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COVID-19 Data Dives: What We Have Learned About SARS-CoV-2 Transmission

Muge Cevik, MD, MSc

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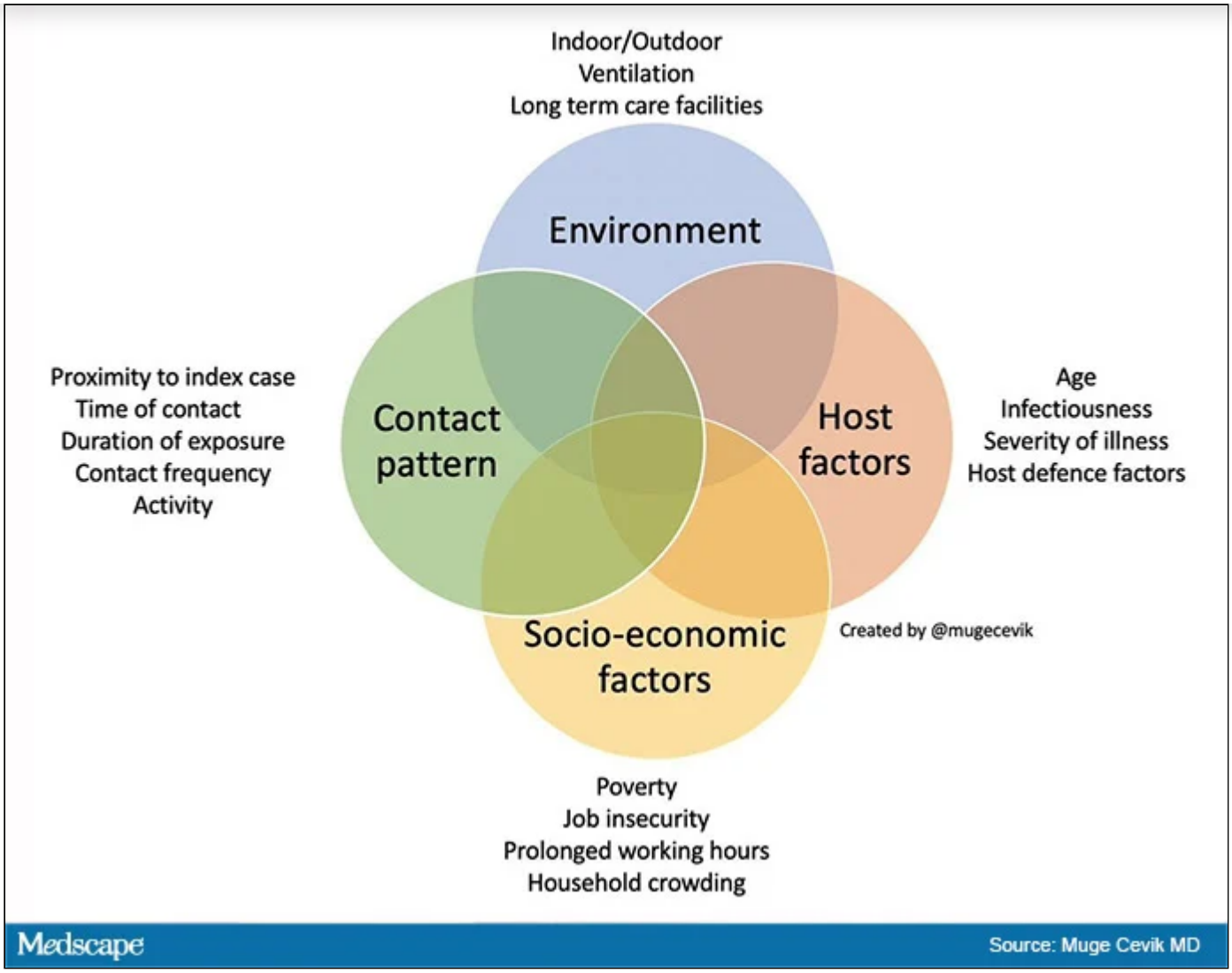
Over the past 6 months, we've learned a lot about how SARS-CoV-2 spreads. Let's review what the evidence tells us so far about SARS-CoV-2 transmission dynamics, high-risk activities, and environments, based on a recent article my colleagues and I published in *Clinical Infectious Diseases.*



The risk for transmission is complex and multidimensional. It depends on many factors, including contact pattern (ie, duration, proximity, activity), individual factors, environmental factors (ie, outdoor, indoor), and socioeconomic factors (ie, crowded housing, job insecurity).

