Election from Berry et al.

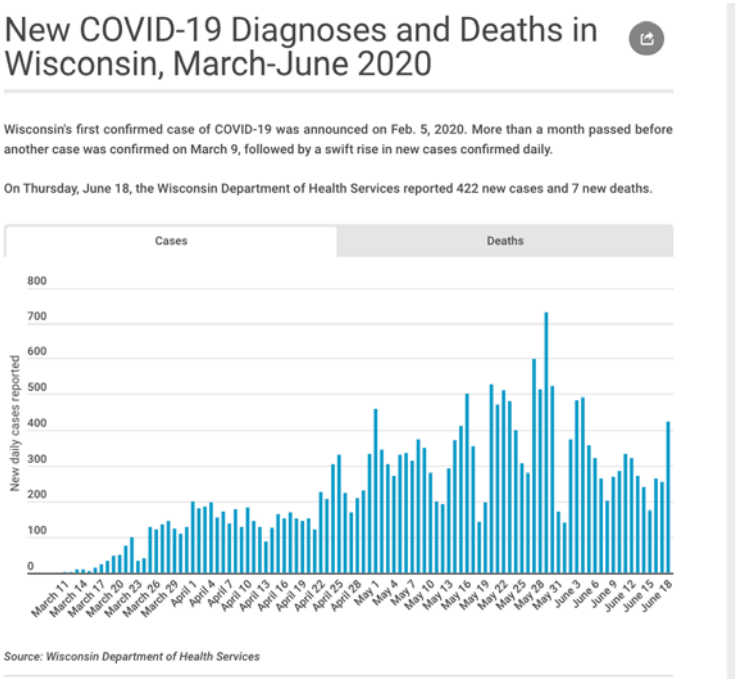
63. On April 29, Leung et al. also posted a pre-print in which they estimated the number of transmission events that took place on April 7 based on the number of reported cases that occurred after a delay meant to capture the incubation period and delay in patient presentation and subsequent reporting of Covid-19. These authors used a deconvolution method to estimate the number of transmission events that occurred on election day. Based on this analysis, the authors also found no association between the election and Covid-19 case rates [95].



A

Number of confirmed cases of Covid-19 following April 7 Wisconsin Election from Leung et al.

Note that the graphic shown below corresponds to the longer-term data provided by the Wisconsin Department of Health Services which shows a rise in cases beginning around April 21 and including a subsequent period that was not captured in the Berry or Leung data [96].



Number of confirmed cases of Covid-19 following April 7 Wisconsin through June 18

64. Cotti et al. conducted a third study which differed from the previous two in that 1) it compared county-level data on the proportion of people voting in-person and the proportion of Covid-19 tests that were positive; 2) it extended the time period assessed until May 3; 3) it factored measures of social distancing and county-specific demographics (population, population density); and 4) it used the proportion of tests that were positive rather than just positive cases to control for temporal differences in testing (97). This study found that counties with higher than average in-person voting had twice the rate of Covid-19 positive tests in the weeks that followed the election. Across a range of exploratory models, the team found a large post-election increase in Covid-19 cases in counties that had more in-person votes per voting location, all else being equal. They also noted a decrease in the number of new positive Covid-19 cases in counties with relatively more mail-in absentee votes after accounting for differences in in-person voting, county-

level COVID-19 testing, and population measures. I consider this third paper a much more rigorous and persuasive study given the thorough attempt to determine the relationship between the amount of in-person voting per polling station and subsequent Covid-19 diagnoses in the relevant counties. The quantitative comparison between different counties with different levels of in-person voting and subsequent outcomes makes this a more reliable approach than a simple time series that does not adjust for other factors as in the first two studies cited. I therefore conclude that in-person voting in Wisconsin did indeed pose a risk to voters.

65. Notably, this increase in voter risk occurred despite rigorous attempts by the state to ensure voting safety for the approximately 440,000 people who voted in person. In a memo to the Wisconsin Elections Commission, Meagan Wolfe, the Commission's Administrator, reported on a long list of measures taken and products obtained to address sanitation and personal protective gear:

> Wisconsin's 72 county clerks played a key role in distributing supplies to more than 2,000 polling places. Supplies that were distributed include:
>
> · Over 8,000-liter bottles of liquid 70% ethyl alcohol solution that was used as a hand and surface sanitizer. The solution was sourced from a local distillery as all other state and national supply chain options were exhausted
> · Over 10,000 16oz plastic spray bottles and printed labels for the bottles for the liquid alcohol solution
> · 500,000 isopropyl alcohol wipes for use on voting equipment and electronic touchscreens.
> · Surgical masks for poll workers
> · Latex gloves for poll workers
> · 1.5 million ballpoint pens so that each voter would have their own to sign the poll book and mark their ballot
> · ~2,000 rolls of painter's tape to facilitate social distancing
> · 10,000+ social distancing and public health signs
>
> The National Guard helped with the packaging and distribution of supplies from the stockpile in Madison to regional facilities around the state. The counties then drove to the regional facilities, or coordinated pick up in vehicles large enough, to bring the supplies back to the county office for distribution to the municipalities and/or each polling place.

66. In summary, despite labor-intensive and costly efforts to maintain the safety of in-person voting during the Wisconsin election, a rigorous study provides support for the contention that this election increased Covid-19 transmission.

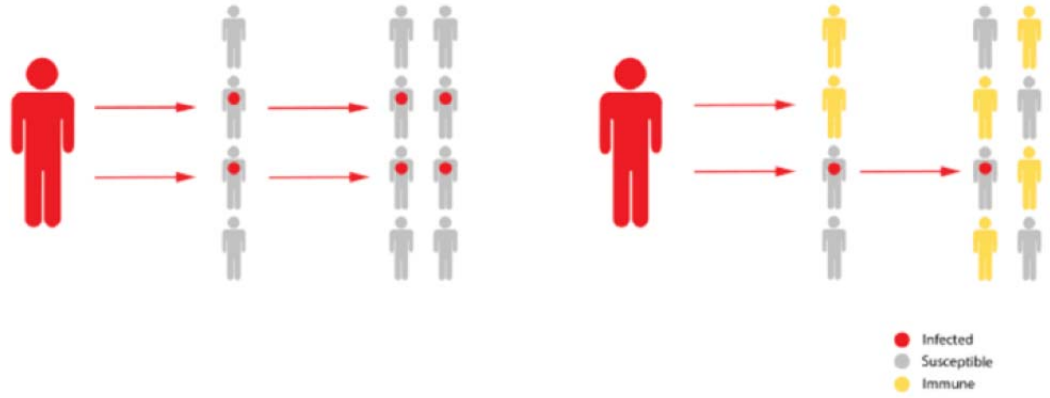
67. ***I was asked to address the likelihood of a persistent or increased risk of transmission of Covid-19 in the fall in the weeks/months leading up to November 3, 2020.*** Epidemiologists have projected a number of future Covid-19 epidemic trajectories based on a range of different possible scenarios but all of these scenarios are similar in that they predict that it is highly likely that Covid-19 will continue to circulate at its current level or at an even higher level in October and November of 2020 unless there is widespread uptake of measures to reduce contacts that result in transmission (lockdowns, school closures, near-universal use of *effective* masks, travel restrictions, etc.).

68. Although it is impossible to know what the actual numbers of cases will be in the future, the likelihood of continued transmission of Covid-19 in the fall 2020 is strongly supported by the principles of infectious disease dynamics. These indicate that the expected future trajectory of Covid-19 will depend on a number of factors including the level of "herd immunity" that has already been achieved to the circulating virus, the extent of social and physical mixing that occurs, and the relative transmissibility of SARS-CoV-2 under different environmental circumstances.

69. It is highly unlikely that enough herd immunity will have been acquired to prevent ongoing Covid-19 transmission in the fall and winter of this year. First, herd immunity is achieved when enough people in a population have been infected and developed immunity so that the likelihood that an infectious person will come into contact with a susceptible person is low. This concept is illustrated in the graphic below. When an infectious person encounters only susceptible

people, he or she can infect all of them but when most of the people an infectious person encounters are immune, relatively few people will be infected by that infectious case.

Table 4 Herd Immunity (From https://www.technologyreview.com/2020/03/17/905244/what-is-herd-immunity-and-can-it-stop-the-coronavirus/)



In a simple model of an outbreak, each case infects two more, creating an exponential increase in disease. But once half the population is immune, an outbreak no longer grows in size.

70. A general rule of thumb is that herd immunity can only be achieved when the proportion of people in a population who are immune is equal to 1-(1/R0), where R0 refers to the basic reproductive number of an infectious disease. This term is defined as the number of people who, on average, will be infected by a single infectious person in an entirely susceptible population. The basic reproductive number of SARS-CoV-2 is estimated between two and three, with an average of about 2.6. This means that about 60 percent of the population would need to be immune before we see Covid-19 cases level out (in the absence of interventions such as social distancing). At present, it is unclear what proportion of the US population is seropositive (in other words, has evidence of an immune response to the infection), but no study conducted in the US to date has suggested that more than 20-30 percent of any specific community is immune and most studies suggest that the number is closer to 2-3 percent. A recent study from Spain, one of the countries that has been most affected by the epidemic, found that only 5 percent of the population was immune (98). Therefore, it is highly unlikely that, short of a catastrophic increase in circulating

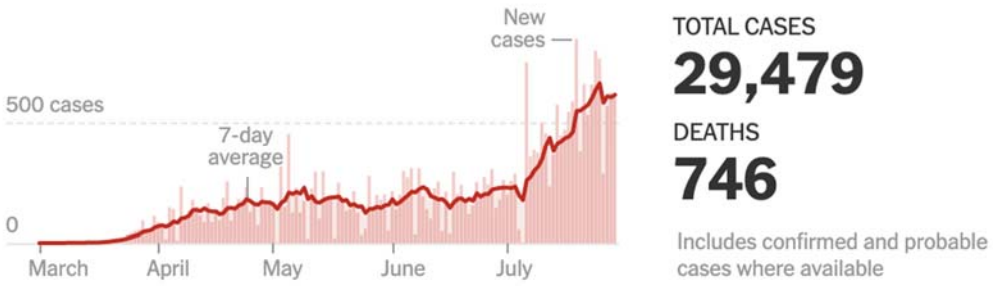
virus, herd immunity will be achieved by November 2020. Furthermore, the lack of herd immunity is in part due to social distancing that has taken place to date and this means that as a population, we remain highly vulnerable to epidemic spread. Finally, because it is unclear whether an immune response to SARS-CoV2 protects against future infection, seropositivity in a population may over-estimate the true level of herd immunity.

71. Secondly, it is highly likely that with the relaxation of social distancing measures and the end of "lock-down" the number of social contacts that people make will increase and that, therefore, the incidence of infection will increase accordingly. There is a linear relationship between the average number of social contacts individuals make and the reproductive number of the infection; as physical and social contacts increase, the incidence of infection will increase proportionately.

72. Third, epidemic spread in the fall and winter could be driven by potential worsening of the epidemic due to changes in temperature or humidity that may be associated with higher viral stability with cooler and drier conditions, seasonal changes in host immunity and/or changes in human behavior (e.g., spending more time indoors). In the fall and winter, the outdoor air is colder, and the air is drier both indoors and out. For influenza, laboratory experiments have shown that absolute humidity — the amount of water vapor in the air — strongly affects viral transmission, with drier conditions being more favorable [44]. Lab studies on SAR-CoV-1 have also confirmed that viruses are stable for longer periods in cooler, drier environments [45]. However, multiple recent studies have suggested that SARS-CoV-2 transmission is still possible in many different climates [46, 47], including in areas with relatively high heat and humidity. The recent rise in cases in many states at a time when the weather is growing warmer and more humid suggests that weather is likely to play only a small role in the ongoing pandemic.

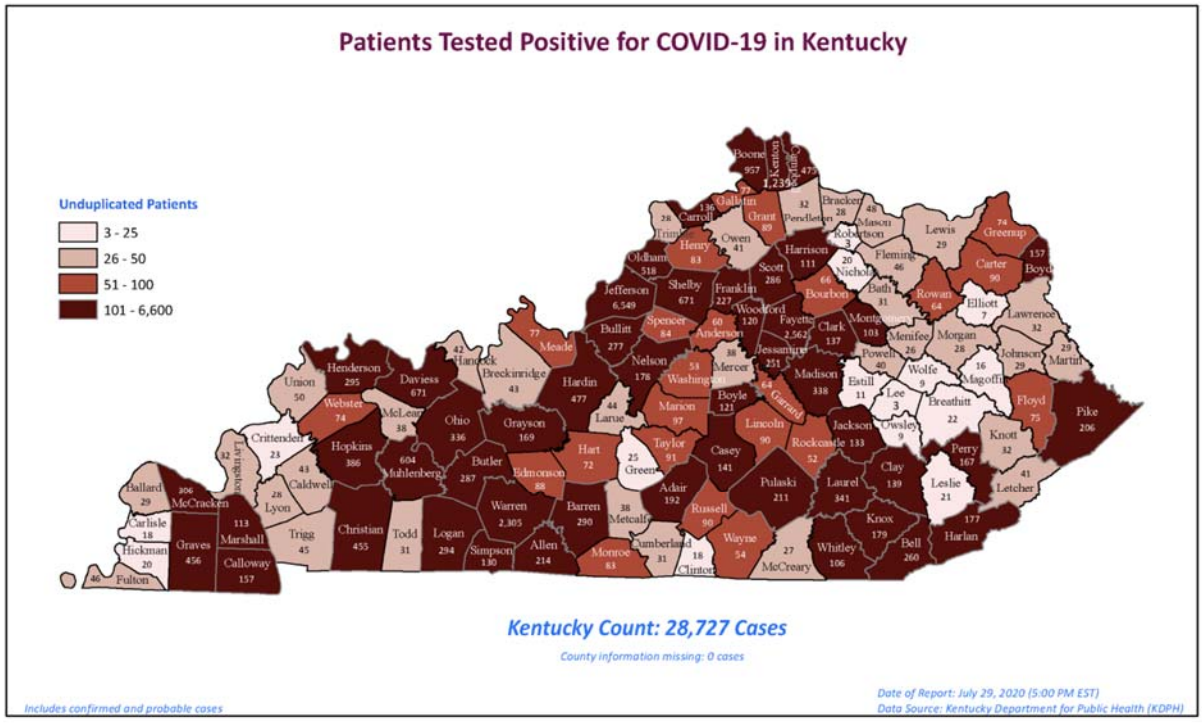
73. Seasonal differences in transmission are also affected by differences in the ways people congregate in different seasons. In the fall and winter, people tend to spend more time indoors with less ventilation and less personal space than they do in the summer. Schools have been identified as the sites of much transmission of respiratory viruses including those that cause measles, chicken pox and influenza. [48, 49]. However, to date, the role of children in the transmission of SARS-CoV-2 is not clear and the relevance of the timing of school openings is not known. Finally, it is likely that host immunity is affected by seasonal changes. One hypothesis has focused on melatonin which has some immune effects and is modulated by the photoperiod [50], which varies seasonally. Vitamin D levels have also been associated with improved human immune responses - these levels depend in part on ultraviolet light exposure which is higher in summer. There is strong evidence for the possible role of vitamin D supplementation in reducing the incidence of acute respiratory infection, as documented in a meta-analysis of randomized trials [51]. To summarize the evidence for seasonal trends in SARS-CoV-2, it is reasonable to expect that, like other beta-coronaviruses, it may transmit somewhat more efficiently in fall and winter than summer.

74. ***I was asked to describe the Covid-19 situation in Kentucky.*** To date, Kentucky has reported 29,479 confirmed Covid-19 cases and 746 deaths from the disease. The figure below shows current status of the epidemic trajectory.



75. Reported cases are likely to be an underestimate of the true number of cases since many infected people do not present for testing. As shown in the following figure, the distribution of cases is not uniform across the state, with more densely populated areas having higher rates

Table 6 County-specific Covid-19 prevalence for Kentucky by July 30, 2020. (from Kentucky Department of Public Health, https://govstatus.egov.com/kycovid19).

