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Communication

Best Prepared, Worst Outcomes: Ethnicity, Structural Inequality and Pandemic Preparedness

Ji Soo Choi [1,2], Daniel Pan [1,2], Mi Joo Choi [1,2] and Julian W Tang [3,*]

1 Division of Epidemiology and Public Health, University of Leicester, Leicester LE1 7RH, UK
2 Department of Infectious Diseases and HIV Medicine, University Hospitals of Leicester NHS Trust, Leicester, LE1 5WW, UK
3 Clinical Microbiology, University Hospitals of Leicester NHS Trust, Leicester, LE1 5WW, UK
* Correspondence: julian.tang6@nhs.net; Tel.: +44-116-258-6516/3574; Fax: +44-116-255-1949

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Abstract: Pandemic preparedness has traditionally been assessed through technical capacity, yet COVID-19 revealed a persistent gap between preparedness on paper and outcomes in practice. This paper examines how structural inequalities, rather than scientific limitations, shaped transmission dynamics and mortality, arguing for a reframing of preparedness around equity and implementation. Drawing on epidemiological evidence, case studies, and policy analysis, we introduce the concept of "social niches" as key transmission engines: structurally defined environments (e.g., occupations, housing, mobility constraints) that concentrate exposure risk and connect otherwise separate contact networks. We show that disparities in COVID-19 outcomes were primarily driven by differential exposure rather than intrinsic biological susceptibility, with transmission amplified in high-contact, resource-constrained settings such as migrant worker housing, informal labour sectors, and care institutions. Early 'one-size-fits-all' pandemic response further magnified these effects, as delays in targeted interventions within high-risk groups led to widespread seeding across populations. We also highlight limitations in prevailing metrics, which prioritised laboratory and epidemiological indicators without sufficient integration of social context, leading to misaligned policy responses. We argue that preparedness frameworks must incorporate auditable equity metrics, disaggregated data, and operational strategies capable of reaching high-exposure populations. In conclusion, effective pandemic preparedness is defined not by assets alone, but by equitable reach and timely implementation. Embedding equity into preparedness planning is essential to prevent recurrent patterns of concentrated transmission and disproportionate impact in future pandemics.

Keywords: pandemic preparedness; health equity; social determinants of transmission

1. Introduction

On paper, the United States ranked among the world's most pandemic prepared nations. In practice, it experienced among the highest cumulative mortality and a historic fall in life expectancy [1,2]. This divergence reflects less a failure of science, but of systems implementation, coordination and policy that overlooked the social hierarchies which shapes exposure and harm. Marked inequalities, both within and between countries and global vulnerability to pandemics reinforced each other, which explains why advances in science continue to fail to keep the world safer from pandemics.

Susceptibility to pandemics, and their consequences, are determined not only by pathogens but also by socio-economic conditions, which shape who is most exposed to infection and, consequently, who is most likely to experience severe disease [3,4]. Ethnic minority populations bore a disproportionate burden of infection and death. Limited access to insurance and primary care, together with delays in diagnostics, PPE, and ventilation improvements further widened these disparities [5–8]. Similarly, public health communication often presumed broadband internet access, English fluency and familiarity with healthcare systems—assumptions that obscured those at greatest risk of being infected [1,9,10]. Cultural factors also affected how different populations reacted to the various pandemic restrictions, like masking, social distancing and self-isolation or self-quarantine; the degree of compliance with these measures depended on how much individuals valued their needs and liberties over those of their society [11–14].

Good plans for pandemic preparedness are therefore only half of the equation. The other half is the ability to translate plans into protection that can reach every community, especially those most exposed through work, housing, transport, immigration status, incarceration or unpaid sick leave. Current readiness metrics, whether national indices or operational checklists (including the WHO Operational Readiness Index), tend to prioritise technical assets (laboratories, stockpiles, emergency plans) over distributive capability and trust. They should, additionally, incorporate auditable indicators of equity (Figure 1), and explicitly assess whether policies address social vulnerabilities and disparities [11]. Pandemic preparedness during peacetime is most effective when those at highest risk are prioritised from the outset.