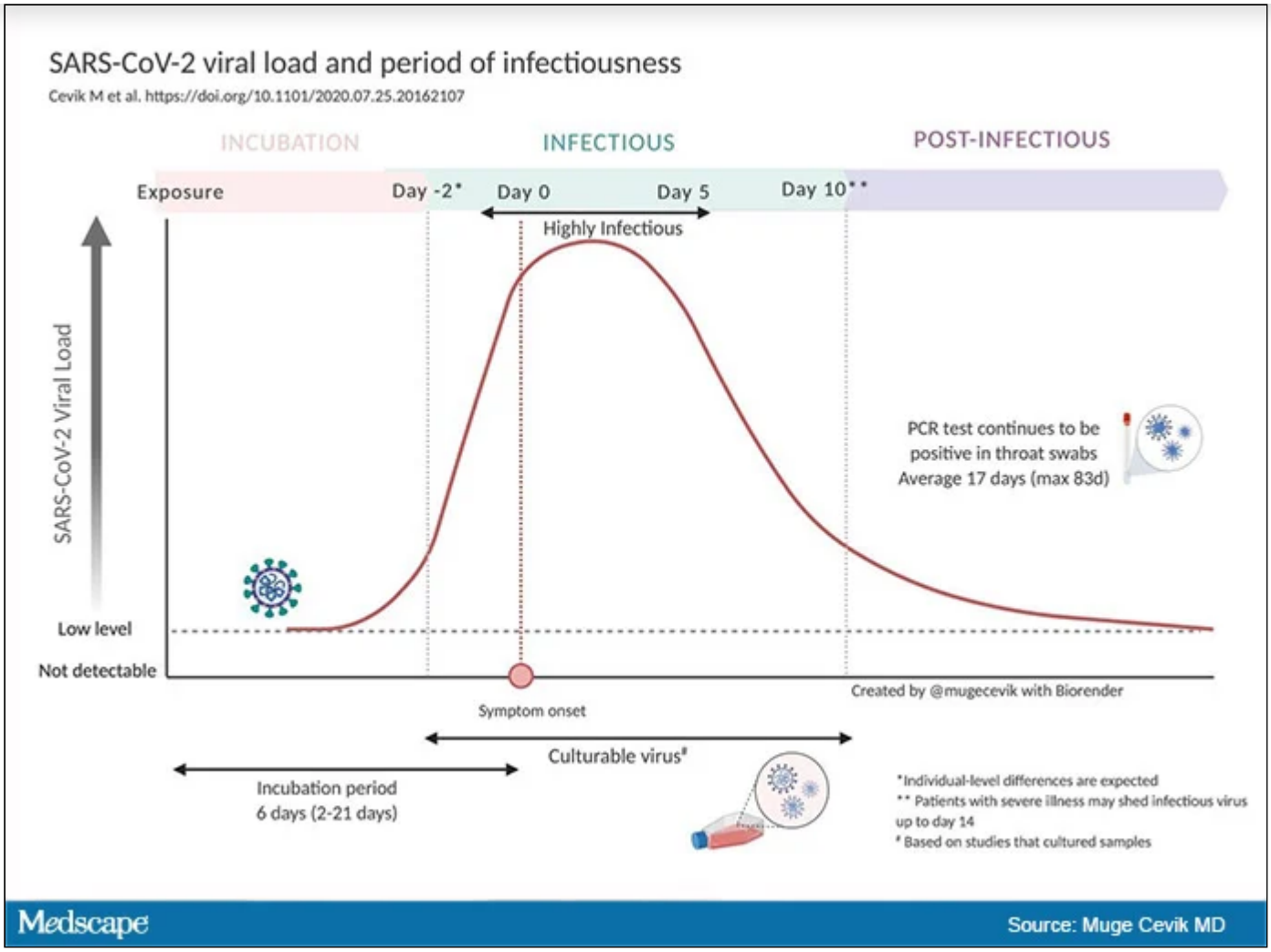
As I outlined in a recent Twitter thread, let's take a look at each of these.

