



GeoHealth

Supporting Information for

Risk analysis of COVID-19 infections in Kolkata Metropolitan City: A GIS-based study and policy implications

Bibhash Nath^{1*}, Santanu Majumder², Jayanta Sen³, Mohammad Mahmudur Rahman⁴

¹ Department of Geography, Hunter College of the City University of New York, NY 10021, USA

² Formerly at Department Geology & Geophysics, Texas A&M University, College Station, TX
77843, USA

³ Department of Economics, West Bengal State University, Kolkata, West Bengal

⁴ Global Centre for Environmental Remediation (GCER), Faculty of Science, The University of
Newcastle, Callaghan, NSW 2308, Australia

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Intervention strategies

We have created a ward wise predominance map based on the ranks of four intervention criteria to show which of these criteria has the highest intra-ward rankings. For example, if a ward has the social distancing rank of 136, susceptibility rank of 123, social awareness rank of 105, and health & hygiene rank of 70 then social distancing is the predominant category based on the highest rank value. We also calculated the strength of this predominant category using rank difference of two highest rank values and percentage total of rank values. Higher the percentage total rank value and/or the rank difference the more predominant the category would be. This map was created to determine the intervention category that would be better suited for different KMC wards during the current cycle of COVID-19 infections.

A rank based 'predominance map' was created to find out what intervention approach should be followed in the hard hit wards (Figure S5). The degree and/or strength of the predominance are highly dependent on how large is the rank difference and how high is the percent total of rank value. The data revealed that 4 out of 15 hard hit wards (ward no. 71, 72, 73 and 82) have all intervention criteria ranked almost equally. This suggests that multiple intervention objectives should be fulfilled to control virus transmission. While three criteria are equally important in 4 wards (ward no. 7, 85, 86 and 94), and two criteria are equally important in 4 wards (ward no. 13, 63, 74 and 76). Two criteria are equally important in 2 wards (ward no. 68 and 70), however, ward no. 33 has a dominant intervention criterion of social awareness. This suggests that other than ward no. 33, multiple risk factors have contributed to the observed intense controlling measures (greater 1 containment zones per 1,000 population) in these hard hit KMC wards.

It is important for the policy makers to adopt and choose priority planning programs based on the degree of different risk factors. For example, if a ward ranked largest based on social distancing index, the planners could implement strict social distancing guidelines by restricting large gatherings that could lead to higher human to human interactions and transmission of the disease. Assistance to those underprivileged populations in the form of subsidy and/or financial packages during the pandemic would help ease their financial burden, because certain occupations pose greater risks of COVID-19 infections, especially those that live in overcrowded

places (Mejia and Cha, 2020). Highly subsidized health care facilities could be made available to the highest priority wards with higher percentage of BPL households to help deal with COVID-19 infections.

The West Bengal State Government has taken various policy decisions to control the transmission of the virus by encouraging people to stay at home isolation and made thousands of containment zones. Free rations have been provided to the poor, migrant workers and homeless people and that would be available freely till June, 2021. In addition to that special focus have been on shelter homes to avoid transmission of disease due to lack of physical distancing. Temporary shelter homes have been made available to the homeless sleeping on the street. Free mask and hand sanitizers have been distributed to the poor, including teaching social distancing protocols. Even with such strong initiatives it is still difficult to contain the virus, perhaps due to lack of people's awareness and reluctant to follow social distancing guidelines as recommended by the administration. COVID-19 pandemic is new and it will take time to adopt the new measures such as social distancing and hand hygiene, so community involvement and educating people are most important to reduce the spread of the virus. A simple mistake in terms of taking adequate precautions and proper cough etiquette could be deadly. Allowing strangers and/or visiting friends would also pose a greater risk to your health (Doolittle, 2020).