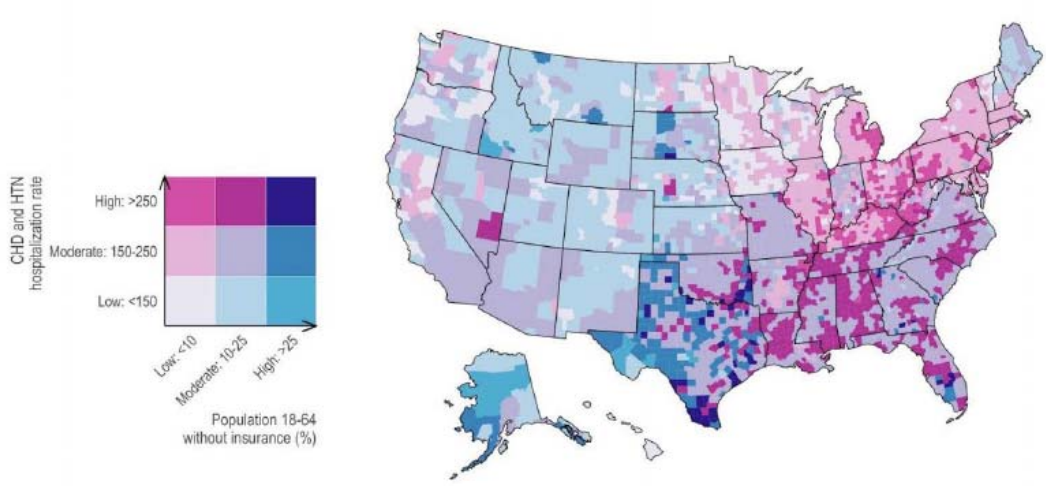


76. To assess the risk of serious disease given a Covid-19 infection, we can turn to the existing data on the prevalence of specific risk factors in the state. The CDC has documented that 36.6 percent of Kentucky residents are obese and an additional 31.9 percent are overweight [58]; 32-38.6 percent of adults ages 20 or older have a diagnosis of high blood pressure [59]. The American Diabetes Association reports that 14.5 of adult Kentucky residents have diagnosed or undiagnosed Diabetes mellitus and that 35.5% has pre-diabetes, and Kentucky also has one of the highest rates of cancer in the country, with a diagnosis rate of new cancers of 510.2 per 100,000 people. [60]. 16.4 percent of the population is 65 years old and over. [61]. Kentucky's population

is 8.4% Black or African American, [62] but Black Kentuckians make up 10% of cases and 15% of deaths the Commonwealth. [63].

77. The population of Kentucky is 3.8% Hispanic or Latino, [64], but Hispanics make up 10% of positive cases. [65]. Kentucky has a life expectancy of 75.9 compared to 78.7 nationally, making it 45th out of the 50 states (https://www.kff.org/state-category/health-status/life-expectancy/).

Table 7. Rates of hypertension and Coronary Heart Disease Nationally. From (https://www.medrxiv.org/content/10.1101/2020.04.08.20058248v1.full.pdf)

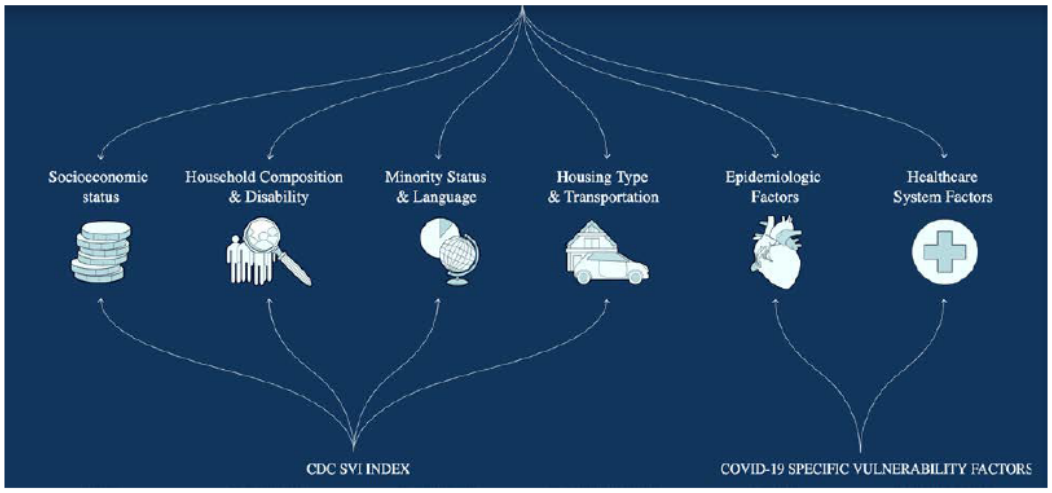


78. It is useful to compare the prevalence of different co-morbidities associated with poor outcomes in Kentucky to other states. The figure above give county-level rates of hospitalizations for coronary heart disease and hypertension demonstrating that Kentucky has comparatively high rates of these diseases and the age distribution of the population.

79. The Kaiser Family Foundation has developed a method to estimate the proportion of a state's population at elevated risk for serious Covid-19 illness. [66]. Using data from the CDC's 2018 Behavioral Risk Factor Surveillance System (BRFSS), they estimated the total number of at-risk adults by state, based on the revised definition from the CDC of adults who are at higher risk of serious illness if they get infected with coronavirus. The relevant factors include

ages 65 or older, heart disease, chronic obstructive pulmonary disease (COPD), uncontrolled asthma, diabetes, and a BMI greater than 40. Based on this analysis, 44% of adults over age 18 in Kentucky are at risk for serious disease with older adults making up 49% of those at high risk.

Table 8 CCVI Score components [48]



80. In another nationwide assessment of risk, the Surgo Foundation has developed a Covid-19 community vulnerability index (the CCVI) to identify communities at especially high risk of being affected by Covid-19 [48]. The CCVI combines indicators specific to Covid-19 with the CDC's social vulnerability index, which measures the expected negative impact of any type of disaster. The indicators are based on the themes listed below.

81. On this scale, Kentucky scored a 76 out of 100 when 100 is the most vulnerable. It ranked thirteenth among the states on this measure, mostly because its high (poor) score in the area of epidemiologic risk factors. These data suggest that in the event of further spread of Covid-19, Kentucky may experience higher levels of disease, disability and death than other states experiencing the same amount of transmission.

82. ***I was asked if herd immunity, progress in vaccine development or the development of drugs to treat Covid-19 will alter the expected course of the Covid-19 pandemic in the United States.*** To date, the proportion of the population that is likely to be immune is far less than that required to achieve herd immunity. This is unlikely to change significantly before November. Although recent studies of the temporal trajectories of the appearance of SARS-CoV-2 antibodies show that most people who are infected with the virus do develop an antibody-mediated immune response, it is not yet clear whether this response is adequate to protect people from future infection or for how long it might be protective. Other coronaviruses, such as those that cause colds, are known to provide protection for periods of approximately one year and this experience has led most Covid-19 experts to accept the "educated guess" that after being infected with SARS-CoV-2, most individuals will have an immune response which will offer some protection over the medium term — at least a year — and then its effectiveness might decline. Until there is empirical evidence of how well-protected previously infected people are in the future, there is no way to confirm or deny the existence of long-term immunity.

83. An effective vaccine is extremely unlikely to have been developed, tested and widely distributed before November. Vaccine development has proceeded at an unprecedented pace. More than 110 candidate vaccines are under development. A number of companies and research teams already have candidate vaccines that are either in human trials (eight have started) or close to ready to trial in humans. The most advanced of these seems to be the ChAdOx1 nCoV-19 vaccine being developed by a group in Oxford, England. The speed with which these vaccines are being developed is partly due to the fact that a great deal of work was done on a SARS-CoV-1 vaccine after the 2002 epidemic and some of that work can be applied to this organism.

84. Despite this extraordinarily rapid progress, it is important to realize that the usual time frame from development to widespread use of a vaccine is over ten years. New vaccines require a complex set of trials to establish safety, immunogenicity, optimal dosing, etc. Phase 1 trials are usually conducted in small groups of healthy volunteers and are designed to establish whether serious adverse effects occur with escalating doses of the agent and whether the vaccine produces the expected immune response. Phase 2 trials are designed to replicate Phase 1 results in a more diverse population of volunteers, to assess whether the expected immune response is generated, and to test different vaccine schedules. Once safety, immunogenicity and optimal dosing are established, Phase 3 studies are conducted to determine vaccine efficacy. Phase 3 studies are usually much larger than phase 1 or 2 studies and are conducted in people at-risk for the infection in question. So the time frame of these trials depends on the actual incidence of infection and is expected to be shorter in regions with very high rates of disease. The completion of all three steps is required for a vaccine to be approved by the FDA. Once a vaccine is approved, it must then be manufactured at a scale that will provide adequate coverage for a large population. The White House has recently announced an initiative, "Operation Warp Speed," to expedite the development of a vaccine that will be available to the US population. Although many scientists question the timeline proposed by the project, the goal is to speed up the development and production of a vaccine so that 100 million doses are available in November of 2020 and the remaining 200 million doses needed to vaccinate the US population are ready by early 2021. Thus, even in the most optimistic scenario, it is highly unlikely that a vaccine will have been distributed and had time to induce an immune response in a significant number of Americans by November 3, 2020. Furthermore, there is no guarantee that the vaccines currently being developed will provide protective immunity from SARS-CoV2. In a recent study of one of the most promising

vaccine candidates, primates that received the vaccine were protected from Covid-induced pneumonia but nonetheless demonstrated high levels of replicating virus in their upper airways. The fact that natural coronavirus infections do not confer long term immunity also suggests that vaccine induced protection may not be durable. [68].

85. Although new and repurposed drugs are being tested and some may be found to be helpful in treating severe Covid-19, this is unlikely to have a major impact on the transmission of the virus and the risk of severe disease or death by November 2020. A number of antiviral drugs are currently being developed and other existing drugs are being "repurposed" as potential therapies for Covid-19. The hope is that these drugs will reduce the rate of death and severe disease in people who are treated with them. As of mid-April, the FDA website had listed 72 active and 211 planned Covid-19 drug trials and almost 1000 drug-development proposals have been submitted to the agency. To date, only Remdesivir and glucocorticoids have been shown in a major, randomized control trial to reduce the duration of illness in Covid-19 patients. In one study, Remdesivir reduced the median time to recovery in hospitalized patients with advanced Covid-19 disease and lung involvement from 15 days for those who received placebo to 11 days for patients treated with Remdesivir [68]. The researchers also noted a survival benefit (which was not "statistically significant") with the Remdesivir group experiencing an 8.0 percent mortality rate compared to 11.6 percent for the placebo group. This suggests that even with the approval of the drugs that have been found to be effective in clinical trials, people with severe Covid-19 are at risk for death as well as the long-term effects of lung damage and other sequelae of infection detailed above.

86. Glucocorticoids have also been found to be associated with reduced mortality from Covid-19 among severely ill people. An early report from a clinical trial found that dexamethasone

reduced deaths by one-third in patients who were mechanically ventilated and by one fifth in other patients receiving oxygen only. There was no benefit among those patients who did not require respiratory support. [101].

87. Other promising therapies for treatment of severe disease have been identified. A recent study in the journal, Nature, found 21 existing drugs that had activity against the virus and could, in principle, be repurposed for the treatment of Covid-19. Of these, 13 could be dosed in a way that adequate concentrations could be achieved in humans. While this is promising news, clinical trials of these agents will need to be conducted before they can be recommended and approved for use by the FDA.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 30th day of July, 2020.

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EXHIBIT A

Harvard Medical School/Harvard School of Dental Medicine
Curriculum Vitae

Date Prepared:	**June 2020**
Name:	**MEGAN MURRAY**
Office Address:	**Harvard Medical School** **641 Huntington Avenue, 4A07** **Boston, MA 02115**
Home Address:	**21 Prince Street** **Cambridge, MA 02139**
Work Phone:	**(617) 432-2781**
Work Email:	**megan_murray@hms.harvard.edu**
Work FAX:	(617) 432-2565
Place of Birth:	Minnesota

Education

1980	AB Magna cum laude	Philosophy	Dartmouth College, Dartmouth, NH
1990	MD	Medicine	Harvard Medical School, Boston, MA
1997	MPH	Public Health	Harvard School of Public Health, Boston, MA
2001	ScD	Epidemiology (James Robins)	Harvard School of Public Health, Boston, MA

Postdoctoral Training

1990-1991	Internship	Internal Medicine	Massachusetts General Hospital, Harvard Medical School, Boston, MA
1991-1993	Residency	Internal Medicine	Massachusetts General Hospital, Harvard Medical School, Boston, MA

1993-1997	Fellowship	Infectious Disease	Massachusetts General Hospital, Harvard Medical School, Boston, MA

Faculty Academic Appointments

1997-2006	Instructor in Medicine	Medicine	Harvard Medical School
1999-2000	Research Associate	Epidemiology	Harvard School of Public Health
2001-2007	Assistant Professor	Epidemiology	Harvard School of Public Health
2004-	Associate		Broad Institute, Cambridge, MA
2006-2009	Assistant Professor	Medicine	Harvard Medical School
2007-2013	Associate Professor	Epidemiology	Harvard School of Public Health
2009-2012	Associate Professor	Medicine	Harvard Medical School
2012-	Professor	Global Health and Social Medicine	Harvard Medical School
2013-	Professor	Epidemiology	Harvard T.H. Chan School of Public Health
2017-	Ronda Stryker and William Johnston Professor of Global Health	Global Health and Social Medicine	Harvard Medical School

Appointments at Hospitals/Affiliated Institutions

01/98-09/02	Clinical Assistant in Medicine	Dept. of Internal Medicine	Massachusetts General Hospital
09/02-09/06	Assistant in Medicine	Dept. of Internal Medicine	Massachusetts General Hospital
09/06-02/08	Assistant Physician	Dept. of Internal Medicine	Massachusetts General Hospital

02/08-09/10	Consultant (Medicine Services)	Dept. of Internal Medicine	Massachusetts General Hospital

Other Professional Positions

Year	Position Title	Institution	Level of effort
1980-1984	Refugee Camp Coordinator	Intergovernmental Committee for Migration, Phanat Nikhom, Thailand	
1984	Public Health Educator	Matanyok Rural Training Project, Rift Valley, Kenya	
2004-	Research Director	Partners In Health, Boston	36 days per year

Major Administrative Leadership Positions

Local

2007-	Director of Research	Division of Global Health Equity, Brigham and Women's Hospital and Partners In Health, Boston, MA
2010-	Director	Research Core, Department of Global Health and Social Medicine, Harvard Medical School, Boston, MA
2012-2013	Member	Executive Leadership Team, Global Health Delivery Partnership, Harvard Medical School, Brigham and Women's Hospital and Partners In Health, Boston, MA

Committee Service

Local

1986-1990	Curriculum Committee	Harvard Medical School Member
2001-	Infectious Disease-Epidemiology Graduate Admissions Committee	Harvard School of Public Health Member
2003-2005	Faculty Council	Harvard School of Public Health Member
2004-	Steering Committee for the Residency in Global Health	Brigham and Women's Hospital Member
2005-	Human Subjects Committee	Harvard School of Public Health Member
2005	Task Force on Women in Sciences and Engineering	Harvard University, Cambridge, MA Member
2006	President's Task Force on Avian Influenza	Harvard University Member

2006	Search Committee for Dean of Educational Programs	Harvard School of Public Health Member
2007	Epidemiology Curriculum Committee	Harvard School of Public Health Member
2007	Search Committee for Compliance Officer	Harvard School of Public Health Member
2007	Search Committee for Assistant Professor in the Division of Social Medicine and Health Inequalities	Brigham and Women's Hospital Member
2008	Search Committee for Assistant Professor in Infectious Disease Epidemiology	Harvard School of Public Health Member
2009	Search Committee for Assistant Professor in Infectious Disease Epidemiology	Harvard School of Public Health Chair
2010	Global Health Epidemiology Committee	Harvard School of Public Health Member
2010-2011	Strategic Leadership Team	Brigham and Women's Hospital Member (Co-Chair Community Engagement Mission Area)
2012	Ad Hoc Committee to Evaluate Professorial Candidate	Harvard Medical School Member
2012-2016	Professor of Population Medicine Search Committee	Harvard Pilgrim Health Care Institute Member
2012	Ad Hoc Evaluation of Professorial Appointment Committee	Harvard Medical School Member
2012	Global Health Instructor Search Committee	Harvard Medical School Co-chair
2014-2016	Pershing Square Professorship in Global Health Search Committee	Harvard Medical School Chair
2015	Search Committee for Professor of Biomedical Informatics	Harvard Medical School Member

2016-	Department of Biomedical Informatics Executive Committee	Harvard Medical School Member
2016-	Committee on Promotions, Reappointments, and Appointments (P&R)	Harvard Medical School Member
2018-2019	Dean's Innovation Grants Review Committee	Harvard Medical School Member
2018-2019	Therapeutics Planning Foundry Committee	Harvard Medical School Member
2019-	Center for Computational Biomedicine (CCB) Advisory Committee	Harvard Medical School Member
2019-	Faculty Council	Harvard Medical School/Harvard School of Dental Medicine Member
2020-	Ariadne Spark Grant Review Committee	Harvard Medical School Member
2020-	Greater Boston Consortium on Pathogen Readiness (GBCPR) Working Group on Epidemiology	Harvard Medical School Co-Lead

