



**Article title:** COVID-19 and Informal Settlements - Implications for Water, Sanitation and Health in India and Indonesia

**Authors:** priti parikh[1], Yasmin Bou Karim[2], Jacob Paulose[3], Professor Pam Factor-Litvak[4], Dr. Emily Nix[5], Dr. Dewi Nur Aisyah[6], Hemant Chaturvedi[7], Dr. Logan Manikam[8], Professor Monica Lakhanpaul[9]

**Affiliations:** UCL, Engineering for International Development Centre, Civil, Environmental and Geomatic Engineering[1], Aceso Global Health Consultants Limited[2], UCL, Institute for Environmental Design and Engineering[3], Department of Epidemiology, Columbia University[4], Indonesia One Health University Network[5], Aceso Global Health Consultants Limited, India[6], Population, Policy and Practice, UCL Great Ormond Street Institute of Child Health[7]

**Orcid ids:** 0000-0002-1086-4190[1]

**Contact e-mail:** priti.parikh@ucl.ac.uk

**License information:** This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY) 4.0 <https://creativecommons.org/licenses/by/4.0/>, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

**Preprint statement:** This article is a preprint and has not been peer-reviewed, under consideration and submitted to UCL Open: Environment Preprint for open peer review.

**Funder:** Submission on behalf of Childhood Infections & Pollution (CHIP) Consortium

**DOI:** 10.14324/111.444/000036.v1

**Preprint first posted online:** 02 June 2020

**Keywords:** COVID-19, WASH, Informal settlements, India, Indonesia, infection pathways, Water, The Environment, Policy and law

## **COVID-19 and Informal Settlements - Implications for Water, Sanitation and Health in India and Indonesia**

Priti Parikh\*, Yasmin Bou Karim, Jacob Paulose, Pam Factor-Litvak, Emily Nix, Dewi Nur Aisyah, Hemant Chaturvedi, Logan Manikam and Monica Lakhanpaul on behalf of the Childhood Infections & Pollution (CHIP) Consortium

### **Abstract:**

Informal settlements are home to over one billion people worldwide and are characterised by high population densities and poor environmental conditions. The authors identify the impact of COVID-19 on existing water and sanitation practices and potential pathways for transmission of COVID-19 in informal settlements in India and Indonesia. In the short term, there is an urgent need for mobile hand washing, washing/bathing facilities and toilets. In the long term, COVID-19 provides an opportunity to invest in centralised water and sanitation networked solutions appropriated for high-density settings to integrate those settlements into the city, improve environmental conditions and health in cities.

### **Paper:**

The Influenza pandemic of 1918 (Spanish flu) is considered to be the most lethal pandemic of the twentieth century. It resulted in the largest number of deaths in single countries; high mortality rates were seen in Indonesia and circa 10-20 million fatalities were reported in India<sup>1</sup>. At the time, vaccines, in combination with social measures at the individual, household and societal levels, proved to be effective public health interventions<sup>1</sup>. Years later, COVID-19 poses a similar challenge globally, but the highly contagious nature of the disease and no currently available vaccine requires stringent physical distancing measures, with particular challenges in overcrowded areas.

The ongoing urbanisation and industrialisation processes have contributed to a rapid increase in the number of informal settlements worldwide. These settings are characterised by high population densities and poor environmental conditions and are home to over one billion people today<sup>2</sup>. Residents of overcrowded spaces are also at a higher risk of infections and disease outbreaks<sup>3</sup>. In light of the COVID-19 pandemic, contextualization of interventions to contain the incidence of infections is important. In areas where overcrowding is the norm and access to outdoor space is limited, adherence to key public health messaging on physical distancing and handwashing is challenging, as individual sanitation facilities are virtually non-existent and access to clean water and soap is limited. Measures implemented in mainstream cities are therefore difficult to apply to unplanned high-density informal settlements<sup>4</sup>.

The authors are members of the Childhood Infections and Pollution (CHIP) Consortium aimed at reducing infection and antimicrobial resistance amongst children under five in slums. In 2019, the consortium used tools such as transect walks and focus group discussions to understand pre-pandemic WASH challenges in two settlements in India and Indonesia. Building on this and through consultations with in-country consortium members during the pandemic, this paper identifies the impact of COVID-19 on existing WASH practices and potential pathways for transmission of COVID-19 in these slum areas (see Figure 1).