At the current stage of the pandemic, the best application of our research may be in the ensuing vaccination drive against further COVID-19 infections. The time demands now to open the economy to the maximum level which needs more intensive vaccination of the labor force, both organized and unorganized sectors apart from frontline workers. Unless we vaccinate the population to the level deemed safe in terms of epidemiological perspectives, the virus will remain highly potent. This would increase the chance of a second wave or an emergence of a new mutant strain since we know that the 'virus is mutating, but very slowly'. The emergence of a new virus strain may be more contagious and may have greater transmission power than the current strain. So the question is how vaccination will be done on the priority basis across locational units. Our work on optimized rankings including identification of susceptible populations (e.g., high susceptibility ranks) in different wards in Kolkata Metropolitan City would no doubt help the government to sketch- out a proper vaccination drive.

Supporting Figures

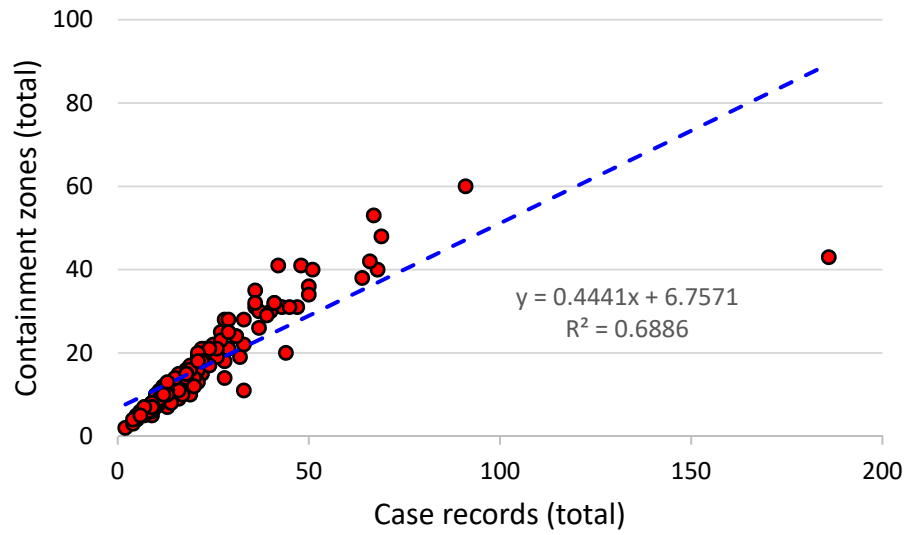


Figure S1. Correlation between ward wise total containment zones and total COVID-19 case records.