National and International

2005-2007	Committee on Infectious Diseases among Gulf War Veterans	Institute of Medicine, Washington, DC Member
2006-2010	IHR Roster of Experts in Modeling Analytical Epidemiology	World Health Organization, Geneva, Switzerland
2007-2009	Global Task on XDR Tuberculosis	World Health Organization
2007	External Review Committee for TB Program	Montreal Chest Institute, McGill University Montreal, Canada Member
2008-2011	STAG (Strategic and technical advisory group) TB	World Health Organization Member
2008	39th Union World Conference 2008 Drug Resistance /MDR-TB management II	International Union TB and Lung Disease Paris, France, Coordinator

2009	Panel to Review the DST/NRF Centre of Excellence for Biomedical TB Research	National Research Foundation, Pretoria, South Africa, Convener
2009-2010	Expert Panel on Tuberculosis and Diabetes	Union of TB and Lung Disease and World Diabetes Federation Member
2010-2015	Advisory Group to Fogarty Grant	Member Public Health Research Institute New Jersey
2010-	Working Group on New Diagnostics	Member, Stop TB Partnership Geneva, Switzerland
2013-2014	Millennium Villages Project Independent Expert Group Meetings	Member Earth Institute, Columbia University Millennium Development Goals Centre West and Central Africa Dakar, Senegal
2013-2014	External Advisory Committee on Tuberculosis	Member Gates Foundation New York City, NY
2016-	Critical Path to TB Drug Regimens (CPTR) Initiative	Member

Professional Societies

1995-	Infectious Disease Society of America	Member
1997-	Society for Epidemiologic Research	Member
2007-	International Union of TB and Lung Disease	Member
2007-	Global Health Council	Member
2009-	American Society for Tropical Medicine	Member

Grant Review Activities

2004	Fogarty International Center/NIH Study Section ZRG1 ICP-3(03)	NIH, Bethesda, MD Member

2005	Improving Tuberculosis Control in Africa; Mathematical Modeling of Intervention Trials	Wellcome Trust Review London, England Member
2008	Postdoctoral Program Review for Indonesian PhDs	Royal Netherlands Academy of Arts and Sciences (KNAW), Amsterdam, Holland Referee
2008	Center for AIDS Research Scholar and Feasibility Scientific Reviewer Committee	Harvard School of Public Health Member
2009, 2010	Center for Scientific Review/NIH study section l ZRG1 IDM-P 50 R	NIH Ad hoc Member
2009-2016	Center for Scientific Review/NIH Study Section on Clinical Research and Field Studies of Infectious Diseases (CRFS)	NIH Permanent Member
2009	Wellcome Trust London, England	Ad hoc Reviewer
2010	National Science Foundation South Africa	Ad hoc Reviewer
2012	Center for Scientific Review/NIH Study Section ZRG1 AARR-K (52)	NIH Ad-hoc Member
2015	Center for Scientific Review/NIH Study Section ZRG1 IMST-K (50)S	NIH Ad-hoc Member
2017	Center for Scientific Review/NIH Study Section ZAI1 LG-M (M1) NIAID Clinical Trial Implementation Cooperative Agreement (U01/R01)	NIH Ad-hoc Member
2018	Center for Scientific Review/NIH Clinical Research and Field Studies of Infectious Diseases [CRFS] Study Section ZRG1 IDM-R (02)	NIH Ad-hoc Member
2019	Center for Scientific Review/NIH Study Section ZRG1 IDM-R (50)	NIH Ad-hoc Member

Editorial Activities

Ad hoc Reviewer

Science
Nature Medicine
New England Journal Medicine
Lancet
Lancet Infectious Diseases
Lancet Pulmonary Medicine
Epidemiology
American Journal of Epidemiology
International Journal of Tuberculosis and Lung Diseases
British Medical Journal
British Medical Journal, Global Health
Emerging Infectious Diseases
PLoS Medicine
PLoS Pathogens
PLoS One
Scandinavian Journal of Infectious Disease
Journal of the American Medical Association
American Journal Respiratory and Critical Care Medicine
Journal of Clinical Microbiology
Antimicrobial Agents and Chemotherapy
PNAS (Proceedings of the National Academy of Sciences)
Bulletin of the World Health Organization
Clinical Infectious Disease
Journal Infectious Disease
Annals of Internal Medicine
American Journal of Tropical Medicine and Hygiene
Royal Society Proceedings B
BMC Medicine
BMC Genomics
BMC Public Health
BMC Biology
BMC Health Services
Interface
Epidemics
Royal Society Open Science
mBio

Other Editorial Roles

2004-	Member of Editorial Board	European Journal of Epidemiology
2005-2012	Associate Editor	International Journal of TB and Lung Disease

2009-	Associate Editor	PLOS Medicine

Honors and Prizes

1980	Dartmouth General Fellowship	Dartmouth College
1990	Aesculupian Society	Harvard Medical School
1990	Paul Dudley White Fellowship	Harvard Medical School
1996	Howard Hughes Post-Doctoral Research Fellowship	Howard Hughes Medical Institute
1997	Tapplin Fellowship Award	Harvard School of Public Health
2001	Teaching Award	School of Public Health, Boston University
2002	Teaching Award	Harvard School of Public Health
2004	Ellison Senior Scholar	Ellison Medical Foundation
2008	Recognition Award	Harvard School of Public Health
2010	Nominated for Mentorship Award	Harvard Medical School
2010-11	Landolt Chair	Ecole Polytechnique Federale de Lausanne

Report of Funded and Unfunded Projects

Funding Information

Past

1997-2003 Molecular epidemiology of tuberculosis
NIH/NIAID 1K08AI001430-01
PI
This study explored the use of molecular epidemiologic data for epidemiologic inference and evolutionary studies of *M. tuberculosis*.

2000-2003 Population-based investigations of tuberculosis
NIH R01AI046669
Co-investigator
In this project, population-based genetic studies of human specimens were used to determine the clinical consequences of mutations in genes associated with bacterial antibiotic resistance and virulence.

2002-2005 Transmissibility and fitness of drug-resistant TB, Sverdlovsk
WHO T9-181-270
PI
This project assessed epidemiologic risk factors for TB drug resistance, identified locally prevalent drug-resistance profiles, used molecular epidemiological analyses to measure association between clustering and specific drug-resistance mutations, and assessed demographic distribution of drug resistance in prison and local community, evaluating extent of transmission between the two groups.

2003-2005 INH resistance in Beijing/W Isolates of *M. tuberculosis*
NIH R21 AI055800
Co-investigator
This project sought to identify risk factors associated with Isoniazid resistance which may be pathogen and/or host- specific and which may lead to acquisition of MDR-TB, after controlling for compliance.

2003-2005 Decision analysis for TB control
Bill Melinda Gates Foundation
Co-investigator
This project developed a decision-analytic model that could be used with data from different countries to assess the potential benefits, costs, and cost-effectiveness of the full range of policy options for dealing with MDR-TB, including preventive therapy, active case finding, diagnostic testing and treatment.

2004-2009 Curriculum in Emerging Infectious Diseases
NIH/NIGMS K073000-04
PI ($363,933)
This project aimed to develop and implement a core course in transmission dynamics of emerging infectious diseases, taking an interdisciplinary approach that incorporates case-based seminars and short courses.

2005-2007 Evaluation of a community based HIV-TB adherence support program in a government ARV-rollout site in KwaZulu-Natal, South Africa
Harvard University Center for AIDS Research
Co-investigator
This study evaluated the feasibility of community-based adherence support program designed to improve HIV/AIDS and TB outcomes among a cohort of HIV patients in a government ARV treatment program.

2006-2007 Ferroportin Polymorphisms and Tuberculosis Susceptibility
William F. Milton Fund/Harvard Medical School
PI
This study assessed the association between Ferroportin (FPN1) mutations, iron intake and TB susceptibility in South Africa.

2006-2010 Macrophage Iron Metabolism and Tuberculosis Infection
NIH/NIAID R21 AI068077-01
PI ($271,375)
We elucidated the role of host macrophage iron status on the growth of *M. tuberculosis* and explored the impact of iron and ferroportin status on cellular immune function.

2006-2011 Epidemiology of Multidrug-Resistant Tuberculosis in Peru
NIH/NIAID R01 A1057786-01A2
Co-investigator
The goal of this project is to provide new knowledge about the transmission dynamics of multidrug-resistant tuberculosis in a high TB-burden area in Peru and will measure within-household transmission of various strains of TB, assess the impact of socio-demographic and clinical confounders and risk modifiers, and measure associations between specific resistance mutations and phenotypes.

2007-2009 A Postmortem Study of the Burden of MDR and XDR Tuberculosis Among Adult Inpatient in KZN Deaths Occurring at Edendale Hospital Kwazulu-Natal South Africa
Massachusetts General Hospital
PI ($60,050)
This study estimated the burden of tuberculosis among seriously ill individuals in KZN and measured the proportion of TB among these patients which is drug-resistant by conducting postmortem tests at Edendale Hospital KZN.

2007-2014 Epidemiology and Transmission Dynamics of MDR/XDR Tuberculosis
NIH/NIAID U19 A1076217
PI ($13,422,751)
We conducted a series of linked interdisciplinary research projects focused on the emergence and transmission of multidrug and extensively drug resistant TB: a cohort study of host and microbial factors associated with MDR and XDR TB in Lima, Peru; a study characterizing *M. tuberculosis* strain diversity and its contribution to the emergence and spread of MDR; and a study using epidemic and individual predictive models to support public health policy and clinical decision-making for MDR and XDR TB.

2009 Systematic Reviews of Diabetes and Tuberculosis Interactions
PI ($25,000)
International Union of TB and Lung Disease
We evaluated the links between TB and diabetes by conducting a series of systematic reviews and meta-analyses.

2009-2012 Bioaerosols Production and Influenza Study
Pulmatrix Inc.
PI ($348,393)
The project measured the particle production in persons diagnosed with active influenza, measured the quantity and size distribution of influenza virus particles generated and exhaled by persons infected with influenza during normal tidal breathing, and measured the secondary attack rate of influenza within their households.

2009-2013 Treat TB: Technology, Research, Education and Technical Assistance for TB
USAID (subcontract through International Union against TB and Lung Disease)
Co-investigator
The subproject aims were to develop a modeling tool to assist national policy-makers in selecting the appropriate tests and strategies for the diagnosis of tuberculosis in specific types of epidemiological settings, with an emphasis on low- and middle-income countries, taking into account a variety of modifying factors including drug resistance and HIV.

2009-2014 Strengthening and Studying Community Based
Integrated Primary Health Care Systems in Rural Rwanda
Doris Duke Foundation
Co-investigator
The PHIT Partnership strengthened integrated primary health care delivery in Rwanda. The Partnership deployed a care-based intervention, conduct implementation research to generate data for ongoing monitoring, evaluation, and quality improvement of the intervention.

2009-2014 MIDAS Center for Communicable Disease Dynamics
NIH/NIGMS U54 GM088558-01
Co-investigator
This project advanced the quantitative study of communicable diseases through training/education, transdisciplinary research, and public health policy and will develop statistical and novel modeling methods, train mathematical modelers, perform outreach, and develop software for the analysis of communicable disease data.

2012-2013 Identification of GyrA/B Mutations that Predict Fluoroquinolone Resistant TB
Harvard University Center for AIDS Research
Co-investigator
This project evaluated the correlation between newly-developed molecular genetic probes that can detect mutations in the gryA and gryB genes of tuberculosis which may render them more resistant to first and later generation quinolones.

2013-2014 African Health Facility Capacity to Roll Out Technological Interventions
Gates Foundation
PI ($17,232)
This project summarized the following outcomes across Rwanda health facilities: the percent and number of health facilities with electricity currently; estimate percent of health

clinics with electricity within five years; percent and number of facilities with rapid HIV testing available; and the distribution of HIV testing staffing.

Current

2014-2020 Integrated discovery and development of innovative TB Diagnostics
NIH/NIAID CETR U19AI109755
PI ($29,218,333)
This multi-disciplinary collaboration is designed to enable the discovery of new biomarkers of *Mycobacterium tuberculosis* drug resistance, identify optimal clinical sampling strategies directed toward detection of *Mtb* DNA and develop and test a sensitive micro-array based rapid diagnostic. Our long-term goal is to develop a diagnostic strategy that will improve the diagnosis of childhood and DR TB and stem the further spread of the disease. *This grant is in a no cost extension phase.*

2015-2022 Metabolic Factors that Control the Spectrum of Human Tuberculosis
NIH/NIAID TBRU U19AI111224
Co-PI ($19,815,180)
This consortium project focuses on the link between host immune and metabolic factors and their impact on progression and persistence of tuberculosis. Teams focusing on human subjects, bio-informatics, and metabolomics work in parallel to identify targets including pathways linking human metabolism and immune response, T cells involved in *Mtb* response, pathogen determinants of drug resistance and pathogen-shed markers of clinical TB phenotypes. Each project includes validation of these targets in the guinea pig model.

2018- Metabolic Factors that Control the Spectrum of Human Tuberculosis
NIH/NIAID TBRU U19AI111224-04 Supplement
Co-PI ($200,000)
This supplement to the TBRU consortium project is a new collaborative, multi-disciplinary effort that conducted a genome-to-genome approach aimed at the identification of interacting molecular patterns in *Mtb* and the human host. The same approach and new methods will be adaptable and easily applicable to other populations being studied within the TBRU program.

2019-2024 Bacterial Determinants of Treatment Response in Mycobacteria Tuberculosis
NIH/NIAID U19AI142793-01
PI ($14,633,712)
This study will focus on the discovery of the genetic determinants of drug tolerance and resistance in mycobacteria tuberculosis both through mechanistic bench studies and through a genome wide association study of treatment failure in TB patients.

2019-2021 Randomised trial of an intervention to increase tuberculosis notifications by private practitioners in Indonesia, plus sequencing and susceptibility sub studies
CRDF Global u/d USDA (59-0210-06-004) DAA3-19-64909-2
United States Research Leader ($99,917)

This study will evaluate whether a tailored intervention package increases notifications of tuberculosis (TB) by private practitioners in Bandung, Indonesia.

2020-2023 Are TB neighbourhoods a high risk population for active intervention?
CRDF Global u/d NIAID
United States Research Leader ($99,999)
This study will confirm whether neighborhoods around known, routinely diagnosed TB index cases are high risk sub-populations which may warrant active intervention to enhance TB control.

Unfunded Projects

2003 Transmission dynamics of SARS (Co-leader)
I co-led a team that developed a mathematical model of the transmission dynamics of SARS. (Lipsitch et al. Science 2003)

2005-2011 TB Genome Project (Collaborator)
Whole genome sequencing of sets of drug resistant *M. tuberculosis* isolates.
I led a collaboration with the Broad Institute to identify, sequence and analyze progressively resistant isolates of *M. tuberculosis* to identify drug resistance mutations and to characterize compensatory or enabling mutations. We currently have one manuscript under review and several in preparation.

2006 Cost-effectiveness of testing the blood supply for West Nile Virus (Supervisor)
I supervised a doctoral student in the development of a combined transmission/cost-effectiveness model on West Nile Virus. (Korves et al. PLoS Med 2006; Korves et al. Clin Infect Dis 2006)

2006-2010 Determinants of tuberculosis (Advisor)
I supervised two doctoral students to carry out epidemiologic studies and meta-analyses of the associations between determinants (smoking and diabetes mellitus) and tuberculosis and to use the parameters thus obtained to construct mathematical models assessing the impact interventions directed at these determinants. (Jeon et al. PLoS Med 2008; Jeon et al, Trop Med and Int Health 2010; Lin et al. Lancet 2008; Lin et al. Am J Respir Crit Care Med 2009, Murray M et al, IJTLD 2010, Baker M et al. BMC Medicine 2011, Lin et al. IJTLD 2011). I supervised Dr. Olivia Oxlade on work that is a further extension of this project.

2007-2009 Timing of ART in patients co-infected with HIV and TB in Rwanda: an observational approach (Initiator)
I initiated this project and supervised a doctoral student in the collection and analysis of the data. This work led to a paper published in PLoS Medicine (Franke M et al. PLoS Med 2011).