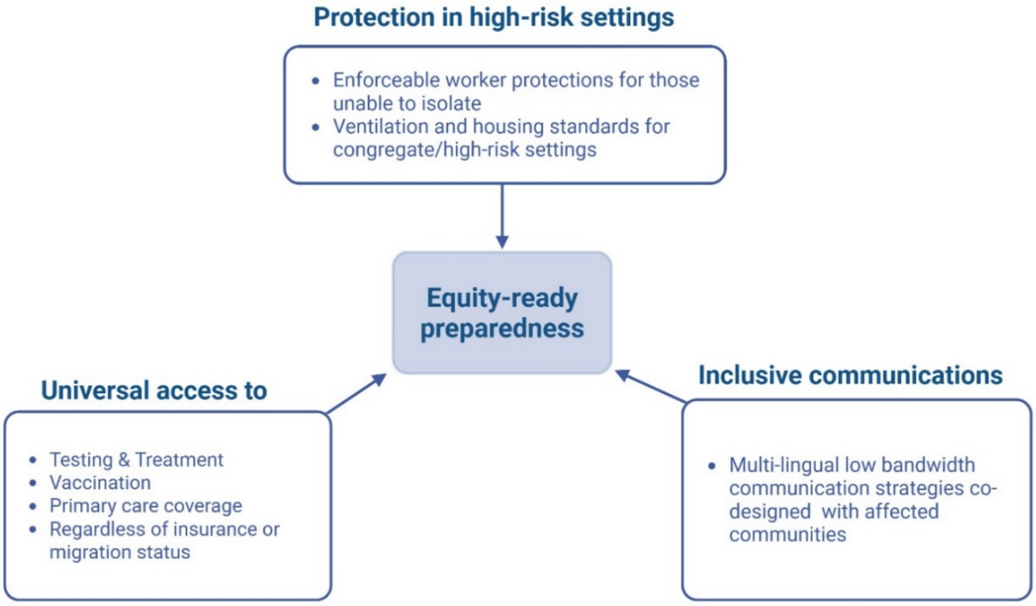

Figure 1. Auditable equity metrics for pandemic preparedness.

2. Social Niche as Transmission Engine

In the context of pandemic preparedness, we use social niche to describe a structurally derived micro-environment, typically defined by occupation, housing, mobility, or economic constraints, that links otherwise separate contact networks, and can designate those who may be at highest risk of being infected; such as public-facing and lower-wage occupations, those who are mainly indoors with limited ventilation, shared or overcrowded housing, employer-provided accommodation, high reliance on public transport; and settings where workers have low job security and limited access to sick pay.

The COVID-19 burden borne by marginalised communities was driven less by biological susceptibility than by context: where people lived, how they travelled, the conditions under which they worked, and whether they could afford to isolate [5,12,13]. Transmission clustered in such settings, concentrated in households (including multi-generational homes), and then spilled into wider community networks [14,15]. The same mechanisms operated across borders: within-country inequities amplified transmission, while global inequities shaped which populations could access protective measures.

Two widely observed examples illustrate such dynamics. In Singapore, early containment success was undermined by large outbreaks among migrant workers living in high-density dormitories and working in construction and industrial sites. By early May 2020, the overwhelming majority of reported cases were concentrated in dormitory residents [16]. The outbreak was eventually controlled through mass testing and targeted containment, but only after substantial spread in a niche that was structurally primed for transmission [16,17]. In the city of Leicester within the United Kingdom, prolonged restrictions were linked to ongoing illegal working during lockdown within the textile industry, where closed-door production took place in poorly ventilated factories with minimal capacity for distancing or masking [18]. Importantly, where workers lacked formal protections and did not qualify for income support, adherence with pandemic restrictions became financially impractical [19,20]. These examples demonstrate the predictable outcome of preparedness strategies that treat organisational capacity as sufficient while leaving high-exposure social niches unprotected.

Another further example is when ethnic minority groups were identified to be disproportionately affected during the pandemic. Two large meta-analyses [4,8], conducted at two different times during the pandemic demonstrated that globally, disproportionately worse clinical outcomes from COVID-19 in ethnic minority groups, compared to majority groups was consistently driven by a higher risk of infection, and not by increased mortality (pooled adjusted risk ratio for infection for Asians: 1.50, 95% confidence interval [CI]: 1.24–1.83; pooled adjusted risk ratio for Black: 1.85, 95% CI: 1.46–2.35 in 2020; and pooled adjusted risk ratio for infection in South Asians: 3.00, 95% CI: 1.59–5.66 and for Black: 1.78, 95% CI: 1.59–1.99 in 2022).