Contact pattern. We now know that sustained close contact drives the majority of infections and clusters. For instance, close family and friend contacts and gatherings pose a higher risk for transmission than market shopping or brief community encounters.

Even within the same household, frequent daily contact with the index case, like dining in close proximity or spouses and partners sharing the same sleeping space, has been associated with increased risk for transmission.

For non-household contacts, engaging in group activities such as dining together or playing board games has been found to pose high risk for transmission, as do get-togethers that typically amass large clusters, such as weddings and birthday parties. Other examples include gatherings in pubs, church services, and close business meetings. These findings suggest that group activities pose a higher risk for transmission. The risk increases with longer and frequent exposure, close proximity, number of contacts, and group activities, especially dining.

Individual factors. Individual factors for infectiousness vary extensively. Many people either do not infect anyone or infect a single person. A large number of secondary cases are caused by a small number of infected people. Although many factors are at play, individual variation in infectiousness plays a major role.



While patients without symptoms can transmit the virus to others, emerging evidence, detailed in two publications — a preprint and a published article — suggests that asymptomatic index cases transmit to fewer secondary cases. Attack rates (the number of people who become ill out of the number of people made at risk by exposure) are highly correlated with symptom severity.

Transmission is also affected by other host factors, including host defense mechanisms and age. For instance, given the same exposure, susceptibility to infection increases with age. It's higher in those over 60 compared with younger or middle-aged adults.

Environmental factors. The impact of contact pattern also depends on the setting of the encounter. Contact tracing studies suggest that indoor settings are associated with a risk for transmission that is 20-fold higher than for outdoor environments.

Prolonged indoor contact in a crowded and poorly ventilated environment increases the risk for transmission substantially. But decreasing occupancy and improving ventilation through opening windows and doors can lower the risk.

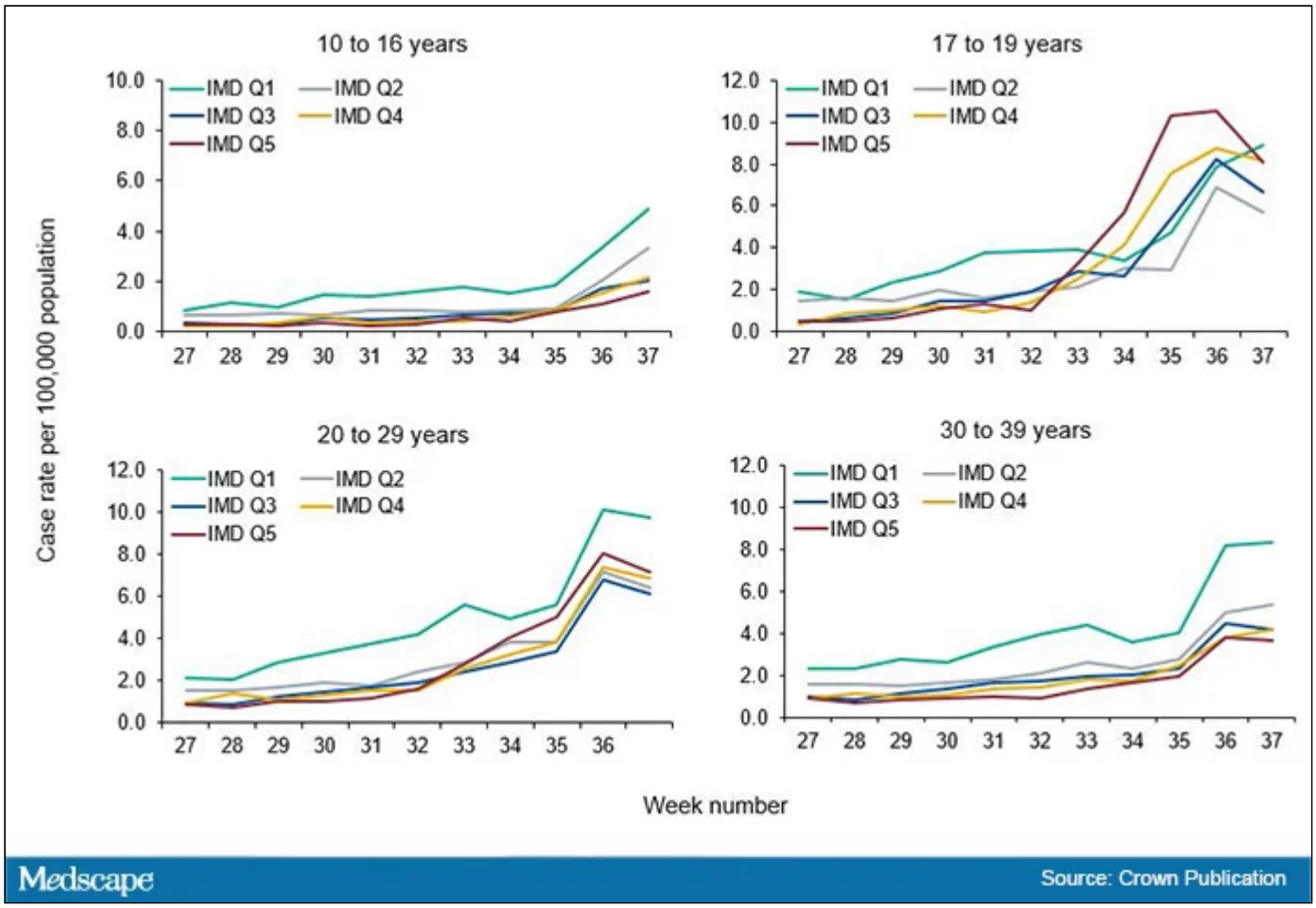
The largest outbreaks from across the world have been reported in long-term care facilities (such as nursing homes), homeless shelters, prisons, and meatpacking plants where many people spend several hours working, living together, and sharing communal spaces.