2007-2009 Metabolic modeling of *M. tuberculosis* (Collaborator)

I collaborated with a team of bio-informaticists on a project to fit a metabolic flux model to *M. tuberculosis* expression data to mycolic acid production. (Colijn et al. PLoS Computational Biology, 2009)

2008-2009 Structural analysis of *M. tuberculosis* "resistome" (Collaborator)
I collaborated with George Church on a project to define the structural basis of drug resistance in *M. tuberculosis* using sequence data. We published one paper together (Sandgren et al. PLoS Med 2009).

2008-2010 *M. tuberculosis* isoniazid and quinolone mono-resistance in South Africa (Mentor)
I supervised two trainees who are investigating the frequency and outcomes of mono-resistance in *M. tuberculosis* in South Africa. We published two papers in this area. (Jeon C et al, 2010, Jacobson K et al, 2011).

2008-2010 ART Outcomes in Rwanda for 1000 HIV patients (Co-investigator)
I provided technical support and supervised the data collection and analysis team. We have published a paper on this topic (Rich et al, 2011).

2009-2010 Within host dynamics of TB and the evolution of drug resistance. (Initiator)
I collaborated with my former trainees, Ted Cohen and Caroline Colijn, on a project to model the within-host evolution of drug resistance (Colijn C et al, PLoS One, 2011).

2009-2011 Sex trafficking and HIV transmission in India (Advisor)
I supervised a doctoral student in the analysis of data and construction of a mathematical model of HIV transmission among trafficked sex workers in India. We published several papers together.

2010-2012 Cholera transmission in the Democratic Republic of the Congo and Haiti. (Collaborator and Adviser). I worked with a team including hydraulogists and infectious disease modelers on the transmission routes by which cholera spreads. We published three papers (Rinaldo et al, Proc Natl Acad Sci, 2012; Bompangue et al, PLoS Curr 2012; Bompangue et al, Lancet, 2012).

2012- Poverty traps in under-resourced settings (Collaborator)
I collaborate with Matthew Bonds on a range of studies to understand the role of infectious diseases in creating poverty traps in Rwanda and other under-resourced settings.

2014-2015 MDR TB in India
I worked with a Fulbright fellow to assess the burden of MDR TB in India.

2013-2016 Ebola Diagnostics, Asymptomatic Infection and Modeling (Initiator and Collaborator)
I worked with the Partners in Health clinical teams in Sierra Leone to evaluate two point of care diagnostic tests and supervised Gene Richardson in a study of asymptomatic Ebola infections and Ibrahim Diakite on a study of dynamic modeling of Ebola vaccination strategies.

2012- Impact of Health Research Capacity Building (Team Leader)
I lead a team focused on the implementation and assessment of Health Research Capacity Building in Africa.

2014- Yaws epidemiology and impact of mass drug administration (Collaborator)
I work with my former student, Eric Mooring, on the evaluation of data collected during a mass drug administration campaign in Papua, New Guinea.

2014- Health System Strengthening in Madagascar (Collaborator)
I work on developing methods to evaluate the impact of health system strengthening in Madagascar and other implementation sites.

2018-2019 Investigation of Services delivered for TB by External care system – especially the Private sector (INSTEP) (Collaborator)
I worked on quantitative measure of health seeking pathways and delays, diagnostic and treatment behaviors of private providers and qualitative (or mixed methods) analysis of provider behaviors and the reasons behind them as assessed via direct interviews.

Training Grants and Mentored Trainee Grants

1990-2011 Multidisciplinary AIDS Training Grant
NIH NIAID T32AI007387
Mentor (PI: Martin Hirsch)
The major goal was to provide in depth laboratory experience in a specific research area of virology, immunology, molecular biology, oncology, epidemiology molecular genetics, or molecular therapeutics to selected postdoctoral candidates.

1992-2022 Program for AIDS Clinical Research Training (PACRT)
NIH NIAID T32 AI007433
Mentor (PI: Kenneth Freedberg)
The major goal is to provide training in quantitative research methodologies with a focus on HIV clinical research to pre-doctoral PhD students and physicians at formative stages in their careers.

1998-2020 Epidemiology of Infectious Diseases
NIH NIAID T32 AI007535
Mentor (PI: George Seage)
The major goal is to increase the number of graduates who will be capable of drawing on diverse tools – including sophisticated approaches to causal inference, transmission-dynamic modeling, model fitting, population genomics and phylogenetics – in a knowledgeable way to meet the infectious disease threats of a new generation.

2004-2009 Molecular Approaches for Understanding TB Dynamics
NIH NIAID K08 5K08AI055985
Co-Mentor to Ted Cohen

The major goal of this five-year training program K award focused on the development of new analytic tools to evaluate molecular data from tuberculosis patients.

2009 AMSTH Postdoctoral Fellowship in Tropical Infectious Diseases
Mentor to Karen Jacobson
The major goal was to fund to conduct research focused on infectious diseases of low and low-middle income countries.

2010-2013 Predicting the impact and cost-effectiveness of technical and non-technical approaches to TB control in low and middle income countries
CIHR (Canadian Institute for Health Research) Fellowship MFE106987
Mentor to Olivia Oxlade
The goal was to predict, in 3 low and middle income countries, the epidemiologic impact and cost effectiveness of a technical approach to TB control (using improved diagnostic tests for earlier diagnosis of active TB disease) versus a non-technical population level intervention designed to reduce tobacco use and alcohol consumption.

2010-2014 The Economic Impacts of Community-Based Integrated Health Care Systems in Rural Rwanda
NIH Fogarty K01 TW008773
Mentor to Matthew Bonds
The major goal of this K award was to measure the specific economic consequences of expanded community-based integrated primary healthcare in Rwanda by measuring the partial effects of malnutrition, disease, schooling and socioeconomic status on each other.

2011 Modifiable risk factors for tuberculosis disease in children
Parker B. Francis Fellowship in Pulmonary Research
Mentor to Molly Franke
The major goal was to identify modifiable risk factors for TB in children.

2011-2016 Geospatial Clustering and Molecular and Social Epidemiology of Drug Resistant TB
NIH Fogarty K01 5K01TW009213
Co-Mentor to Karen Jacobson
The major goal of this K award was to estimate the burden of drug resistant TB and assess the heterogeneity of disease burden in different geographic locations, to examine the association of host risk factors and population determinants with regions of high drug resistant TB burden, and to describe the spatial and molecular clustering of strains of drug resistant TB in this province. My role was to mentor Karen Jacobson in research in molecular and social epidemiology of TB.

2012-2013 US-Italy Fulbright Scholarship
Mentor to Anna Odone

2012-2016 The Role of Development Assistance for Health in Reducing Child Mortality
NIH NICHD 4K01HD071929-05
Epidemiology mentor to Chunling Lu

The major goal of this K award was to obtain background knowledge of epidemiology so as to understand the disease profiles of under-five children of different age groups in developing countries.

2013-2014 Controlling Drug Resistant Tuberculosis (TB): A Review of Literature and an Attempt for Designing Innovative Approaches in Indian Setting
Core Fulbright Visiting Scholar Research Grant
Mentor to Sachin Atre

2013-2015 Gene Mutations and Tuberculosis Resistance
American Lung Association Research Award
Mentor to Maha Farhat
The major goal was to investigate the genetic sequences of known and candidate resistant genes for a large panel of TB drugs, to determine which mutations predict the extent of resistance, and if specific combinations of mutations interact to affect this resistance level. The information will be used to guide the development of a much needed rapid diagnostic test for drug resistant TB.

2014 Genetic determinants of drug resistance in mycobacterium tuberculosis
Parker B. Francis Fellowship in Pulmonary Research
Mentor to Maha Farhat
The major goal was to investigate the genetic sequences of known and candidate resistance genes for a large panel of TB drugs to determine which mutations predict the extent of resistance and use this information to guide the development of improved diagnostic tests for resistance.

2014-2017 Integrating Pediatric Care Delivery in Rural Healthcare Systems
NIH NICHD 5DP5OD019894
Mentor (PI: Duncan Maru)
The major goal was to increase the timely engagement in acute care for children to receive evidence-based World Health Organization protocols aimed at reducing child mortality and to implement a Chronic Care Model for pediatric patients under the age of twenty suffering from a chronic disease.

2014-2019 Infectious Disease and Basic Microbiological Mechanisms
NIH NIAID T32 2T32AI007061
Mentor (PI: Marcia Goldberg)
The major goal is to train scientists who have a career goal of solving medically relevant problems and who elect rigorous laboratory or epidemiologic training in any of the Harvard adult infectious disease programs or other Harvard-based institutions participating in this program.

2015-2017 New Tools for the Interpretation of Pathogen Genomic Data with a Focus on Mycobacterium Tuberculosis
NIH Fogarty K01 5K01ES026835
Principal Mentor to Maha Farhat

The major goal of this K award was to develop a web-based public interface to several analysis tools, to develop and study an MTB gene-gene network, and to study the performance of methods in current use for the association of genotype and phenotype in pathogens, and develop a generalizable power calculator for the best performing method.

2016-2017 Genetic Determinants of Drug Resistance in Mycobacterium Tuberculosis
NIH URM Supplement U19AI109755-03S1
PI & Mentor to Ibrahim Diakite (Total direct costs $82,633)
The major goal of this supplement was to develop and validate a prediction model that will define the optimal set of mutations to be assessed to improve the performance of rapid molecular diagnostics.

Report of Local Teaching and Training

Teaching of Students in Courses

Boston University

1998-2001	SPH EB755: Infectious Disease Epidemiology 34 students of public health	Boston University School of Public Health 2.5-hr sessions per week for 15 weeks

Harvard School of Public Health

2001-2003	ID293: Inference in Infectious Disease Epidemiology 15 students of public health	Harvard School of Public Health 4-hr sessions per week for 8 weeks
2001-2004	EPI225: Infectious Disease Dynamics 5 medical students, 50 students of public health	Harvard School of Public Health 4-hr sessions per week for 8 weeks
2002	ID267: Infectious Disease Epidemiology Seminar 2 medical students, 8 students of public health	Harvard School of Public Health 2-hr sessions per week for 16 weeks
2002-2003	ID229: Epidemiology of Infectious Disease Developing Countries 50 students of public health	Harvard School of Public Health 2-hr session
2002	EPI269: Epidemiological Research in Obstetrics and Gynecology 30 advanced students of public health	Harvard School of Public Health 1-hr session

2003-2006	IMI202: Tuberculosis 10 medical students, 10 students of public health	Harvard School of Public Health 2-hr sessions
2003-2004	ID287: Bioterrorism: Public Health Preparedness and Response 30 students of public health	Harvard School of Public Health 1-hr session
2004-2007	EPI285: Infectious Disease Dynamics 50 graduate students of public health	Harvard School of Public Health 5-hr per week for 16 weeks
2008-2015	EPI501: Dynamics of Infectious Diseases 50 graduate students of public health	Harvard School of Public Health 4-hr sessions per week for 8 weeks
2008-2010	GHP539: The Social, Political and Economic Dimensions of Infectious Diseases in Developing Countries 20 medical and graduate students of public health	Harvard School of Public Health 2-hr session
2008	IMI 227: Genetics and Genomics of Infectious Diseases: Tuberculosis, Malaria 25 graduate students of public health	Harvard School of Public Health 2-hr session
2008-2015	ID269: Respiratory Epidemiology 18 medical and graduate students of public health	Harvard School of Public 2-hr sessions
2009-2011	IMI202: Tuberculosis the Host, the Organism and the Global 9 graduate students of public health	Harvard School of Public Health 2-hr session
2015, 2017, 2019	Epi225 Epidemiology of HIV 30 graduate students of public health	Harvard School of Public Health 2-hr session
2016 -	Epi502: Biology and Epidemiology of Antibiotic Resistance 20 graduate students of public health	Harvard School of Public Health 2-hr session

Harvard University/FAS

2004	FAS Freshman Seminar 24p: How Epidemics Happen 12 undergraduate students	Harvard College, Cambridge, MA 3-hr sessions per week for 16 weeks

2005-2006	FAS Freshman Seminar 25m: Epidemics as a Metaphor 12 undergraduate students	Harvard College 2-hr sessions per week for 16 weeks
2006-2007	FAS Freshman Seminar 25m: What Epidemics Mean: Infectious Disease in a Social Context 12 undergraduate students	Harvard College 2-hr sessions per week for 16 weeks

Formal Teaching of Residents, Clinical Fellows and Research Fellows (post-docs)

2003	The Transmission Dynamics of *M. tuberculosis*: Models and Molecular Epidemiology	Research Seminar Department of Epidemiology Harvard School of Public Health One-hour lecture
2004	Transmission of TB in the Community Invited Lecture	Infectious Disease Society of America Boston, MA One-hour lecture
2007	Genetic Heterogeneity in *M. tuberculosis*	Department of Genetics and Complex Diseases Harvard School of Public Health One-hour lecture

Clinical Supervisory and Training Responsibilities

1996-2007	Attending and supervision of clinical infectious disease fellows/Massachusetts General Hospital	Daily supervision for 6 weeks per year

Laboratory and Other Research Supervisory and Training Responsibilities

2002-2004	Supervision of Julia E. Aledort, doctoral research fellow/Harvard School of Public Health	Weekly mentorship for 18 months
2002-2006	Supervision of Stephen Resch, doctoral research fellow/Harvard School of Public Health	Weekly mentorship for 18 months
2004-2006	Supervision of Johanna Daily, Master's student /Harvard School of Public Health	Monthly mentorship for 24 months
2007-2008	Supervision of Preetika Muthukrishnan, Master's student/Harvard School of Public Health	Weekly mentorship for 24 months

2009	Supervision of Daniel Pletzer, Undergraduate intern/Upper Austria University of Applied Sciences, Hagenberg, Austria	Daily laboratory mentorship for 3 months
2010	Supervision of Matsie Mphahlele, doctoral candidate at Stellenbosch University, Visiting Fogarty scholar	Weekly mentorship for 3 months
2010	Supervision of Laurence Laser, visiting Master's student from Ecole Polytechnique Federale de Lausanne	Weekly mentorship for 9 months
2018	Supervision of Junkun Ren, Master's student in epidemiology, Harvard T.H. Chan School of Public Health	Mentorship for 3 months

Formally Supervised Trainees and Faculty

1999-2004 Caroline Korves, ScD / Epidemiologist, Analysis Group, Inc.
I was Dr. Korves's doctoral supervisor at the Harvard School of Public Health. Published two research papers together, one in PLoS Medicine and Clinical Infectious Disease.

2001-2006 Theodore Cohen, MD, MPH, DPH / Professor, Department of Epidemiology, School of Public Health, Yale University
I was Dr. Cohen's DPH advisor at the Harvard School of Public Health and his primary mentor on his NIH K08 grant. Published 36 research papers together, including one in Science, one in Nature Medicine, and one in PNAS.

2003-2005 Anson Wright, MSc / WASH Advisor, Millennium Villages Project
I supervised Ms. Wright's master's thesis on preparedness for a *Yersinia pestis* bioterrorism attack.

2004-2006 Kristina Wallengren, PhD, MPH / Executive Director and Founder, THINK (Tuberculosis and HIV Investigative Network)
I was Dr. Wallengren's post-doctoral advisor at Harvard School of Public Health. We published three papers together.

2004-2010 Molly Franke, ScD / Assistant Professor, Department of Global Health and Social Medicine, Harvard Medical School
I was Dr. Franke's doctoral advisor at Harvard School of Public Health and continue to mentor her in her role at HMS. We have published 18 research papers together.

2005-2010 Erin Johnson, PhD / Associate Professor, Department of Biology, John Carroll University

I was Dr. Johnson's post-doctoral advisor at Harvard School of Public Health. Published two papers together in FEMS Immunology and Medical Microbiology and Infection and Immunity.

2005-2009 Hsien-Ho Lin, MD, MPH, ScD / Associate Professor in Epidemiology, Institute of Epidemiology and Preventive Medicine, National Taiwan University College of Public Health
I was Dr. Lin's advisor at Harvard School of Public Health. Published nine research papers together, including in PLoS Medicine, the Lancet, and American Journal Respiratory Critical Care Medicine.

2005-2011 Meghan Baker, MD / Instructor, Department of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute
I was Dr. Baker's advisor at the Harvard School of Public Health, Boston, MA. We have published five papers together.

2006-2009 Andreas Sandgren, MSc, PhD / Deputy Head, ReAct Europe
I was Dr. Sandgren's post-doctoral research advisor at Harvard School of Public Health. We published three research papers together, including one in PLoS Medicine.

2006-2010 Christie Jeon, MSc, ScD / Assistant Professor, Cedars-Sinai Division of Hematology/Oncology and Department of Epidemiology, UCLA Fielding School of Public Health
I was Dr. Jeon's doctoral advisor at the Harvard School of Public Health. We published ten research papers together including one in PLoS Medicine.