Factors associated with exposure to respiratory infections can often be different to factors that contribute to developing severe disease following infection [13]. Structural conditions such as income, housing density, occupational control, and access to paid leave strongly shape exposure, while age, comorbidity, and healthcare access contribute to severity once infected [21]. These domains overlap: the same structural disadvantage that increases exposure can also increase chronic disease burden and barriers to care. However, in the early phase of a pandemic, the speed and scale of spread were often determined disproportionately by exposure concentration in high-contact settings. This is why preparedness must be assessed not only by technical readiness, but also by the ability to deliver risk-reducing interventions into high-exposure niches rapidly and at scale.

One example where all these factors came together is within care homes for the elderly, which are common in Western developed countries, and represent a specific vulnerability in any pandemic or other outbreak situation. High concentrations of older individuals with multiple chronic diseases makes them particularly vulnerable to a rapidly spreading infectious agent. A shortage of laboratory reagents led to elderly patients being discharged from hospitals back to their residential homes without being able to check for viral clearance [22]. A lack of community testing capacity in the early part of the pandemic also underestimated the amount of virus circulating in the community [23], which allowed well-intentioned visitors to such care homes to further spread the virus amongst this vulnerable population [24]. Other institutionalised care centres, such as hospices, were also unaware of rising incidence in their staff and patients until mass testing was initiated, which allowed effective interventions to be implemented [25].

Finally, focus on biological explanations for disparities risks mis-specifying the policy response. While biological heterogeneity may exist, the dominant drivers of observed inequities during COVID-19 were consistently aligned with differential exposure, occupational constraint, housing conditions, and access barriers, factors that are actionable through public health and social policy. A preparedness framework that does not explicitly map and protect these niches will repeatedly reproduce the same pattern; concentrated spread in structurally exposed groups, followed by population-wide consequences [5,16–26].

3. Timing: Why the First Weeks Matter

The first weeks of a pandemic set its trajectory. Transmission accelerates exponentially within the first few weeks (depending on the pathogen's incubation period and duration of transmissibility), leaving only a brief window in which early action can prevent widespread seeding across workplaces and households [26,27]. Evidence from UK counterfactual timing modelling by Arnold and colleagues suggests that introducing social distancing and lockdown one week earlier was associated with an estimated 74% reduction in cumulative laboratory-confirmed cases (and around 93% reduction with implementation two weeks earlier), highlighting how minor delays in the initial phase can translate into large downstream epidemic burdens [28]. Therefore, measures calibrated to the 'average' majority population risk leaving those at greatest exposure (e.g., bus drivers) unprotected precisely when appropriate interventions can be most effective [29,30]. High levels of such inequalities make the population more vulnerable to pandemics, potentially increasing their duration and socio-economic disruption [30,31].

An equity-first model must be operational from the outset, anticipating: structural drivers, occupational risk, housing density, ethnic group and access barriers—to develop responses around them [14]. Mathematical modelling of outbreak data routinely incorporate age, sex and comorbidity. They should, from the start, also integrate the social determinants of health and be supported by routine, high quality disaggregated data. Designing for inclusion under plausible "worst-case scenarios" will help to protect the most vulnerable, preserve healthcare capacity, safeguard essential workers and shorten socio-economic disruption.

Workers in the insecure, high-risk, gig economy (food delivery, taxi drivers, freelance workers in: online tasks, hospitality, childcare, plumbing, electrician, construction, etc.), where there are no benefits, pension contributions, or contracted hours, where payment is often upon delivery, played a complex role in the pandemic [31–33]. From one perspective, they became essential workers, for food and parcel deliveries during lockdown, and the use of taxis as an alternative to the higher risk public transport. Yet, they were another potential vectors to propagate transmission further. Many gig workers may have had more formal contracted jobs prior to the pandemic, but many chose to leave or were released from those jobs as the economy contracted. However, the lack or regulation or control of this worker population also allowed its flexibility, enabling such workers to fill essential niches during a time of crisis.

4. From Metrics to Meaning: Aligning Evidence with Transmission Risk

Pandemic decisions hinge on interpretation as much as measurement. During COVID-19, policy-makers often relied on epidemiological and laboratory metrics, such as basic reproductive number (R_0), PCR and lateral flow (rapid antigen) assay positivity rates, as direct proxies for transmission rates and infectiousness without adequate context and/or understanding of their limitations [34]. Yet, during the early part of a pandemic (before the development of effective vaccines and antivirals) onward transmission depends not only on viable virus, but on emission (dose and duration of particles released), exposure intensity, contact networks and behaviours, and the presence, or absence of non-pharmaceutical interventions [34,35]. Evidence for developing policy-making must connect the virology to the relevant community context, so that decisions reflect true transmission risk [36].