The largest clusters of cases observed in the United States have all been associated with prisons or jails. In the largest meatpacking plant in Germany, while the common point of potential contact was workplace, the risk was higher for those in a single shared apartment or bedroom, or in a carpool.

Socioeconomic factors. Global figures suggest that the COVID-19 pandemic is strongly shaped by structural inequities, adverse living and working conditions, and structural racism that drive household and occupational risks.

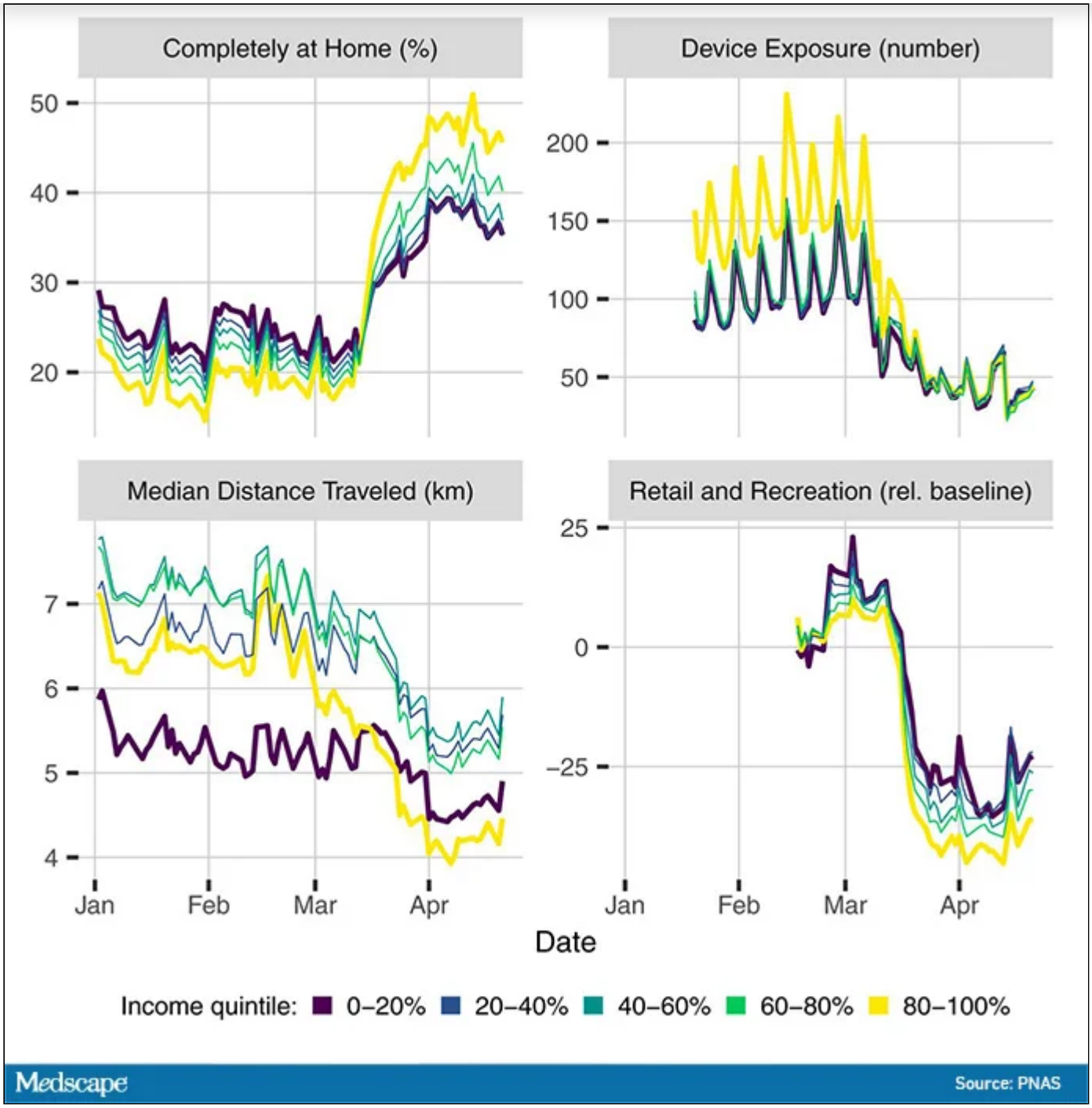
deaths.