2006-2011 Kathleen Wirth, ScD / Research Scientist, Department of Biostatistics, Harvard School of Public Health
I was Dr. Wirth's doctoral advisor at the Harvard School of Public Health. We published two papers together, including one in Epidemiology.

2006-2008 Caroline Colijn, PhD / Professor, Department of Mathematics, Simon Fraser University
I was Dr. Colijn's post-doctoral advisor at Harvard School of Public Health. Published twelve research papers together, including one in American Journal Respiratory Critical Care Medicine and one in PLoS Computational Biology.

2007-2009 Gape Machao, MSc / Monitoring and Evaluation Officer, UNICEF Botswana
I supervised Mr. Machao's master's thesis on rapid diagnostic testing for TB in Botswana.

2008-2010 Ellen Brooks-Pollock, MSc, PhD / Lecturer, Veterinary Public Health, Bristol Veterinary School
I was Dr. Pollock's post-doctoral research advisor at Harvard School of Public Health. We published two papers together.

2008-2013 Karen Jacobson, MD / Assistant Professor of Medicine, Section of Infectious Diseases, Boston University School of Medicine

I was Dr. Jacobson's research mentor for her infectious disease post-doctoral research fellowship. We published nine papers together.

2008-2010 Tsering Pema Lama, MSc. Postdoctoral Fellow / Consultant, The George Washington University Milken Institute School of Public Health
I supervised Ms. Lama's master's thesis.

2009-2015 Matthew Bonds, PhD / Assistant Professor, Department of Global Health and Social Medicine, Harvard Medical School
I was Dr. Bonds' mentor on his K award on poverty traps and currently mentor him in his role in my department. We have published five papers and two book chapters together.

2009-2012

1. Razvan Sultana, MD, PhD / Computational Biologist, University of Hawaii John A. Burns School of Medicine

I co-supervised Dr. Sultana's doctoral thesis in Bio-informatics at Boston University on genomic analysis of drug resistant TB. We have published three papers together.

2010-2016 Hanna Guimaraes, MA, PhD / Postdoctoral Researcher, RIVM National Institute for Public Health and the Environment
I was Ms. Guimaraes' doctoral adviser while she conducted research for her degree from Portugal. We published four papers together.

1.

2010-2016

2. Maha Farhat, MD, MSc / Assistant Professor of Biomedical Informatics, Harvard Medical School

3. I was Dr. Farhat's postdoctoral mentor and supervised her analysis of whole genome sequence data on *M. tuberculosis* for the identification of novel mutations associated with drug resistance. We have published 12 papers together.

4.

2010

5. Joanne Salmon, MD, MPH / Clinical Instructor, Division of Infectious Diseases, Department of Medicine, The University of British Columbia

6. I supervised Dr. Salmon's master's thesis on community health workers and impact on TB treatment outcomes: a multi-country proposal.

7.

2010-2014 Chuan-Chin Huang, MS, ScD / Instructor in Medicine, Harvard Medical School
I was Dr. Huang's doctoral adviser. We have published eight papers together.

8.

2010-2014 Olivia Oxlade, PhD / Epidemiologist and Modeler, McGill International TB Centre
I was Dr. Oxlade's postdoctoral research supervisor in her work on modeling the determinants of TB. We published three papers together.

2010-2016 MaryCatherine Arbour, MD / Assistant Professor of Medicine, Department of Global Health and Social Medicine, Harvard Medical School
I mentored this junior faculty member at the Division of Global Health Equity, Brigham and Women's Hospital in her work on education and health outcomes in a cluster randomized trial of school-based interventions in Santiago, Chile. We published two papers together.

2011 *1.* Devra Barter, MS / Emerging Infections Epidemiologist, Colorado Department of Public Health & Environment

I co-supervised Ms. Barter's master's thesis on out-of-pocket expenses during TB treatment which is published in BMC Public Health.

2011-2013 Silvan Vesenbeckh, MD / Senior Registrar, Infectious Diseases, Groote Schuur Hospital
I supervised Dr. Vesenbeckh's postdoctoral work on cholera transmission in the DRC and Haiti. We published three papers together.

2011-2015 Philips Loh, MS / Doctoral candidate, Department of Epidemiology, Harvard School of Public Health
I supervised Mr. Loh's master's thesis and served as his doctoral adviser.

2012-2013 Alexis Krumme, MS, ScD / Research Specialist, Division of Pharmacoepidemiology and Pharmacoeconomics, Brigham and Women's Hospital
I supervised Ms. Krumme's master's thesis. We published one paper together.

2012-2015 Xeno Acharya, MPH / Senior Consultant, Healthcare AI, PA Consulting
I was Mr. Acharya's doctoral adviser. We have published one paper.

2013-2014 106. **Anna Odone, MD, MPH, PhD / Associate Professor of Public Health, Università Vita-Salute San Raffaele**

I was Ms. Odone's postdoctoral research supervisor for her work on socioeconomic risk factors for acquired and primary MDR-TB in Lima, Peru. We published one paper together.

2013-2014 Sachin Atre, PhD / Study Coordinator, Johns Hopkins Center for Clinical Global Health Education
I supervised Dr. Atre's work on MDR-TB management and policy in India, and the effective use of information technology in TB control. We published one paper together.

2013-2015 Emilia Ling, MS / Medical Student, Stanford University
I supervised Ms. Ling's master's thesis at HSPH. We published one paper together.

2013-2016 Assumpta Mukabutera, PhD / Instructor, University of Rwanda School of Public Health
I supervised Dr. Mukabutera's doctoral thesis on rainfall and child health outcomes. We published three papers together.

2014-2016 Rebecca Butler, MS / Biostatistician, Kaiser Permanente
I supervised Ms. Butler's master's thesis.

2014-2016 Gustavo Velasquez, MD, MPH / Research Associate, Department of Global Health and Social Medicine, Harvard Medical School

I supervised Dr. Velasquez's postdoctoral work examining the relationship between phenotypic pyrazinamide resistance and multidrug-resistant tuberculosis (MDR-TB) treatment outcomes. We published four papers together.

2014-2017 Ibrahim Diakite, PhD / Associate Scientist in Modeling & Meta-Analysis, Pharmerit International
I supervised Dr. Diakite's postdoctoral project that aimed to advance the quantitative study of communicable diseases especially the Mycobacterium Tuberculosis by using a combination of different mathematical techniques such as differential equations, stochastic process, branching process, and mathematical game theory. We published two papers together.

2014-2018 Omowunmi Aibana, MD, MPH / Assistant Professor, General Internal Medicine, University of Texas McGovern Medical School
I supervised Dr. Aibana's work on Tuberculosis in Ukraine through a T32 mechanism based at Brown Medical School. We published five papers together.

2014-2019 Eric Mooring, MPhil, ScD / Epidemic Intelligence Service, Centers for Disease Control and Prevention
I was Dr. Mooring's doctoral adviser. We have published three papers together.

2014-2020 Ruoran Li, MPhil / Doctoral Student, Department of Epidemiology, Harvard T.H. Chan School of Public Health. I was Dr. Li's doctoral adviser. We have published one paper together.

2016-2018 Silvia Chiang, MD / Assistant Professor of Pediatrics, Brown Alpert Medical School
I supervised Dr. Chiang in her postdoctoral study of adolescent tuberculosis. We have published two papers together and have one under review.

2017-2018 Katrin Sadigh, MD / Fogarty Global Health Fellow, Harvard T.H. Chan School of Public Health
I supervised Dr. Sadigh in her clinical research as part of the Department of Infectious Disease, Brigham and Women's Hospital/Massachusetts General Hospital combined program.

2017-2019 Taylor Chin, BA / Master's student, Department of Epidemiology, Harvard T.H. Chan School of Public Health
I supervised Ms. Chin's master's thesis.

2017-2019 Tori Cowger, MPH / Doctoral Student, Department of Epidemiology, Harvard T.H. Chan School of Public Health
I was Ms. Cowger's doctoral adviser.

2017- Alexander Chu, MPH / Post-baccalaureate premedical candidate, Harvard Extension School.

2017-	Annelies Mesman, PhD / Postdoctoral Research fellow, Department of Global Health and Social Medicine, Harvard Medical School. I supervised Annelies Mesman in her postdoctoral study of tuberculosis. We have published two papers together.
2019	Gerson Galdos Cardenas, PhD / Postdoctoral Research fellow, Department of Global Health and Social Medicine, Harvard Medical School.
2019-	Kamela Ng, PhD / Postdoctoral Research fellow, Department of Global Health and Social Medicine, Harvard Medical School.
2019-	Qi Tan, MD, PhD / Postdoctoral Research fellow, Department of Global Health and Social Medicine, Harvard Medical School.

Presentations

Invited Presentations and Courses

Local, Regional, National, and International Invited Presentations and Courses

Local Invited Presentations

No presentations below were sponsored by outside entities

2001	Styblo's Rule revisited Freeman Symposium Research Seminar Department of Epidemiology Harvard School of Public Health
2002-2003	Molecular epidemiology of tuberculosis Invited Lecture Hot Topics Series Harvard School of Public Health
2003	The transmission dynamics of *M. Tuberculosis*: Models and Molecular Epidemiology Research Seminar Department of Epidemiology Harvard School of Public Health
2003	Inferring the evolution of *M. Tuberculosis* from comparative genomics Research Seminar Infectious Disease Unit Harvard Medical School
2003	The epidemiology of Severe Acute Respiratory Syndrome (SARS) Invited lecture Kennedy School of Government Harvard University
2003	Transmission dynamics, epidemiology and SARS

Research Seminar
Department of Epidemiology
Harvard School of Public Health

2003 Modeling the molecular epidemiology of TB
Freeman Symposium Research Seminar
Department of Epidemiology
Harvard School of Public Health

2003 Molecular epidemiology and the transmission dynamics of tuberculosis
Research Seminar
The Broad Institute

2004 The epidemiology of SARS
Hot Topic Series
Harvard School of Public Health

2005 Epidemiology of multi-drug resistant tuberculosis
Grand Rounds
Massachusetts General Hospital

2006 Iron metabolism and *M. Tuberculosis*
Research Seminar
The Broad Institute

2006 Natural variation in *M. Tuberculosis*
Research Seminar
The Broad Institute

2006 Avian influenza
Department of Environmental Health
Harvard School of Public Health

2006 Three epidemics and how they happened
Department of Epidemiology Seminar
Harvard School of Public Health

2006 Transmission dynamics of drug sensitive and resistant tuberculosis infectious disease
Research Seminar
Partners Infectious Disease
Boston, MA

2007 Genetic heterogeneity in *M. Tuberculosis*
Department of Genetics and Complex Diseases
Harvard School of Public Health

2007	Epidemiology of HIV and tuberculosis Department of Epidemiology Seminar Harvard School of Public Health
2008	A multi-disciplinary approach to MDR and XDR tuberculosis Department of Epidemiology Seminar Series Harvard School of Public Health
2008	Making multidisciplinary research work: the example of MDR tuberculosis Seminar Series Department of Social Medicine and Health Inequalities Brigham and Women's Hospital
2008	Conducting research in international settings Best Practices in International Scientific Collaboration (Panel discussion) 2nd annual New England Tuberculosis Retreat Harvard Initiative for Global Health Harvard Medical School
2009	Genomic epidemiology of MDR and XDR tuberculosis The Broad Institute
2009	A multi-disciplinary approach to XDR tuberculosis Grand Rounds Department of Medicine Brigham and Women's Hospital
2009	Social justice and the effort to address MDR TB Symposium on an Idea of Justice Harvard University and the China Research Council
2010	The evolution of drug resistant tuberculosis Grand Rounds Department of Medicine Massachusetts General Hospital
2010	Overview of Murray research team Freeman Symposium Research Seminar Department of Epidemiology Harvard School of Public Health
2011	Deans' Research Update Harvard School of Public Health
2011	Innovation in global health Massachusetts General Hospital Department of Medicine Bicentennial Reunion

Department of Medicine
Massachusetts General Hospital

2013 TB in the 21st century: the convergence of the infectious and metabolic diseases
Seventh Annual New England Tuberculosis Symposium
The Broad Institute

2014 Ebola and the research equity agenda
Global Health Advisory Council
Harvard Medical School
Boston, MA

2015 Ebola Update
Global Health Advisory Council
Harvard Medical School
Boston, MA

2015 HIV and TB co-infection
Harvard T.H. Chan School of Public Health
Boston, MA

2015 Converging epidemics: tuberculosis and diabetes
Oxford Immunotec
Marlborough, MA

2015 Burke Global Health Fellowship Symposium
Harvard Global Health Institute
Cambridge, MA

2017 Host and bacterial determinants of TB infection and disease: a longitudinal cohort study
Spring Seminar
Center for Communicable Disease Dynamics
Harvard T.H. Chan School of Public Health, Boston, MA

2017 Host and bacterial determinants of TB infection and disease: insights from a large cohort study
IDMP Seminar
Broad Institute of MIT and Harvard, Cambridge, MA

2017 Tuberculosis and the vitamin A connection
Talks at 12
Harvard Medical School

2018 How to write an NIH grant
Training to Teachers Mongolia
Harvard Medical School

Regional

No presentations below were sponsored by outside entities

2001 Genetics and phenotypic variability within *M. Tuberculosis*
Invited lecture
Boston University

2001 Problems in the molecular epidemiology of tuberculosis
Research Seminar
Massachusetts State Laboratory Institute (MSLI), Boston, MA

2006 Three epidemics
Kay Stratton Lecture
Massachusetts Institute of Technology, Cambridge, MA

National

No presentations below were sponsored by outside entities

2004 Transmission of TB in the community
Infectious Disease Society of America, Boston, MA

2006 Modeling MDR tuberculosis
National Partners Meeting on MDR Tuberculosis, Atlanta, GA

2006 Transmission dynamics of Drug Resistant tuberculosis
Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, CA

2008 Host iron metabolism genes
Workshop on Biofilms, Iron and Drug Refractory TB
Colorado State University, Fort Collins, CO

2008 The impact of strains diversity and mechanisms of strains competition on the Potential Performance of New TB Vaccines
Microbial Diseases Lecture Series
Yale School of Public Health, Hartford, CT

2008 The role of mathematical modeling in evaluating interventions to control epidemics: the example of tuberculosis
Howard Hughes Medical Institute
California Institute of Technology, Pasadena, CA

2008 An interdisciplinary approach to extensively drug resistant tuberculosis
Howard Hughes Medical Institute
California Institute of Technology, Pasadena, CA

2008	Number of MDR-TB and XDR-TB patients receiving treatment today: Successes/Failures/Consequences Forum on Drug Discovery, Development and Translation Institute of Medicine of the National Academies, Washington, DC
2009	The evolution of XDR-TB in *M. tuberculosis* Seminar Series Biology Department Williams College, Williamstown, MA
2009	The evolution of XDR-TB in *M. tuberculosis*: a multidisciplinary approach Grand Rounds Presentation Division of Infectious Diseases Hennepin County Medical Center, Minneapolis, MN
2009	Mathematical modeling Infectious Diseases Clinical Cases Conference Division of Infectious Diseases Hennepin County Medical Center, Minneapolis, MN
2009	The evolution of XDR-TB: a multidisciplinary approach 2009 National TB Conference-TB Elimination-"It Takes a Village" Centers for Disease Control and Prevention, Atlanta, GA
2009	The Gates Project overview Mycobacteriology Laboratory Branch (MLB) Division of Tuberculosis Elimination Seminar Centers for Disease Control and Prevention, Atlanta, GA
2010	Social, economic and biological determinants of tuberculosis Taskforce for Disease Eradication Carter Center Atlanta, Georgia
2010	Estimating the impact of social and biological determinants on TB and modeling their modification Texas School of Public Health Brownsville, Texas
2010	The evolution of XDR tuberculosis Mary Hitchcock Hospital Hanover, New Hampshire
2011	Molecular methods to detect drug resistance in *M. tuberculosis* Workshop on TB and HIV Diagnostics in Adult and Pediatric Populations National Institutes of Health Washington, DC