During the COVID outbreak, India has been under a stringent lockdown where people's movements have been restricted to essential outings. In informal settlements, however, women are typically responsible for water collection and waste disposal, which requires them

to frequently leave their homes, as very few dwellings have water connections. These communal points for water collection create additional high-risk transmission pathways, given personal protective equipment (PPE) are not available. In our observational work, we did not see evidence of the water being stored in clean containers, a risk for household transmission of COVID-19 poses to the elderly and vulnerable in households where multiple generations live together. Beyond that, leakages in pipes normally result in contamination of water sources; water buckets are not cleaned regularly; and standing in long queues for water collection in narrow lanes is not usually accompanied by physical distancing, all of which could lead to further transmission risks.

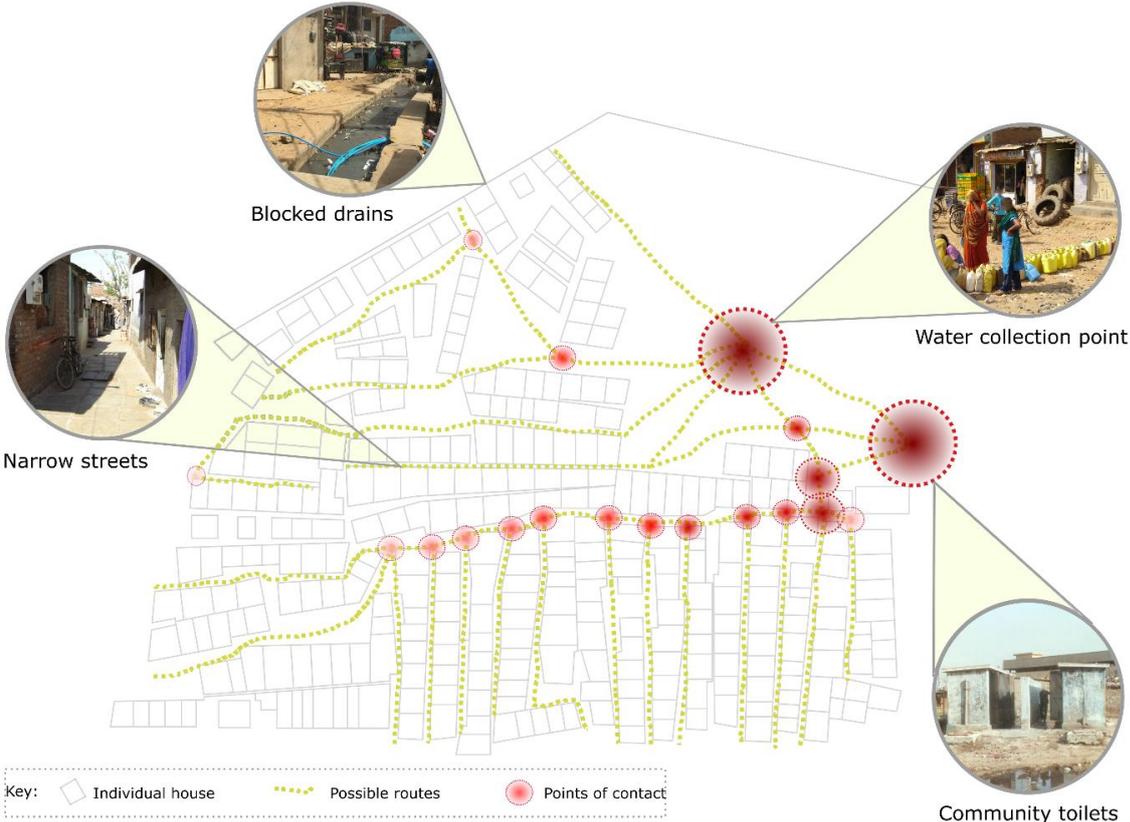


Figure 1: Illustrative representation of potential COVID-19 transmission pathways in slums in India and Indonesia

The majority of residents also practice defecation in open fields, rivers and water streams within or nearby their communities with limited scope for physical distancing and hand washing/appropriate hygiene measures. Open drains in these settlements are often blocked with solid waste and effluents and as the workers who are typically responsible for maintaining the drains are reluctant to come into the communities during the lockdown, hence deteriorating conditions and higher levels of risk to other infectious diseases are on the horizon. Early evidence suggests traces of COVID-19 virus have been found in the faeces of some patients diagnosed with COVID-19 as well as in untreated wastewater<sup>5</sup>. It is premature to tell the impact of exposure to human faeces and wastewater; however, it could result in added risk for COVID infections.