Public Health England's surveillance report shows that while the number of infections in England is increasing mainly in the 20-29 and 30-39 age groups, SARS-CoV-2 is spreading most in highly deprived areas where people are employed in poorly paying jobs and can't afford to isolate.



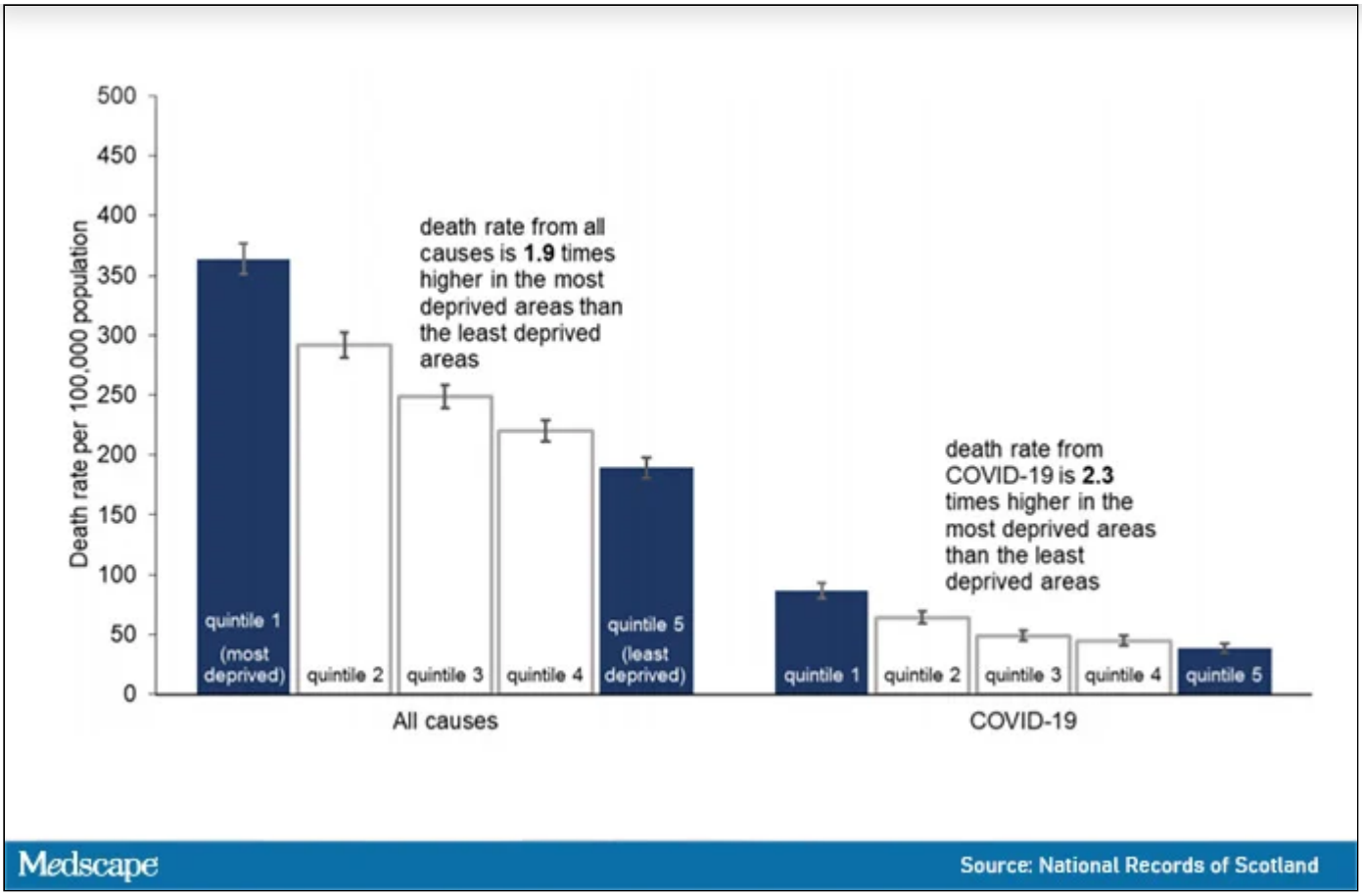
In Madrid, 37 neighborhoods are seeing the highest incidence, four times the average in the rest of Spain. These areas have common factors: They are poorer, denser, and have a large immigrant population.

