

Learning from COVID-19 and planning post-pandemic cities to reduce pathogen transmission pathways.

With vaccination on its way globally – though at different speeds – but with the continuous emergence of new variants, the COVID-19 pandemic is at a turning point. While significant health and socio-economic challenges will still continue to be posed in the coming years (Iftekhar et al., 2021), the transition towards the post-pandemic city is approaching combined with other agendas, including economic recovery, inclusion, and decarbonisation. Undoubtedly, we will have to learn to live with coronavirus and possibly new pandemic episodes (*ibid*; Mackensie, 2020). As such, the COVID-19 pandemic has constituted a planning inflection point (Dockerill et al., 2021) during which existing approaches to urban development have been questioned and will continue to be as local and national governments, employers and city residents continue to adapt. Such approaches have differed from one country and one place to another highlighting severe discrepancies in approaches towards virus prevention and containment along with individual behaviours, all of which are highly path-dependent of existing cultures (e.g. car use), urban structures and planning systems. Processes that were already transforming cities (e.g. e-commerce , homeworking and temporary transformations of spaces – either vacant or outdoor _ for example streets, pavements and parks) have been accelerated (Bryson et al., 2021; Andres et al., 2021, Brail, 2021, Florida et al., 2021). These processes of pandemic-related urban transformation will lead to alterations in approaches to planning, property development and living and working in cities. Some adaptations will be permanent, others more temporary. Research is still required in this area to inform policy and hence allow appropriate responses to these accelerated changes and their consequences.

While cities and societies are expected to progressively move forward and for some more quickly bounce back from the pandemic through various trajectories, this paper argues that it is important to learn from such an unprecedented health crisis to enhance urban resilience and preparedness for future crises (which includes the climate emergency). From a planning perspective, this is about connecting even further urban management and development with health-led considerations. It is critical that urban planning is based on an appreciation of the complex interrelationships between buildings, streetscapes, human health, and multiple agents of disease. This means also including an understanding of the relationships between health and the location and design of specific buildings including the social, economic, and cultural characteristics of occupants. Ongoing and sustained dialogues amongst planning practitioners and educators, along with other built environment experts (particularly architects), need to develop to enable the identification of approaches for reducing pathogen transmission pathways; this is part of an integrated approach to ‘healthy urbanisms’ that also enhances mental and physical wellbeing and the overall quality of urban life. Developing solutions to address the diversity and inclusivity challenges facing cities has become increasingly important as the pandemic has highlighted the persistence of urban health inequalities (Marmot et al., 2020).

This paper begins by reiterating how the COVID-19 pandemic has challenged existing approaches towards health in cities. The focus then shifts to explore the areas that require attention from urban planners and built environment experts and then finally discusses the development of an integrated approach towards healthy urbanisms in the post-pandemic context.

How has COVID-19 challenged approaches towards health in cities?

COVID-19 returned biological risk management (BRM) in urban environments to the planning agenda. It made apparent that current approaches to planning facilitate respiratory virus transmission requiring dramatic response mechanisms, including lockdowns and/or closure of public work/leisure environments, with long-term health and socio-economic impacts. Urban planning, and the neo-liberal development process, has focused on land use intensification increasing urban density (Webster, 2021). The emphasis was on building smaller residential units in response to high land values, making homeworking difficult, combined with open plan offices and overcrowded public transport systems. It has exacerbated further existing socio-economic inequalities, revealing a strong correlation between the size of individuals' and households' living spaces (Hubbard et al., 2021), access to green spaces (Ahmadpoor and Shahab, 2021), virus transmission and well-being (Otchere-Darko, 2021).

Planning and health have always been intrinsically linked. Since antiquity to 1880, miasma theory assumed that epidemics were explained by exposure to polluted air. In environmental medicine ventilation was one solution. Miasma theory was displaced by germ theory as it was appreciated that pathogens caused specific diseases. The Lancet-UCL Health Commission noted that the urban health penalty had shifted to become an urban advantage (Rydin et al., 2012) as “degenerative diseases and anthropogenic disorders” displaced “infections as the main causes of mortality and disease” (*ibid*, 2082). COVID-19 has returned infectious diseases to the centre of urban debates. The compact city agenda comes with increased opportunities for social interactions and cross-species transmission (CST), including coronavirus transmission (Dietz et al. 2020). The COVID-19 pandemic highlights the need to develop new solutions for reducing opportunities for respiratory tract pathogen transmission based on the spread of viral loaded droplets. This involves limiting the propagation of new and existing pathogens including influenza and measles combined with enhancing well-being amongst urban residents. The risk of aerosol transmission is related to proximity, environmental contamination and these influence the viral dose that is transmitted. Most pathogenic agents transmitted within aerosol droplets do not survive for extended periods; with a secondary issue being fomite transmission.