The first line of defence during the current pandemic is handwashing with soap but in most of the homes visited in our work, soap was not available or, if available, it was not used frequently to wash hands. Some of the households were also reliant on public toilets. Women who use public toilets not only take the risk of enhanced exposure to COVID due to the toilets and associated surfaces being dirty and close physical proximity to other users. Women using

public toilets are often subject to violence which influences how frequently they use those facilities<sup>6</sup>. This can significantly impact their health with those risks further exacerbated during the pandemic.

In contrast to India, Indonesia has taken a more pragmatic approach to COVID-19 by practicing large-scale limitations of mobility instead of a full lockdown. In Indonesian slums, women normally purchase water from traveling vendors who carry water gallons in a wheelbarrow. During the pandemic, this activity continues, even though most vendors do not wear masks and PPE. This has led to an added risk of transmission in these communities. Those who walk to shops to place orders with water vendors are unable to practice physical distancing due to space constraints, intensifying the pathways of human to human transmission. Whilst everyone is urged to wash their hands with water and soap there is a lack of specific governmental WASH interventions targeting informal settlements. For that reason, local leaders have initiated and created additional handwashing facilities near communal areas such as communal washing areas, communal toilets, markets and places of worship.

Most of the households in Indonesian settlements use communal public toilets, as well as communal bathing and washing facilities. Given the space constraints and the number of people sharing the same spaces (in many places, over 20 families use the same facilities), it is challenging to practise physical distancing in those settings. Toilet guardians and cleaners usually do not wear masks or other PPE, leaving them highly vulnerable to infections. The situation in Indonesia is therefore somewhat similar to that of India, where public toilets pose a risk for added transmission of the disease.

In both countries, women carry the heavy burden of the lack of water and sanitation and risk added exposure to COVID-19 as a result of WASH-associated activities. Even though data indicates men suffer more virulent COVID-19 symptoms, to reduce transmission pathways for men it is essential to address the pathways which adversely affect women. This requires integrated gender inclusive planning interventions tailored to all.

In addition to existing vulnerabilities created by the lack of access to adequate water and sanitation services, seasonal factors and climate change also have a role to play. Settlements in India will face water shortages in summer, limiting the ability to wash hands. In both countries the flooding of water streams and rivers in rainy season will exacerbate solid and liquid waste contamination and result in higher incidence of communicable diseases, which will further reduce immunity of local populations and their ability to respond to and recover from COVID-19. There is therefore a need to combine COVID-19 mitigation measures with ongoing climate change mitigation and adaptation measures.

Moving forward, focussed and dedicated health studies in informal settlements will be required to ensure health and well-being of urban citizens, particularly in these settlements, as they are currently a hotbed of infections. Slum health studies will need to include factors such as population densities, faecal contamination, water logging, crowding, and hazards such as flooding and pollution<sup>3</sup>. Future monitoring and evaluation interventions will need to leverage existing social networks and use approaches such as citizen science combined with testing of water sources and testing of viral loading of wastewater.

The COVID pandemic has made even clearer the need for improving the infrastructure of informal settlements and implementation of contextualized public health interventions. In the short term, there is an urgent need for mobile hand washing facilities with soap at regular points through the settlement, ideally per household or if not feasible at street level, added distribution of soap and portable communal washing/bathing facilities and toilets, possibly using local community centres and schools. Additionally, water vendors, shopkeepers and sanitation workers need to be provided PPE both for their safety and the safety of others.

In the long term, radical changes are required in city planning, as informal settlements are currently bypassed from mainstream infrastructure interventions. Even in the pre-pandemic era slum residents perceive water and sanitation to be their top priority<sup>7</sup>. Hence, moving forward, targeted investment is required to improve access to water and sanitation services in settlements, as well as river/blue space cleaning and restoration activities. In fact, the high population density of such areas offers economies of scale, high returns to infrastructure investments and create healthy environments<sup>8</sup>.

COVID-19 provides an opportunity to invest in centralised water and sanitation networked solutions appropriated for high density settings. This would facilitate the integration of those settlements into the mainstream city, improve environmental conditions and health in cities. Since informal settlements provide the work force of cities - higher risks of transmission of infections in those communities also poses a risk for other parts of the city. That said, targeted environmental improvements will uplift the ability of cities to respond to pandemics and health of local populations with reduction in transmission pathways to infections.