At population level, similar interpretative gaps were evident [37]. Early reports of low mortality in some countries reflected limited testing rather than true incidence, with subsequent data on excess mortality later revealing the unseen toll [38]. The opposite can also be true. The UK often attributed lower early COVID-19 case numbers in some South-East Asian countries to more extensive testing and contact tracing. This framing overlooked the rapid, widespread uptake of voluntary masking, which likely also contributed to reduced transmission, resulting in fewer cases in the community that could be more easily identified and isolated without impacting too much on the wider society.

There may also be some degree of inertia within developed countries with little experience of infectious diseases outbreaks to follow other countries' examples [39–41]. Reliable situational awareness of how the virus is spreading requires a careful examination of indicators which are less sensitive to testing variation, including hospital occupancy, intensive care capacity and utilisation, the level of illness in care homes, and wastewater surveillance, etc., interpreted within the relevant social and clinical context [2].

One of the main arenas for these debates concerned whether SARS-CoV-2 was transmitted via aerosols and whether masking, in any form, could reduce infection risk [42,43]. Much of this played out at a technical level, with scientists disputing the strength and nature of the evidence and governments and infection control teams weighing whether to revise guidance as the pandemic evolved, including at the World Health Organization (WHO). At the same time, these debates had immediate practical implications for the public, shaping everyday decisions about masking and physical distancing [44]. In countries with recent experience of major respiratory outbreaks—particularly in East and Southeast Asia, shaped by SARS-CoV-1 and avian influenza—people responded quickly, with widespread voluntary masking early in the pandemic [45,46]. Other populations in Western countries that had no experience of such infectious agents were more hesitant to adopt such behaviours and instead argued more intensely about their effectiveness [47,48]. Several factors likely shaped these responses. First, direct experience of prior outbreaks—or the absence of it—may have influenced how seriously populations perceived the risk. Second, trust in government guidance mattered: where trust was high, people were more likely to follow official advice irrespective of ongoing scientific debate. Third, access to information, including the ability to review and compare guidance online, may have affected behaviour. In some settings, including parts of South America, lower trust in national authorities appeared to shift reliance towards WHO recommendations rather than domestic guidance [49]. To some extent, here, the inequalities are more political, i.e., relating to the levels of government trust which varies substantially between countries (likely based on their differing historical experiences); the level of access to searchable internet websites that can help people decide on what to do; and the presence and availability of local trusted experts who are willing and able to share their expertise—without fear of reprisals if these contradict the local government advice.

5. Conclusions beyond COVID-19 Redefining Pandemic Preparedness

The next pandemic will highlight the same structural weaknesses. If equity remains optional rather than operational, the paradox of "best prepared, worst outcomes" will recur. National frameworks must integrate social vulnerability as a core metric of readiness. The World Health Organisation's emerging framework recognises the importance of equity in relation to pandemic preparedness; especially the disproportionate harms can arise from entrenched racism and racial discrimination, producing health inequities that persist across the life course and generations [50]. The framework emphasises stratifying inequalities by infection risk status (thus recognising the disproportionate higher risks of exposure seen in some ethnic groups) and across societal, community and individual levels. Additionally, the Global Council on Inequality, AIDS and Pandemics, has published a report which identifies clear links between high levels of inequality and disease outbreaks turning into pandemics. Inequalities make pandemics more economically disruptive, deadly and more prolonged; in turn, pandemics increase inequality, thereby fuelling a 'cyclical self-reinforcing relation' that has played out during COVID-19 as well as with AIDS, Ebola, influenza, mpox and other disease outbreaks [51].

In summary, equity cannot be retrofitted once a pandemic begins, it must be built in during peacetime. A truly prepared healthcare system is one that safeguards its most exposed first. Preparedness is not a matter of assets but of reach, i.e., the ability to deliver protection with equity and speed.

Author Contributions

J.S.C. and D.P.: conceptualization, methodology, writing and original draft preparation; M.J.C.: writing, reviewing and editing; J.W.T.: conceptualization, supervision, writing, reviewing and editing. All authors have read and agreed to the published version of the manuscript and accept responsibility for the integrity and accuracy of the work.

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