Previous research suggests that although social distancing during the 2009 H1N1 pandemic was successful in reducing infections, the effect was most pronounced in households with greater socioeconomic advantage. Similar findings are emerging for COVID-19.



COVID-19 could now be endemic in some parts of England that combine severe deprivation; poor housing; and large Black, Asian, and minority ethnic communities. National lockdown had little effect in reducing the level of infections in these parts of the north of England.

A real overlap in the causes of mortality and deprivation can be seen in the figure below. Data from Scotland demonstrate that the age-standardized rate of deaths involving COVID-19 in the most deprived quintile was more than double (2.3 times higher) that of the least deprived quintile.



In summary, the disproportionate impact of COVID-19 on households living in poverty, and the racial and ethnic disparities observed in many countries, emphasize the need to urgently update our definition of "vulnerable" populations for COVID-19 and address these inequities.

These include social and income protection and support to ensure that low-paid, nonsalaried, and contract workers, who typically are without any guarantee of a minimum number of work hours, can afford to follow isolation and quarantine recommendations. Provision of protective equipment for workplaces and community settings is also essential.

The viral load peak that occurs early in the disease course indicates that preventing continuing transmission requires immediate self-isolation with symptom onset (for a minimum of 5 days). Patient education should prioritize isolation practices, and policies should include supported isolation.

There are many things that could be done within families to decrease transmission. We need to provide clear instructions and means of support to enable those with symptoms or positive tests and their contacts to isolate.

Policymakers and health experts can help the public differentiate between lower-risk and higher-risk activities, and environments and public health messages could convey a spectrum of risk to the public to support engagement in alternatives for safer interaction.

Without clear public health communication about risk, individuals may fixate on unlikely sources of transmission — outdoor activities — while undervaluing higher-risk settings, such as family and friend gatherings and indoor settings. So the advice has to be clear and in line with transmission dynamics. Avoid crowded, indoor, poorly ventilated environments. Spend more time outdoors. Maintain your distance (more is better but 6 feet is not a panacea). Improve ventilation: Open windows and doors. Wear a mask indoors. Wash hands.

Some high-risk settings like nursing homes, prisons, shelters, and meatpacking plants will require public health strategies tailored to those specific environments. This will need to include personal protective equipment and routine testing to identify infected individuals early in the disease course.

Muge Cevik, MD, MSc, is a clinician and researcher in infectious diseases and medical virology at the University of St. Andrews. Her research interests focus on HIV, tuberculosis, viral hepatitis, emerging infections, and tropical infections in low- and middle-income countries. During the COVID-19 pandemic, in addition to working on the front lines of the response, she provided scientific input to the chief medical officer for Scotland, and provides expert input to the WHO Information Network for Epidemics about the COVID-19–related infodemic.

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