2011	Understanding the transmission dynamics of drug resistant tuberculosis: a multidisciplinary approach Annual Biomedical Research Conference for Minority Students St. Louis, Missouri
2012	Evolution of drug resistance World TB Day Symposium Boston University Boston, Massachusetts
2012	High throughput sequencing of drug resistance targets for Mycobacterium tuberculosis National Institute of Allergy and Infectious Diseases Sponsored meeting Washington, DC
2013	Genetic determinants of drug resistance in *Mtb* World TB Day Symposium Weill Cornell Medical College New York City, New York
2015	Tuberculosis and diabetes The Comstock Lecture Johns Hopkins School of Public Health Baltimore, Maryland
2016	Tuberculosis and diabetes 20th Annual Conference of Union-North America Region/National TB Controllers Association Joint Meeting Denver, Colorado
2017	Risk factors for TB disease progression: evidence from a cohort study in Peru 9th Annual CEND (Center for Emerging and Neglected Diseases) Symposium: Deconstructing TB: Insights from Fundamental Research University of California, Berkeley, California
2017	Public health and the environment: interdisciplinary research and emerging infectious disease Ecology & Evolution of Infectious Diseases UC Santa Barbara, California
2018	Women in science 2018 Women in Science Symposium Colorado State University Fort Collins, Colorado

2019 Who gets TB infection and disease in Lima, Peru
Epidemiology Grand Rounds
Columbia University Mailman School of Public Health
New York, New York

2019 Who gets TB infection and disease in Lima, Peru
UPGG Tuesday Seminar Series
Duke University
Durham, North Carolina

International

No presentations below were sponsored by outside entities

2001 Determinants of cluster distribution in *M. tuberculosis*
Research Seminar
University of Warwick, Coventry, United Kingdom

2002 Pathogenesis of tuberculosis
Invited Lecture
Peruvian Thoracic Society, Lima, Peru

2002 Problems in the molecular epidemiology of tuberculosis
Research Seminar
Karolinski Institutet, Stockholm, Sweden

2003 The fitness of MDR-TB: what do we know
Invited Lecture
World Health Organization, Tallin, Estonia

2004 Molecular epidemiology of TB in Sverdlosk, Russia
Invited Lecture
International Union Against Tuberculosis and Lung Disease (IUTLD) Meeting
Moscow, Russia

2005 The fitness of MDR-TB strains
Invited Lecture
Desmond Tutu Center for Tuberculosis Research
University of Stellenbosch, Matieland, South Africa

2005 The current and future status of Multi-Drug Resistant TB
Invited Lecture
Novartis Symposium on TB Drug Development, Bagamoyo, Tanzania

2006 XDR-TB surveillance

Task Force on XDR-TB
World Health Organization, Geneva, Switzerland

2007 Mathematical models of population effects of potential TB vaccines
Keystone Symposium of Challenges of Global Vaccine Development
Cape Town, South Africa

2007 Modeling vaccine effects
Modeling Symposium at the 38th Union World Conference on Lung Health
Cape Town, South Africa

2007 Genomic epidemiology of infectious diseases: a new science
US-Japan Meeting
Hainan, China

2008 The molecular evolution of extensively drug resistant tuberculosis
Keystone Symposium of Pathogenesis and Control of Emerging
Infections and Drug-Resistant Organisms
Bangkok, Thailand

2008 TB Drug Resistance Mutation Database
39th Union World Conference 2008
International Union of TB and Lung Disease
Paris, France

2009 The evolution of multi-drug resistance in *M. tuberculosis*
Engineering and Physical Sciences Research Council Workshop
on the Evolution of Antibiotic Resistance
Imperial College, London, England

2009 The evolution of multi-drug resistance in *M. tuberculosis*
School of Biosciences Seminar Series
University of Birmingham, Birmingham, England

2009 Diagnosis of drug resistant TB
Fondation Mérieux International Scientific Conference on Latest Approaches to HIV
Infection Management: A Focus on HIV, TB and HIV/Hepatitis Co-Infection
New Delhi, India

2009 Tuberculosis and diabetes: interactions between two epidemics
TB/DM Expert Meeting
International Union of TB and Lung Disease
Paris, France

2009 Differences between epidemiology of TB in rich and poor countries
Union World Conference of Lung Health

Cancun, Mexico

2009 Modeling the potential impact of changing risk factors and social determinants
Union World Conference of Lung Health
Cancun, Mexico

2010 The evolution of drug resistance in TB
Ecole Polytechnique Federale de Lausanne
Lausanne, Switzerland

2010 Identification of drug resistance mutations in *M. tuberculosis*
Fondation Mérieux
Annecy, France

2010 Guidelines for management of tuberculosis and diabetes
World Health Organization
Geneva, Switzerland

2010 Data for developing diagnostics for MDR TB
Christian Medical College
Vellore, India

2010 Beyond labs and pills for improved tuberculosis control: what role for TB programmes?
41st Union World Conference on Lung Health
Berlin, Germany

2011 Iron transport polymorphisms and TB susceptibility
Ecole Polytechnique Federale de Lausanne
Lausanne, Switzerland

2011 Evaluating health interventions using DHS oversamples
Doris Duke Charitable Foundation Population Health Implementation Training Partnership Grantee Meeting
Ifakara, Tanzania

2012 Overview: Transmission dynamics and epidemiology of drug resistant TB
Lima, Peru

2012 The transmission dynamics of drug resistant TB
Harvard China Fund
Shanghai, China

2012 Understanding the epidemic dynamics of drug resistant TB
Keystone Symposia Conference – Drug Resistance and Persistence in Tuberculosis
Kampala, Uganda

2012	The social, environmental and biologic determinants of tuberculosis TB Day in Braga: From the hospital to the bench and back. Braga, Portugal
2012	Studying the link between nutrition and TB Risk: problems and strategies International Conference of the Union for TB and Lung Disease Kuala Lumpur, Malaysia
2012	TB and diabetes: what we know, what we don't know International Conference of the Union for TB and Lung Disease Kuala Lumpur, Malaysia
2013	Genetic diversity of DR TB: implication for future diagnostics Institute of Medicine and Chinese Academy of Sciences Workshop The Global Crisis of Drug-Resistant Tuberculosis and the Leadership of the BRICS Countries: Challenges and Opportunities Beijing, China
2013	Evolution of drug-resistance in TB genomes International Conference of the Union for TB and Lung Disease Paris, France
2014	The genetics and pathogenesis of MDR and XDR TB drug resistance Conference on Retroviruses and Opportunistic Infections (CROI) Boston, MA
2014	Genetic basis for transmission of MDR-TB 9th International Conference on the Pathogenesis of Mycobacterial Infections Stockholm, Sweden
2015	Issues in the management and prevention of drug resistant and sensitive TB Invited Lecture Bogomolets National Medical University Kiev, Ukraine
2015	TB and diabetes mellitus outcomes 19th Annual Conference of the Union-North America Region Vancouver, BC, Canada
2015	The transmissibility of drug resistant TB RePort Consortium Meeting Boston University Boston, Massachusetts

2015	The TB drug resistance database 46th Union World Conference on Lung Health Cape Town, South Africa
2016	Diabetes and environmental co-morbidities with TB Keystone Symposia Conference - Tuberculosis Co-Morbidities and Immunopathogenesis Keystone, Colorado
2016	Enabling next generation whole genome sequencing readouts directly from sputum samples and in the clinic: hype or hope? 47th Union World Conference on Lung Health Liverpool, United Kingdom
2017	Infectiousness and transmission of tuberculosis American Thoracic Society 2017 International Meeting Washington, DC
2017	Recent insights in the meaning of latency in tuberculosis 30th Annual Doctor Dorothy Wiselberg Seminar McGill University Montreal, QC, Canada
2017	Next generation whole genome sequencing for tuberculosis: ready for clinical practice? 48th Union World Conference on Lung Health Guadalajara, Mexico
2017	Estimating the adolescent tuberculosis burden in the 30 high-TB burden countries 48th Union World Conference on Lung Health Guadalajara, Mexico
2017	Insights into TB from a longitudinal cohort study in Lima, Peru National TB program Lima, Peru
2018	Insights into TB from a longitudinal cohort study in Lima, Peru Otago University Dunedin, New Zealand
2018	Grant Writing Mongolian National University of Medical Sciences Ulaanbaatar, Mongolia

2019	Bacterial determinants of TB progression 50th Union World Conference on Lung Health Hyderabad, India
2019	Genetic variations of mycobacterium tuberculosis that are associated with tuberculosis transmission 50th Union World Conference on Lung Health Hyderabad, India

Report of Clinical Activities and Innovations

Current Licensure and Certification

1996	Licensed in Medicine in Massachusetts
1996	Board Certified in Internal Medicine
1997	Board Certified in Infectious Disease

Practice Activities

1998 – 2007	Attending Physician	Infectious Disease Consult Services, MGH, Boston, MA	3-5 new consults, 20-30 follow-ups per day 3-6 weeks per year

The unit provides consults on infectious disease issues to all medical, surgical and other specialty wards. I saw patients referred to the specialty unit in conjunction with a team that includes an infectious disease fellow and rotating medical students and residents. In addition to this bedside clinical teaching, I also participated in weekly clinical conferences and seminars that are designed to maximize teaching.

Report of Scholarship

Peer reviewed publications in print or other media

Research investigations

1. Murray MJ, Murray NJ, Murray AB, **Murray MB**. Refeeding-malaria and hyperferraemia. Lancet 1975;1:653-4.
2. Murray MJ, Murray AB, **Murray MB**, Murray CJ. Somali food shelters in the Ogaden famine and their impact on health. Lancet 1976 Jun 12;1:1283-5.
3. Murray MJ, Murray AB, **Murray MB**, Murray CJ. Parotid enlargement, forehead edema, and suppression of malaria as nutritional consequences of ascariasis. Am J Clin Nutr. 1977 Dec;30(12):2117-21.
4. Murray MJ, Murray AB, Murray NJ, **Murray MB**. Diet and cerebral malaria: the effect of famine and refeeding. Am J Clin Nutr. 1978 Jan;31(1):57-61.

5. Murray MJ, Murray AB, Murray NJ, **Murray MB**. Serum cholesterol, triglycerides and heart disease of nomadic and sedentary tribesmen consuming isoenergetic diets of high and low fat content. Br J Nutr. 1978 Jan;39(1):159-63.
6. Murray MJ, Murray AB, Murray NJ, **Murray MB**. The effect of iron status of Nigerien mothers on that of their infants at birth and 6 months, and on the concentration of Fe in breast milk. Br J Nutr. 1978 May;39(3):627-30.
7. Murray MJ, Murray AB, **Murray MB**, Murray CJ. The adverse effect of iron repletion on the course of certain infections. Br Med J 1978 Oct 21;2:1113-5.
8. Murray MJ, Murray AB, Murray NJ, **Murray MB**, Murray CJ. Molluscum contagiosum and herpes simplex in Maasai pastoralists; refeeding activation of virus infection following famine? Trans R Soc Trop Med Hyg. 1980;74(3):371-4.
9. Murray JM, Murray AB, **Murray MB**, Murray CJ. Rarity of planar warts in Cushite nomads: antiviral effect of milk? Lancet. 1980 Jul 19;2(8186):143-4.
10. Murray MJ, Murray AB, Murray NJ, **Murray MB**. Infections during severe primary undernutrition and subsequent refeeding: paradoxical findings. Aust N Z J Med. 1995 Oct;25(5):507-11.
11. **Murray M**, Rasmussen Z. Measles Outbreak in a Northern Pakistani village: epidemiology and vaccine effectiveness. Am J Epidemiology 2000;1:811-9.
12. Piatek A, Telenti A, **Murray M**, El-Hajj H, Jacobs WR Jr, Kramer FR, Alland D. Genotypic analysis of *M. tuberculosis* in two distinct populations using molecular beacons: implications for rapid susceptibility testing. Antimicrob Agents Chemother 2000;1:103-10.
13. **Murray MB**, Determinants of cluster distribution in the molecular epidemiology of tuberculosis. Proc Natl Acad Sci U S A 2002 Feb; 99:1538-43.
14. **Murray MB**, Alland D. Methodological problems in the molecular epidemiology of tuberculosis. Am. J. Epidemiology 2002;155: 565-71.
15. **Murray MB**. Sampling bias in the molecular epidemiology of tuberculosis. Emerg Infect Dis 2002 Apr; 4:363-9.
16. Hughes A, Friedman R, **Murray M**. Genomewide pattern of synonymous nucleotide substitution in two complete genomes of *Mycobacterium tuberculosis.* Emerg Infect Dis 2002 Nov;8:1342-6.
17. **Murray MB**. Molecular epidemiology and the dynamics of tuberculosis transmission among foreign-born people. CMAJ 2002;167:355-6.
18. Lipsitch M**, Murray MB**. Multiple equilibria: Tuberculosis transmission require unrealistic assumptions. Theor Popul Biol 2003 Mar; 63:169-7.
19. Alland D, Whittam T, **Murray M**, Cave DM, Hazbon M, Dix K, Kokoris M, Duesterhoeft A, Eisen JA, Fraser CM, Fleischmann RD. Modeling bacterial evolution with comparative-genome based marker systems. Application to *M. tuberculosis* evolution and pathogenesis. J Bacteriol 2003;185:3392-9.
20. Lipsitch M, Cohen T, Cooper B, Robins JM, Ma S, James L, Gopalakrishna G, Chew SK, Tan CC, Fisman D, Samore M, **Murray M**. Transmission dynamics and control of severe acute respiratory syndrome. Science 2003; 300:1966-70.
21. Kudva IT, Griffin RW, **Murray M,** John M, Perna NT, Barrett TJ, and Calderwood SB. Insertions, deletions and single nucleotide polymorphisms at rare restriction enzyme sites enhance discriminatory power of polymorphic amplified typing sequences, a novel strain typing system for escherichia coli O157:H7. J Clin Microbiol 2004 Jun;42:2388-97.

22. Cohen T**, Becerra MC, **Murray MB.** Isoniazid resistance and the future of drug-resistant tuberculosis. Microb Drug Resist 2004;10:280-5.

23. Cohen T**, **Murray M**. Modeling epidemics of multidrug-resistant *M. tuberculosis* of heterogeneous fitness. Nat Med 2004 Oct;10:1117-21.

24. Becerra MC, Pachao-Torreblanca IF, Bayona J, Celi R, Shin S, Kim JY, Farmer P, **Murray M.** Expanding tuberculosis case detection by screening household contacts. Public Health Rep 2005;120:271-7.

25. Cohen T**, **Murray M**. Incident tuberculosis among recent US immigrants and exogenous reinfection. Emerg Infect Dis 2005;11:725-8.

26. Korves C**, Goldie S, **Murray M**. Cost-effectiveness of alternative blood screening strategies for West Nile Virus in the United States. PLoS Med 2006; 3:0211-21.

27. Louw GE, Warren RM, Donald PR, **Murray MB**, Bosman M, Van Helden PD, Young D, Victor TC. Frequency and implications of pyrazinamide resistance in managing previously treated tuberculosis patients. Int J Tuberc Lung Dis 2006 Jul;10:802-7.

28. Cohen T**, Lipsitch M, Walensky R, **Murray M**. Beneficial and perverse effects of isoniazid preventive therapy for latent tuberculosis infection in HIV-TB co-infected populations. Proc Natl Acad Sci U S A 2006 May 2;103:7042-7.

29. Resch S, Salomon J, **Murray M,** Weinstein M. Cost-effectiveness of treating multidrug-resistant tuberculosis. PLoS Med 2006 Jul;3:1302-9.

30. Mathew TA, Shin SS, Ovsynakova TN, Gelmanova I, Balbuena D, Atwood S, Peremetin GG, Strelis AK, **Murray M.** Causes of death during TB treatment in Tomsk Oblast, Russia. Int J Tuberc Lung Dis 2006; 10:857-63.

31. Korves C**, Goldie S, **Murray M.** Blood screening for the West Nile virus: the cost-effectiveness of a real-time trigger-based strategy. Clin Infect Dis 2006 Aug 15;43:490-3.

32. Hazbón MH, Brimacombe M, Bobadilla del Valle M, Cavatore M, Guerrer MI, Varma-Basil M, Billman-Jacobe H, Lavender B, Fyfe J, García-García L, León C, Bose M, Chaves G, **Murray M**, Eisenach KD, Sifuentes-Osornio J, Cave MD, Ponce de León A, Alland D. Population genetics study of isoniazid resistance mutations and evolution of multidrug-resistant *Mycobacterium tuberculosis.* Antimicrob Agents Chemother 2006;50:2640-9.

33. Johnson R, Warren R, Strauss OJ, Jordaan AM, Falmer AA, Beyers N, Schaaf HS, Cloete K, **Murray M**, van Helden PD, Victor TC. An outbreak of drug resistant tuberculosis caused by a Beijing strain in the Western Cape, South Africa. Int J Tuberc Lung Dis 2006;10:1412-4.

34. Lipsitch M, Cohen T, **Murray M**, Levin BR. Antiviral resistance and the control of pandemic influenza. *PLoS Med* 2007 Jan;4:0111-21.