### References:

1. Kant, L., & Guleria, R. (2018). Pandemic Flu, 1918: After hundred years, India is as vulnerable. *The Indian journal of medical research*, 147(3), 221–224. [https://doi.org/10.4103/ijmr.IJMR\\_407\\_18](https://doi.org/10.4103/ijmr.IJMR_407_18)
2. UNSTATs, <https://unstats.un.org/sdgs/report/2019/goal-11/>, Accessed 5 May 2020
3. Ezeh, A., Oyebode, O., Satterthwaite, D., Chen, Y.F., Ndugwa, R., Sartori, J., Mberu, B., Melendez-Torres, G.J., Haregu, T., Watson, S.I. and Caiaffa, W., 2017. The history, geography, and sociology of slums and the health problems of people who live in slums. *The lancet*, 389(10068), pp.547-558.
4. Wilkinson, A., 2020. Local response in health emergencies: key considerations for addressing the COVID-19 pandemic in informal urban settlements. *Environment and Urbanization*, p.0956247820922843.
6. CDC, 2020, <https://www.cdc.gov/coronavirus/2019-ncov/php/water.html>, Accessed 5 May 2020.
5. Belur, J., Parikh, P., Daruwalla, N., Joshi, R. and Fernandes, R., 2017. Perceptions of gender-based violence around public toilets in Mumbai slums. *International journal of comparative and applied criminal justice*, 41(1-2), pp.63-78.
7. Parikh, P., Parikh, H. and McRobie, A., 2012. The role of infrastructure in improving human settlements. *Proceedings of the Institution of Civil Engineers: Urban Design and Planning*, 166, pp.101-118.
8. Lilford, R.J., Oyebode, O., Satterthwaite, D., Melendez-Torres, G.J., Chen, Y.F., Mberu, B., Watson, S.I., Sartori, J., Ndugwa, R., Caiaffa, W. and Haregu, T., 2017. Improving the health and welfare of people who live in slums. *The lancet*, 389(10068), pp.559-570.

### Acknowledgements:

The authors are members of the Childhood Infections and Pollution (CHIP) Consortium aimed at reducing the infection & antimicrobial resistance amongst children under five in slums using a One Health (i.e. human, animal, environment) and technology-enabled citizen science approaches. The Consortium has undertaken work in urban slums in Jaipur, Jakarta & Antofagasta.

In addition to the authors, members of the CHIP Consortium consists of Prof Wiku Adisasmito, Shereen Al Laham, Dr Alexandra Albert, Dr Hector Altamirano-Medina, Anila Atin, Dr Neha Batura, Yebeen Ysabelle Boo, Meghan Cupp, Prof Rajib Dasgupta, Prof Keiji Fukuda, Julia Vila Guilera, Prof Muki Haklay, Dr Rebecca Katz, Dr Rajesh Khanna, Dr Sanweer Khatoon, Dr Nancy Leung, Dr Clare Llewelyn, Ria Marwaha, Chyntia Mayadewi, Natasha Mayandra, Dr Krishna Mohan, Dr Rintaro Mori, Dr Prejit, Prof Erika Ota, Dr Raj Panda, Prof Joseph Malik Peiris, Dr Mahen Perera, Satya Prakesh, Rajendra Prasad, Dr Obaidur Rahman, Dr Omar Risk, Dr Kaushik Sarkar, Sanjay Sharma, Radhika Sharma, Premraj Sharma, Mr Sandeep Soni, Dr Pradeep Srivastava & Dr Hein Min Tun. Organisations include; global universities (UCL, Columbia University, Georgetown University, University of Hong Kong, St Luke's University Tokyo, Public Health Foundation India, University of Antofagasta, Jawaharlal Nehru University, Rajasthan University of Veterinary & Animal Sciences) and NGOS (i.e. Save the Children India, PKPU Human Initiative, Jeevan Ashram Sanstha), private sector (Aceso Global Health Consultants Ltd), networks (India Center for One Health Education, Advocacy, Research and Training & Indonesia One Health University Network).

Consortium members had an opportunity to critically review results and contribute to the process of finalisation of this paper. The co-authors vouch for the accuracy and integrity of the work, and accept full responsibility for the content of the paper.

**Twitter**

Follow @Aceso\_GHC for CHIP Consortium updates.

Other twitter handles: @pritiparikh73