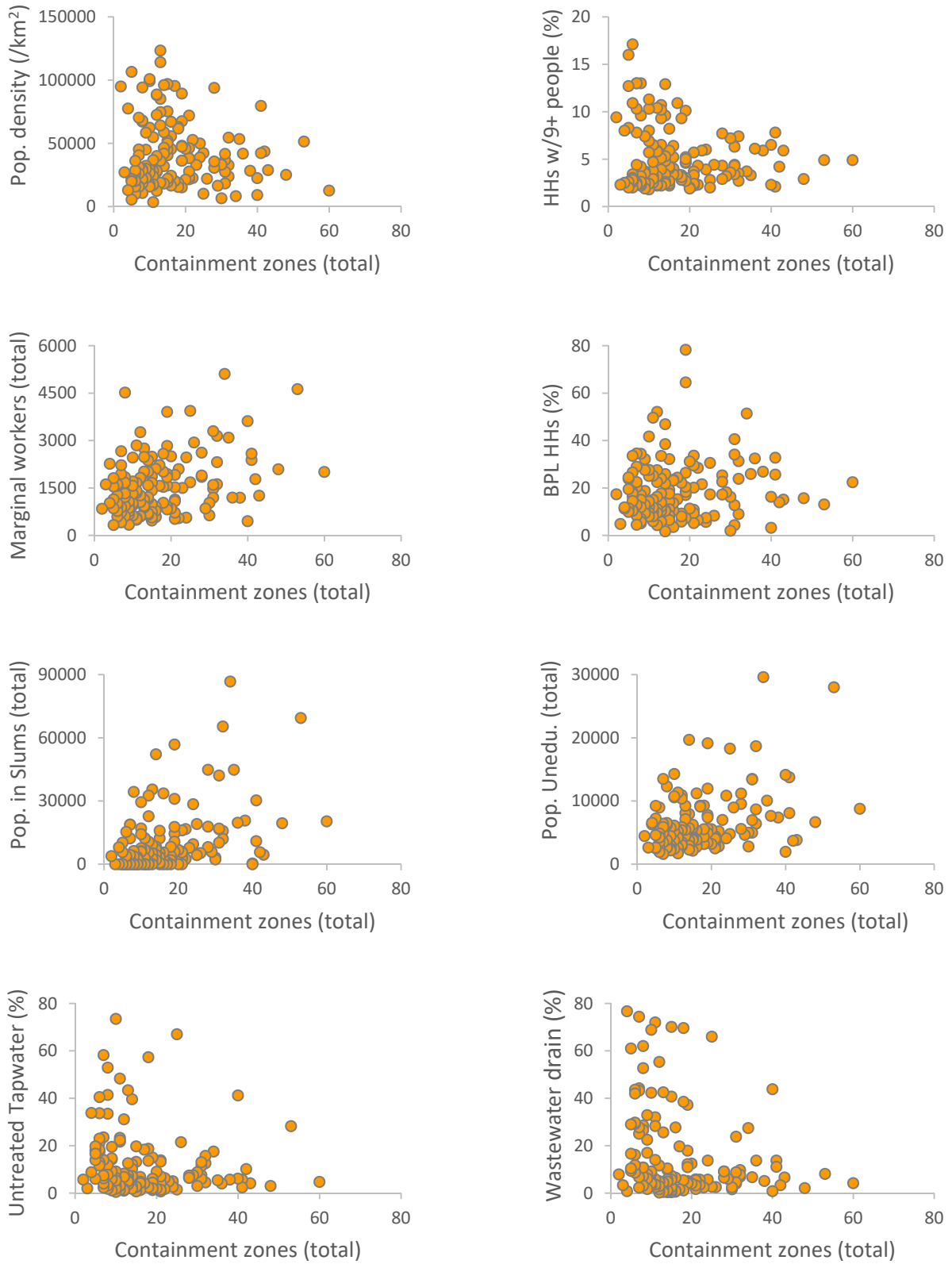


Figure S2. Relationship between demographic characteristics and total containment zones in different wards of Kolkata Municipal Corporation.