35. Lin HH**, Ezzati M, **Murray M**. Tobacco smoke, indoor air pollution and tuberculosis – A systematic review and meta-analysis. PLoS Med 2007: 0173-89.

36. Gelmanova I, Keshavjee S, Golubchikova VT, Berezina VI, Sterlis AK, Yanova GV, Atwood S, **Murray M**. Barriers to successful tuberculosis treatment in Tomsk, Russia: Non-adherence, default and the acquisition of multi-drug resistance. Bull WHO 2007;85:703-11.

37. Victor TC, Streicher EM, Kewley C, Jordaan AM, van der Spuy GD, Bosman M, Louw H, **Murray M**, Young D, van Helden PD, Warren RM. Spread of an emerging *Mycobacterium tuberculosis* drug-resistant strain in the Western Cape of South Africa. Int J Tuberc Lung Dis 2007;11:195-201.

38. Colijn C**, Cohen T, **Murray M.** Emergent heterogeneity in tuberculosis epidemics. J Theor Biol 2007 Aug 21;247:765-74.

39. Cohen T**, Colijn C, Wright A, Zignol M, Pym A, **Murray M**. Challenges in estimating the total burden of drug resistant tuberculosis. Am J Respir Crit Care Med 2008 Jun 15; 177:1302-6.
40. Cohen T**, Colijn C, Finklea B, **Murray M.** Exogenous re-infection and the dynamics of tuberculosis epidemics: local effects in a network model of transmission. J R Soc Interface 2007 Jun 22;4:523-31.
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45. Lin HH**, **Murray M**, Cohen T, Colijn C, Ezzati M. Integrated analysis of respiratory diseases and risk factors in China: The effects of smoking and solid fuel use on COPD, lung cancer, and tuberculosis. Lancet 2008; 372:1473-83.
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47. Sandgren A**, Strong M, Muthukrishnan P, Weiner BK, Church GM, **MB Murray.** Tuberculosis drug resistance mutation database. PLoS Med 2009;6:e2.
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49. Lin HH**, Ezzati M, Chang HY, **Murray M.** Association between tobacco smoking and active tuberculosis in Taiwan: prospective cohort study. Am J Respir Crit Care *Med* 2009 Sep 1;180(5):475-80.
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51. Brooks-Pollock E**, Cohen T, **Murray M**. The impact of realistic age structure in simple models of tuberculosis transmission. PLoS One. 2010 Jan 7;5(1):e8479.
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53. Harries AD, **Murray MB**, Jeon CY, Ottmani S, Lonnroth K, Barreto, ML, Billo N, Brostron R, Bygbjerg IC, Fisher-Hock S, Mori T, Ramaiya K, Roglic G, Stransgaard H, Unwin N, Viswanathan V, Whiting D, Kapur A. Defining the research agenda to reduce the joint burden of disease from Diabetes Mellitus and Tuberculosis. Trop Med Int Health. 2010;15(6):659-63.

54. Calver AD, Falmer AA, **Murray M**, Strauss OJ, Streicher EM, Hanekom M, Liversage M, Masibi M, van Helden PD, Warren RM, Victor TC. Emergence of increased resistance and extensively drug-resistant tuberculosis despite treatment adherence, South Africa. Emerg Infect Dis. 2010 Feb;16(2):264-71.
55. Cohen T**, **Murray M**, Wallengren K, Samuel L, Wilson D. The prevalence of drug sensitive and drug resistant tuberculosis among patients dying in hospital in KwaZulu-Natal, South Africa: a postmortem study. PLoS Med. 2010;7(6):e1000296.
56. Jacobson KR**, Tierney DB, Jeon CY, Mitnick CD, **Murray M**. Treatment outcomes among patients with extensively drug-resistant tuberculosis: systematic review and meta-analysis. Clin Infect Dis. 2010 Jul 1;51(1):6-14.
57. Becerra MC, Appleton SC, Franke MF, Chalco K, Bayona J, **Murray M,** Mitnick CD. Recurrence after treatment for pulmonary multidrug-resistant tuberculosis. Clin Infect Dis. 2010 Sep 15;51(6):709-11.
58. Wirth KE**, Tchetgen Tchetgen EJ, **Murray M**. Adjustment for missing data in complex surveys using doubly robust estimation: Application to commercial sexual contact among Indian men. Epidemiology. 2010 Nov;21(6):863-71.
59. Jeon CY**, Harries AD, Baker MA, Hart JA, Gooneskera S. **Murray MB**. Bi-directional screening for tuberculosis and diabetes: a systematic review. Trop Med Int Health. 2010 Nov;15(11):1300-14.
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61. Johnson EE**, Sandgren A, Cherayil BJ, **Murray M**, Wessling-Resnick M. The role of ferroportin in macrophage-mediated immunity. Infect Immun. 2010 Dec;78(12):5099-106.
62. Jeon CY**, Calver AD, Victor TC, Warren RM, Shin SS, **Murray MB**. Use of fluoroquinolone antibiotics leads to tuberculosis treatment delay in a South African gold mining community. Int J Tuberc Lung Dis. 2011 Jan;15(1):77-83.
63. Cohen T**, Wilson D, Wallengren K, Samuel EY, **Murray M**. Mixed strain M. tuberculosis infections among patients dying in hospital in KwaZulu-Natal, South Africa. J Clin Microbiol. 2011;49(1):385-8.
64. Becerra MC, Appleton SC, Franke MF, Chalco F, Arteaga F, Bayona J, **Murray M**, Atwood SS, Mitnick CD. Tuberculosis burden in households of patients with multi-drug resistant tuberculosis and extensively drug resistant tuberculosis. Lancet. 2011 Jan 8;377(9760):147-52.
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69. Brooks-Pollock E**, Becerra M, Goldstein E, Cohen T, **Murray M**. Epidemiological inference from the distribution of tuberculosis cases in households in Lima, Peru. J Infect Dis. 2011 Jun 1;203(11):1582-9.
70. Cohen T**, **Murray M**, Abubakaar I, Zhang A, Sloutsky A, Arteaga F, Chalco K, Franke F, Becerra MC. Multiple introductions of multidrug resistant tuberculosis into households. Emerg Infect Dis. 2011 Jun;17(6):969-75.
71. Baker MA**, Harries A, Lonnroth K, **Murray M**. The impact of diabetes on tuberculosis treatment outcome: A systematic review. BMC Med. 2011 Jul 1;9(1):81.
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74. Jacobson KR**, Theron D, Victor TC, Streicher EM, Warren R, **Murray M**. Treatment outcomes of Isoniazid-Resistant Tuberculosis patients, Western Cape Province, South Africa. Clin Infect Dis. 2011 Aug;53(4):369-72.
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Community-based HIV Treatment Program in Rural Rwanda. J Acquir Immune Defic Syndr. 2012 Mar 1;59(3):e35-42.
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(** = mentee)

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Thesis

Murray, MB. Problems in the Molecular Epidemiology of Tuberculosis [Dissertation]. Boston (MA): Harvard School of Public Health; 2001.

Narrative

To date, my career has focused on two main areas: advancing progress in tuberculosis management and control and developing research capacity in low and middle-income countries.

My work on tuberculosis has shifted over the past twenty years from a focus on dynamical modeling of TB epidemics to field studies on the bacterial and host determinants of TB infection and disease. Between 2008-2013, I led a multi-disciplinary consortium that studied the impact of drug resistance of the transmission dynamics of tuberculosis in Lima, Peru. This project followed over 18000 people for TB-associated outcomes and has generated data that has allowed my team to also address a range of host and environmental factors that contribute to the transmission and disease burden of TB. More recently, our work in this area has centered on the links between host metabolic and immune function as determinants of the outcome of TB infection. This work, which is funded through an NIH consortium grant which I co-lead with Dr. Branch Moody, is another multi-disciplinary collaboration, this time among immunologists, epidemiologists, geneticists and veterinary pathologists.

My work on drug resistant tuberculosis has also led me to use targeted and whole genome sequencing to study "genomic epidemiology" and to elucidate the genetic basis of drug resistance phenotypes. To date, we have sequenced over 1500 TB strains and have created an innovative data interface tool that allows us to use whole genome data in epidemiologic studies. Currently, we are funded by NIH to identify, collect, archive, sequence and analyze the drug resistance genes in *M. tuberculosis* strains from around the world. These data are then passed to

our collaborators who attempt to validate our findings by generating and phenotyping *Mtb* variants and to our industry partners who are developing point of care diagnostic tests to detect drug resistance. I am the PI of this collaborative project which is funded through an NIH Center for Excellence in Translational Research.

In addition to my roles on my grant-funded projects, I am the research director for the Division of Global Health Equity in the Department of Medicine at the Brigham and Women's Hospital and the non-governmental organization, Partners In Health (PIH). In that capacity, I support the research mission of the Global Health Delivery Partnership by building research infrastructure and mentoring junior faculty interested in research careers. At HMS, I lead the Department of Global Health and Social Medicine's "research core," a team of eight epidemiologists, biostatisticians and programmers in the task of identifying and developing research opportunities in affiliation with PIH and other NGO's clinical field sites. Much of this work focuses on developing methods to evaluate the health interventions implemented in these sites and in designing and carrying out studies to conduct such evaluations. Increasingly, our mission has encompassed the training and development of independent researchers from the countries in which we work.

Almost all my academic work has been conducted in the context of training graduate students and post-doctoral fellows. I have directly supervised 39 graduate students or post-doctoral fellows, almost all of whom have published with me. Fourteen of my former trainees have gone on to tenure track faculty positions and six have joined international and non-governmental organizations focused on global health. Among many committee assignments, I am particularly proud of my contribution to the Task Force on Women in Science and Engineering which made recommendations that I believe have improved the working lives of many women in science at Harvard. I have served on the Human Subjects Committee at HSPH, co-chaired the Community Engagement Mission of the Strategic Leadership Team at the Brigham and Women's Hospital and led a number of junior and senior faculty searches.

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE
CASE NO. 20-CI-00538

MARGARET STERNE, HELEN LeMASTER, FRED MOZENTER, and DEBRA GRANER — **PLAINTIFFS**

V.

MICHAEL ADAMS, in his official capacity as Secretary of State of the Commonwealth of Kentucky, et al. — **DEFENDANTS**

DECLARATION OF MICHAEL CHANEY

I, Michael Chaney, hereby declare:

I make this declaration based on my personal knowledge and if called to testify I could and would do so competently as follows.

1. I am 49 years old and live in Lexington, Kentucky.

2. I am a United States citizen and a registered Kentucky voter. I have never lost my right to vote by reason of a felony conviction or court order.

3. I have been diagnosed with congestive heart failure.

4. I only leave the house about every other week for doctor's appointments and to go to the grocery store. When I do, I use a respirator because my doctor recommended I wear one for added protection against the virus when I have to go into public.

5. My three roommates and I are taking Covid-19 very seriously. One of my roommates is immunocompromised. She is unemployed and stays home to protect her health. Another roommate works from home and does not leave the house very often. My third roommate works at a uniform factory. He has assured me that workers socially distance and

wear masks. When he gets home, he removes his clothes, takes a shower, and completes a "decontamination" routine he has developed. He occasionally accompanies me to the grocery store, but otherwise does not go out. We keep a lot of hand sanitizer around the house.

6. This year, my doctor recommended I vote by mail due to my heart condition and the risk posed to my health by COVID-19. I plan to apply for a mail-in ballot for November election.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 28 day of July, 2020.

Michael Chaney

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
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V.

MICHAEL ADAMS, in his official capacity as Secretary of State of the Commonwealth of Kentucky, et al. — **DEFENDANTS**

DECLARATION OF MACARTHUR DARBY

I, MacArthur Darby, hereby declare:

I make this declaration based on my personal knowledge and if called to testify I could and would do so competently as follows.

1. I am 74 years old and live in Prospect, Kentucky in Jefferson County.

2. I am a United States citizen and a registered Kentucky voter. I have never lost my right to vote by reason of a felony conviction or court order.

3. I am totally blind and have been diagnosed with cancer. I live on my own and do not have nearby family. My daughters live in Atlanta and Washington, D.C.

4. Generally, I only leave my home to go to doctor's appointments and to pick up prescription medication, though on a few occasions I have made visits to Kroeger, Costco, the T-Mobile store, and a clothing store. My neighbors used to pick up my prescriptions for me, but they have told me they are limiting their public outings due to Covid-19 and I took it to mean that they can no longer assist me. My meals come to me through a meal service plan and Instacart.

5. A limited number of people have regularly been in my home since March, including an individual who comes once a week to mow my lawn and make necessary repairs; my housekeepers, who come every other week; and a pest control employee who comes every three months. My computer technician comes on an as-needed basis. To the best of my knowledge, we each wear masks and maintain appropriate distance. My daughter, her partner, and her son also came to visit me in June.

6. I usually vote in person at a precinct near my home using a machine for voters with seeing impairments. The machine reads my ballot to me and allows me to make my selections without assistance. However, because I am at increased risk from Covid-19, I need to vote by mail in November and any other elections held during the pandemic. I voted by mail in the June 23 primary election. My daughter assisted me in completing my ballot when she was visiting from Atlanta.

7. Voting in person is not safe for me right now. It would expose me to infection. I have two in-person voting options. One is to take the paratransit system to cast an absentee in-person ballot on the necessary machine in my county clerk's office. However, I estimated that the trip to and from the office, plus time spent casting my ballot, would be approximately three hours. My other option is to travel by paratransit to my polling place on Election Day. During one election, it took me about two hours to vote because a poll worker had difficulty operating the machine and providing me with instructions. Ultimately, I had to have someone read my ballot to me so that I would not miss my paratransit bus. Generally, it usually takes me two to three hours to go vote, including travel to and from my polling location and time casting my ballot.

8. I also want to exercise my right to cast a secret ballot. I want my county clerk to transmit a ballot to me using the same technology currently used to electronically transmit ballots to military members and people overseas. This method of delivery would allow me to use the reader technology on my computer to review my ballot, make my selections on my computer, then print and send my ballot to my clerk. If I cannot get my absentee ballot electronically transmitted to me and complete it on my computer, I will be forced to ask someone for assistance to complete my ballot and forfeit my right to a secret ballot. I should have the same right as every other Kentuckian to cast a secret ballot.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 28th day of July, 2020.

/s/ MacArthur Darby

MacArthur Darby

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE
CASE NO. 20-CI-00538

MARGARET STERNE, HELEN LeMASTER, FRED MOZENTER, and DEBRA GRANER — **PLAINTIFFS**

V.

MICHAEL ADAMS, in his official capacity as Secretary of State of the Commonwealth of Kentucky, — **DEFENDANTS**

ANDY BESHEAR, in his official capacity as Governor of the Commonwealth of Kentucky,

COMMONWEALTH OF KENTUCKY STATE BOARD OF ELECTIONS,

DEANNA BRANGERS, in her official capacity as a member of the Kentucky State Board of Elections,

ALBERT B. CHANDLER, III in his official capacity as a member of the Kentucky State Board of Elections,

KATRINA FITZGERALD, in her official capacity as a member of the Kentucky State Board of Elections,

JAMES LEWIS, in his official capacity as a member of the Kentucky State Board of Elections,

GEORGE RUSSELL, in his official capacity as a member of the Kentucky State Board of Elections,

DWIGHT SEARS, in his official capacity as a member of the Kentucky State Board of Elections,

CORY SKOLNICK, in his official capacity as a member of the Kentucky State Board of Elections,

and

SHERRY WHITEHOUSE, in his official capacity as a member of the Kentucky State Board of Elections

DECLARATION OF DEBRA GRANER

I, Debra Graner, hereby declare:

I make this declaration based on my personal knowledge and if called to testify I could and would do so competently as follows.

1. I am 69 years old and reside in Franklin County. I had my right to vote restored in 2019.

2. I am married to and live with Plaintiff Fred Mozenter, who is receiving treatment for bladder cancer and has been diagnosed with Type 2 Diabetes, reduced kidney function, and hypothyroidism. I have been diagnosed with hypertension.

3. Since March, my husband and I have limited our public outings. When we do go out, we wear masks, keep at least 6 feet of distance from other people, and use services that allow us to reduce our contact with other people, such as curbside pickup for our groceries and other goods. We have not had anyone in our home or gone to church since March.

4. I attempted to vote by mail in the June 23, 2020 primary election. Before Gov. Beshear issued his executive order allowing all registered voters to vote by mail, I requested an absentee ballot application, which I received in the mail. However, by the time I received it, Gov. Beshear had issued the executive order and I thought I could submit my request online. My husband's ballot arrived, but mine did not. Although I called my clerk's office multiple times, it was not until June 21 that someone at the clerk's office informed me that my online absentee ballot request had been rejected because I had not returned my paper application. As a result, I chose to vote early in person on June 22.

5. I want to vote by mail in the November 3, 2020 general election because my husband and I are at increased risk from COVID-19. However, should there be an issue again with receiving my absentee ballot, I want to be able to vote early, when there will be less lines and crowding.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 23 day of July, 2020.

Debra Graner

Debra Graner

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE
CASE NO. 20-CI-00538

MARGARET STERNE, HELEN LeMASTER, FRED MOZENTER, and DEBRA GRANER — **PLAINTIFFS**

V.

MICHAEL ADAMS, in his official capacity as Secretary of State of the Commonwealth of Kentucky, — **DEFENDANTS**

ANDY BESHEAR, in his official capacity as Governor of the Commonwealth of Kentucky,

COMMONWEALTH OF KENTUCKY STATE BOARD OF ELECTIONS,

DEANNA BRANGERS, in her official capacity as a member of the Kentucky State Board of Elections,

ALBERT B. CHANDLER, III in his official capacity as a member of the Kentucky State Board of Elections,

KATRINA FITZGERALD, in her official capacity as a member of the Kentucky State Board of Elections,

JAMES LEWIS, in his official capacity as a member of the Kentucky State Board of Elections,

GEORGE RUSSELL, in his official capacity as a member of the Kentucky State Board of Elections,

DWIGHT SEARS, in his official capacity as a member of the Kentucky State Board of Elections,

CORY SKOLNICK, in his official capacity as a member of the Kentucky State Board of Elections,

and

SHERRY WHITEHOUSE, in his official capacity as a member of the Kentucky State Board of Elections

DECLARATION OF HELEN LEMASTER

I, Helen LeMaster, hereby declare:

I make this declaration based on my personal knowledge and if called to testify I could and would do so competently as follows.

1. I am 84 years old and reside in Calloway County, Kentucky. I have never lost my right to vote due to felony conviction or court order.

2. I have been diagnosed with COPD, hypertension, atrial fibrillation, and a thyroid condition. I also had breast cancer and had several lymph nodes removed from my arms.

3. Since March, I have lived with my son and daughter at their home in Calloway County, where I am now registered to vote. My daughter has COPD and hypertension. My son has several health conditions, including AIDS, heart disease, and breathing problems. All three of us are at increased risk from COVID-19.

4. Since moving in with my son and daughter, I have not left the property.

5. If I cannot vote by mail in the November General Election, I will not vote. I cannot risk my health or that of my family by voting in person.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 22 day of July, 2020.

Helen LeMaster

Helen LeMaster

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE
CASE NO. 20-CI-00538

MARGARET STERNE, HELEN LeMASTER, FRED MOZENTER, and DEBRA GRANER — **PLAINTIFFS**

V.

MICHAEL ADAMS, in his official capacity as Secretary of State of the Commonwealth of Kentucky, — **DEFENDANTS**

ANDY BESHEAR, in his official capacity as Governor of the Commonwealth of Kentucky,

COMMONWEALTH OF KENTUCKY STATE BOARD OF ELECTIONS,

DEANNA BRANGERS, in her official capacity as a member of the Kentucky State Board of Elections,

ALBERT B. CHANDLER, III in his official capacity as a member of the Kentucky State Board of Elections,

KATRINA FITZGERALD, in her official capacity as a member of the Kentucky State Board of Elections,

JAMES LEWIS, in his official capacity as a member of the Kentucky State Board of Elections,

GEORGE RUSSELL, in his official capacity as a member of the Kentucky State Board of Elections,

DWIGHT SEARS, in his official capacity as a member of the Kentucky State Board of Elections,

CORY SKOLNICK, in his official capacity as a member of the Kentucky State Board of Elections,

and

SHERRY WHITEHOUSE, in his official capacity as a member of the Kentucky State Board of Elections

DECLARATION OF FRED MOZENTER

I, Fred Mozenter, hereby declare:

I make this declaration based on my personal knowledge and if called to testify I could and would do so competently as follows.

1. I am 72 years old and reside in Franklin County. I have never lost my right to vote due to felony conviction or court order.

2. I have been in remission for bladder cancer since fall 2018, but still receive treatments every six months. Treatment consists of three weeks of instillations that can only be administered in person at my doctor's office. I have also been diagnosed with Type 2 Diabetes, reduced kidney function, and hypothyroidism.

3. Since March, my wife and I have restricted our public outings, though unfortunately I recently had to make an unplanned trip to the emergency room. When we do have to go into public—for example, to pick up pre-ordered groceries or prescriptions—we wear masks, maintain at least 6 feet of distance from other people, and use options that provide for less contact, like the pharmacy's drive-through or having someone load groceries directly into the trunk of our car. We have not had anyone in our home or gone to church since March.

4. This fall, I would prefer to vote by mail in the general election in order to protect myself and my wife against COVID-19.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 22 day of July, 2020.

Fred Mozenter

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE
CASE NO. 20-CI-00538

MARGARET STERNE, HELEN LeMASTER, FRED MOZENTER, and DEBRA GRANER — **PLAINTIFFS**

V.

MICHAEL ADAMS, in his official capacity as Secretary of State of the Commonwealth of Kentucky, — **DEFENDANTS**

ANDY BESHEAR, in his official capacity as Governor of the Commonwealth of Kentucky,

COMMONWEALTH OF KENTUCKY STATE BOARD OF ELECTIONS,

DEANNA BRANGERS, in her official capacity as a member of the Kentucky State Board of Elections,

ALBERT B. CHANDLER, III in his official capacity as a member of the Kentucky State Board of Elections,

KATRINA FITZGERALD, in her official capacity as a member of the Kentucky State Board of Elections,

JAMES LEWIS, in his official capacity as a member of the Kentucky State Board of Elections,

GEORGE RUSSELL, in his official capacity as a member of the Kentucky State Board of Elections,

DWIGHT SEARS, in his official capacity as a member of the Kentucky State Board of Elections,

CORY SKOLNICK, in his official capacity as a member of the Kentucky State Board of Elections,

and

SHERRY WHITEHOUSE, in his official capacity as a member of the Kentucky State Board of Elections

DECLARATION OF MARGARET STERNE

I, Margaret Sterne, hereby declare:

I make this declaration based on my personal knowledge and if called to testify I could and would do so competently as follows.

1. I am 65 years old and reside in Calloway County, Kentucky. My voting rights were restored to me in 2018 and I registered and voted for the first time in the November 2019 general election. I want to vote in the November 2020 general election.

2. My brother and I own a home together. Our 84-year-old mother moved in with us earlier this year because of the COVID-19 pandemic.

3. I was diagnosed with COPD about 15 to 20 years ago, and with high blood pressure about 25 years ago. In March, my doctor's office called me and told me that, because I am at increased risk from COVID-19, I cannot come to the office for appointments. They said that if I need to see the doctor, it can be done over video.

4. My brother is also at risk from COVID-19 because he has several serious health conditions, including AIDS and heart problems. He also relies on an oxygen mask to breathe. His doctor told him that COVID-19 would be a death sentence for him.

5. I have not gone into public since we began self-isolating. We live in a rural area and do not have neighbors. I am terrified of getting COVID-19, and I am scared for my brother and mother as well.

6. If I cannot vote by mail this fall, I will not vote. I cannot take the risk that I will get COVID-19 by voting in person. I believe it would kill me, my brother, and mother.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 22 day of July, 2020.

Margaret Sterne

Margaret Sterne

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
DIVISION ONE (Hon. Phillip J. Shepherd)
CASE NO. 20-CI-00538

MARGARET STERNE, et al. **PLAINTIFFS**

V.

MICHAEL ADAMS, et al. **DEFENDANTS**

[PROPOSED] TEMPORARY INJUNCTION

Plaintiffs Margaret Sterne, Helen LeMaster, Fred Mozenter, Debra Graner, Michael Chaney, and MacArthur Darby moved this Court to enter a Temporary Injunction pursuant to CR 65.04. Plaintiff's Motion sought to (1) enjoin the requirement that voters satisfy a statutorily recognized excuse to vote by mail, pursuant to KRS 177.085(1)(a), during the pendency of the Covid-19 pandemic; (2) enjoin the requirement that voters satisfy a statutorily recognized excuse to vote absentee in person, pursuant to KRS 177.085(1)(d), during the pendency of the Covid-19 pandemic; (3) delay the effective date of the state's new voter ID bill, SB 2, until after the Covid-19 pandemic ends; (4) compel the Defendants to extend Sections 3, 4, 5, 6, 9, and 10 of the emergency regulations (31 KAR 4:190E) during the pendency of the Covid-19 pandemic; and (5) compel the Defendants to electronically deliver Plaintiff Darby an absentee mail-in ballot using the ballot delivery system established pursuant to KRS 117A.030(4), and to make this delivery option available to other voters with documented visual disabilities who choose to vote by mail and select this method of transmission.

Based on the specific facts set forth in the First Amended Complaint, the factual record, and argument given at the hearing on Plaintiff's motion, it appears that the Plaintiffs will suffer

immediate and irreparable injury unless the Defendants are ordered to extend the election procedures used for the June 23, 2020 primary elections for the duration of the Covid-19 pandemic.

The Court specifically finds as follows:

1. There is no adequate remedy at law with respect to Plaintiffs' claims under Section 6. If this Court does not act to compel Defendants to extend the effective date of their emergency regulations through the general election, a substantial percentage of Kentuckians otherwise eligible to vote will be denied the right to do so. *Wallbrecht v. Ingram*, 175 S.W. 1022, 1026-1027 (Ky. 1915).

2. Plaintiffs are likely to succeed on their claim that Defendants' failure to extend critical portions of the emergency regulations through the time of the general election, and to enforce SB 2, will violate Section 6 of the Kentucky Constitution.

3. Plaintiffs and the public at large will suffer immediate and irreparable injury if the current emergency regulations are not extended through, and SB 2's new voter ID requirements are enforced for, the general election. Holding an election under conditions that disenfranchise a substantial percentage of voters "is an invasion of the highest rights of the citizens, and tends to substitute other means of determining the popular will, for elections held by the people." *Wallbrecht*, 175 S.W. at 1027. "Such course, however innocent its motive, cannot be too severely discountenanced." *Id.*

4. In contrast, Defendants will suffer no harm from the requested injunction. Indeed, their actions and public statements to date have demonstrated that (1) making absentee voting available to all Kentuckians is necessary to ensure a free and equal election so long as Covid transmission remains a substantial risk, (2) they have the power necessary to issue such emergency regulations, (3) Defendants have the capacity to administer the absentee voting system laid out in

the emergency rules, and (4) moving to this absentee voting system has not caused widespread voter confusion.

5. Moreover, Defendants—particularly Secretary Adams—have also assured the public that the emergency regulations provided appropriate safeguards to protect election integrity, which they accomplished without the added restrictions of SB 2.

6. In view of the merits of Plaintiffs' claims, the strong public interest in ensuring free and fair elections, and the lack of any harm to Defendants, Plaintiffs are entitled to preliminary and permanent injunctions compelling Defendants to extend critical portions of the rules set forth in 31 KAR 4:190E throughout the Covid-19 pandemic including for the November 3, 2020 general election, and to prohibit them from enforcing the new voter ID requirements of SB 2 until the Covid-19 pandemic ends.

7. Plaintiff Darby is additionally likely to succeed on his claim that failure to electronically transmit his absentee mail-in ballot to him violates Section 147 of the Kentucky Constitution.

8. There is no adequate remedy at law for Plaintiff Darby if his right to a secret ballot under Section 147 is violated; Defendants cannot compensate him for this type of loss. He needs to vote by mail to limit his potential exposure to novel coronavirus and reduce his risk of contracting severe illness from Covid-19; but if he cannot get his absentee mail-in ballot electronically transmitted to him, he will have to seek assistance from another person, forego his right to a secret ballot, and place in them full trust that they have faithfully made his desired selections on his ballot. This situation presents the type of interference with free expression that Section 147 is intended to prevent, and is wholly unnecessary and avoidable in light of the State's existing electronic ballot delivery capabilities under KRS 117A.030(4). Because the State Board

of Elections already makes electronic transmission of absentee ballots available to military and overseas voters, Defendants will not be burdened if required to make the same delivery system available to Plaintiff Darby and similarly situated voters.

9. In view of the merits of Plaintiff Darby's Section 147 claim, the strong public interest in ensuring the right to a secret ballot, and the lack of any harm to Defendants, Plaintiff Darby and other voters with documented visual disabilities who opt to vote by mail, and to receive their ballot electronically, are entitled to preliminary and permanent injunctions compelling Defendants to electronically transmit their absentee mail-in ballots to them using the system established pursuant to KRS 117A.030(4).

Based on these findings of fact and the application of CR 65.04 and decisional law on the application of the rule, *e.g. Maupin v. Stansbury*, 575 S.W.2d 695, 699 (Ky. Ct. App. 1978), and the Court being otherwise sufficiently advised, **IT IS HEREBY ORDERED** that Plaintiff's Motion for a Temporary Injunction is **GRANTED.** The court **ORDERS** as follows:

(1) The requirement that voters satisfy a statutorily recognized excuse to vote by mail, pursuant to KRS 177.085(1)(a), during the pendency of the Covid-19 pandemic, is hereby **ENJOINED**;

(2) The requirement that voters satisfy a statutorily recognized excuse to vote absentee in person, pursuant to KRS 177.085(1)(d), during the Covid-19 pandemic, is hereby **ENJOINED**;

(3) Defendants shall electronically deliver Plaintiff Darby an absentee mail-in ballot using the ballot delivery system established pursuant to KRS 117A.030(4), and to make this delivery option available to other voters with documented visual disabilities who choose to vote by mail and select this method of transmission;

(4) SB 2 is hereby **ENJOINED** until after the Covid-19 pandemic abates; and

(5) Defendants are hereby **ORDERED** to extend the following portions of the emergency regulations (31 KAR 4:190E) during the Covid-19 pandemic:

(a) Section 3, which provides that "[n]otwithstanding KRS 117.077, an application for an absentee ballot due to medical emergency a) shall not require the applicant to state that the emergency condition occurred within 14 days of the election, b) need not be notarized, and c) shall entitle the applicant, upon verification of the application, to vote by absentee, by mail or in person by appointment, as advised, if otherwise a lawful voter";

(b) Section 4, which requires the State Board of Elections to send "a non-forwarding postcard to every registered voter of the Commonwealth to inform them of the changes being made to the [upcoming election] as a result of the COVID-19 pandemic, as well as the steps the voter must take to request an absentee ballot through the SBE secure online portal or by calling their County Clerk. That postcard should continue "to advise voters that, if they will vote in person absentee or in person on election day, they are advised to make an appointment with their County Clerk."

(c) Section 5, which requires the State Board of Elections to "establish a secure online portal that will allow voters to request an absentee ballot through the submission of personally identifiable information" and states that such requests shall "serve as an absentee application in lieu of SBE's 'Medical Emergency Application to Vote Absentee' form." The portal should continue to "transmit the request to the County Clerk of the county in which the requester is registered to

vote," who must in turn "transmit to the voter an absentee ballot within seven (7) days." Id. It also should continue to provide "to County Clerks a unique barcode for each voter's ballot envelope, providing the ability to track the ballot as it [is] mailed out and received back, in order to certify the movement of the ballot through the postal system and to issue voter credit." Id.

(d) Section 6, which provides a deadline for county clerks to mail absentee ballots that "have the return postage paid for by the State Board of Elections" and requires county clerks to count any ballot "delivered by the United States Postal Service and bearing a postmark of [the general election date] or earlier" if received by November 7, 2020. Id.

(e) Section 9, which provides an opportunity for voters to cure any signature problems with mail-in ballots and requires local election officials "to contact the voter using the contact information provided by the voter's absentee ballot application, and provide the voter with a timeframe and manner in which the voter may cure the discrepancy."; and

(f) Section 10, which requires county clerks to allow voters "to schedule appointments to vote absentee in-person by appointment . . . no fewer than 5 days per week in the two weeks before the week of election day." Those "Appointments shall be consistent with public health and social-distancing standards and every reasonable effort shall be undertaken by County Clerks to see that in-person absentee voting is implemented in a manner that limits direct contact between voters, other voters, and election officials, and shall be conducted throughout the Clerk's business hours." Id.

Date: _____

_____
Hon. Phillip Shepherd
Franklin Circuit Court

Tendered by:

/s/ Michael P. Abate
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COUNSEL FOR PLAINTIFFS

**Motion for Pro Have Vice Admission granted, awaiting identification number*