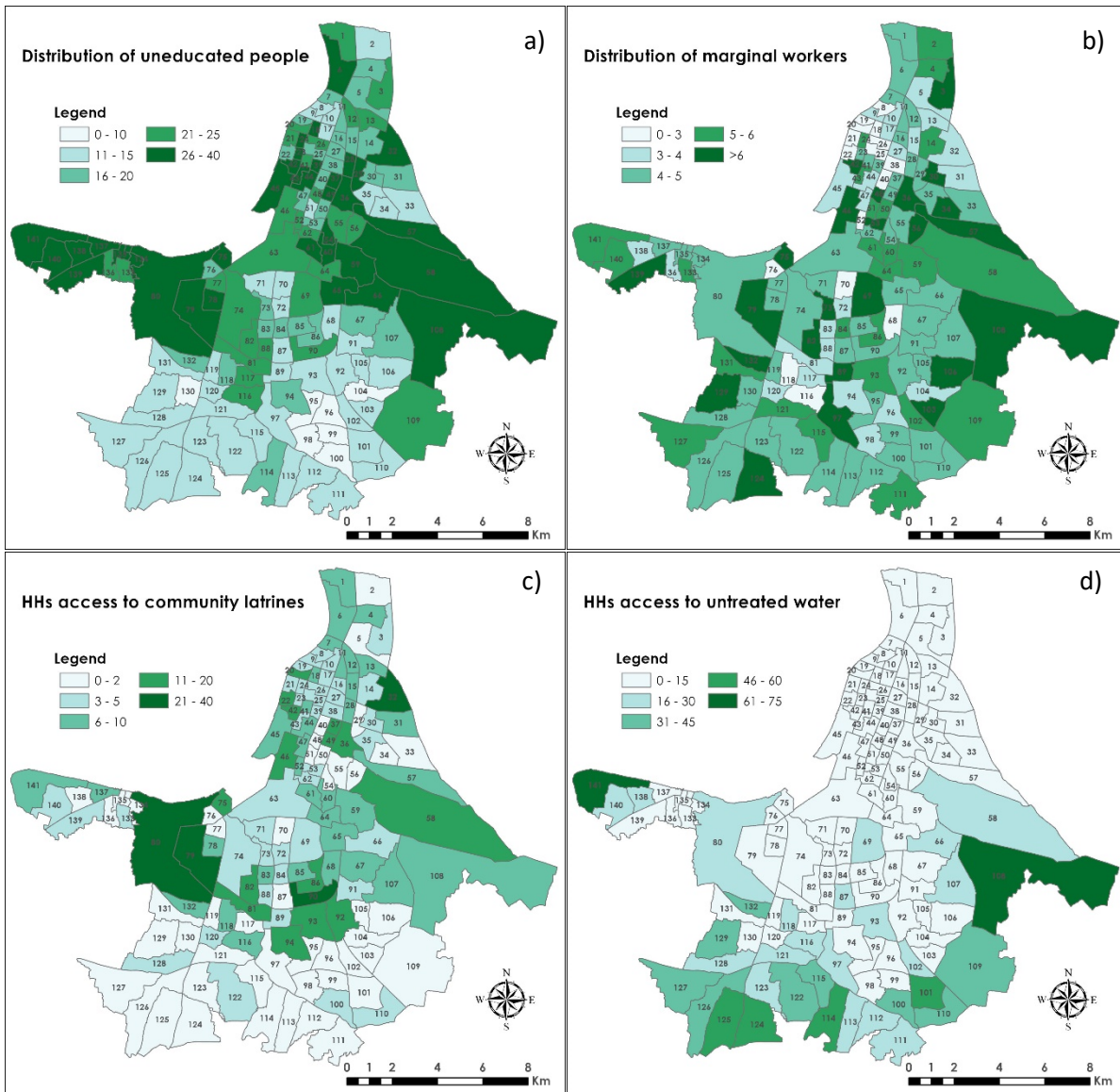


Figure S3. Ward wise distribution of demographic characteristics: a) Percentage of uneducated population, b) Percentage of marginal workers, c) Percentage of household's access to community latrine, and d) Percentage of household's access to untreated water, in Kolkata Municipal Corporation (KMC).

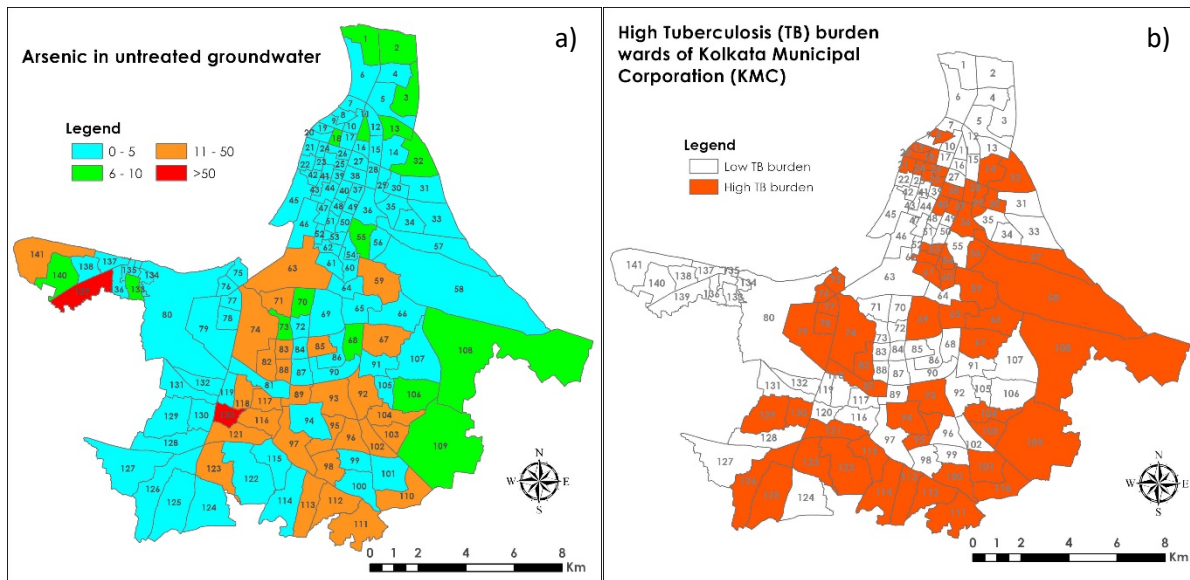


Figure S4. Map showing: a) Arsenic concentration (average; $\mu\text{g/l}$) in untreated groundwater (modified after Chakraborti et al., 2017), and b) High Tuberculosis (TB) burden (modified after Dey et al., 2019) in KMC wards.

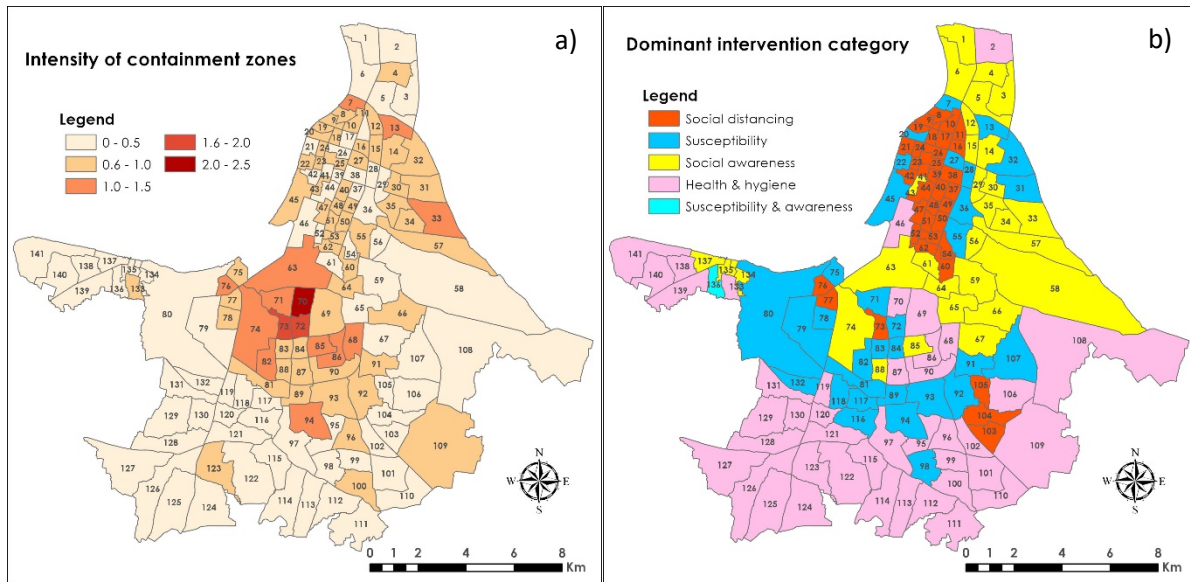


Figure S5. Comparison of the: a) Distribution of hard hit areas within the KMC, and b) Dominant category of COVID-19 intervention criterion. The strength of predominance category depends on the percent total and/or rank difference.

Supporting Table

Table S1. Spearman's rank correlation coefficient (r_R) of different indices in the 'optimized prevention ranks' for different formulations.

Indices	Formulation a	Formulation b	Formulation c	Formulation d
Social Distancing	0.73	0.56	0.64	0.50
Social Awareness	0.86	0.96	0.92	0.79
Susceptibility	0.57	0.60	0.59	0.66
Health & Hygiene	-0.08	-0.06	-0.07	0.28

The weights used are as follows: Formulation – a) 0.5, 0.3, 0.1, 0.1; b) 0.3, 0.5, 0.1, 0.1; c) 0.4, 0.4, 0.1, 0.1; and d) 0.25, 0.25, 0.25, 0.25, respectively for social distancing, social awareness, susceptibility, and health & hygiene.

References

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