We now turn to what does this mean for developing new approaches to planning the post-pandemic city. It is important to differentiate between approaches required for existing built-up areas compared to new developments and urban extensions. The former requires adaptation and new management approaches, and, for the latter, it is important not to construct new buildings and to plan/replan urban areas reducing flexibility and increasing opportunities for pathogen transmission.

Cities, planning and virus transmission

Urban planning and architectural professional bodies have paid limited attention to pandemic risks (Allam and Jones, 2020). Translating these into urban planning requires reconfiguring buildings and connectivity; it also involves considering new approaches to density with a focus on limiting opportunities for environmental contamination and enhancing well-being. A key issue from a public health perspective is to better manage localised air flows within built-up areas that are designed to increase dilution of pathogens and pollutants. This is about thinking malleably, promoting adaptability in urban systems and fabrics including green infrastructure. Small-wins and low-cost adaptations are to be combined with higher cost solutions here as urban structures have not to date been designed with such requirements in mind. This is especially the case for existing streetscapes and urban areas where full transformation will not be realistic nor financially viable (Andres et al., 2021).

COVID-19 has highlighted the importance of adapting and managing indoor and outdoor people flows in urban environments to reduce transmission opportunities. There are three multi-scalar elements to this challenge. First, the built environment, indoors and outdoors, has to be designed to limit close social interactions, when needed, and so reducing droplet spread. This includes accounting for options to replace space optimization by social distance optimization, including the ability to switch to one-way flows of people between and within buildings, combined with effective digital connectivity enabling employees to live away from densely populated urban agglomerations. Second, new thinking is to be applied to residential units with increased consideration given to adaptable multimodal spaces supporting effective work life balance and dual career homeworking and with access to green infrastructure. Supporting future pandemic preparedness and resilience involves considering the design of new developments to reduce opportunities for respiratory transmission. Third, a bi-modal approach to pandemic contingency planning should remain a priority. Cities and buildings should be able to switch rapidly between two modes: times when effective pandemic control measures are in place, and times during pandemic-free periods. Both should include approaches to dilution and flexibility that have been planned into the built environment.

Tackling environmental contamination requires a micro and macro re-assessment of people movement and everyday use of the built environment (*ibid*; Morawska et al., 2020). First, at the micro level, designing out opportunities for hand-to-object transmission. All objects designed into buildings and public spaces have to be assessed for their ability to increase or reduce virus transmission (Emmanuel et al., 2020). Solutions can include contactless approaches (no door handles or light switches) and retrofitting using materials that limit transmission. This also means ensuring that appropriate surfaces are selected to enhance effective cleaning, minimising opportunities for pathogen transmission. These are and have been applied in hospitals already and could be applied to most public-use buildings. Second, disinfection areas at entrance points should be considered as a mandatory design feature. Third, at the macro level, overcrowding is to be managed and controlled. This involves here balancing health optimization with financial considerations. A different design can allow to better manage flows and lead to behavioural changes: reduce bottlenecks at entrances, spread flows over longer periods of time and in public spaces, and so prevent overcrowding, create shared internal spaces that favour wellbeing and (socially-distanced) interactions. At city level, this includes planning multiple alternative routes and transport modes including walking and cycling (Dunning and Nurse, 2021) and providing more green infrastructure to enhance wellbeing (Dempsey and Dobson, 2021). Decentralised approaches to public service delivery, including healthcare and education, are needed. This is counter to the current emphasis on financial optimization with centralised provision. Designing a resilient health system combined with pandemic resilient cities is important here. This leads us to question how planning can develop more integrated approaches to healthy urbanism.

What are the directions for an integrated approach to healthy urbanisms?

It is important for urban planners to address health and wellbeing inequalities and to improve living conditions for a broader range of diverse groups, especially the most vulnerable. One main consequence of the pandemic has been to increase intersectional burdens (Ho and Maddrell, 2020) and this will be exacerbated further in years to come at the global level (between the richer and mostly vaccinated Global North and the majority poorer Global South with lower vaccination rates) and national/city levels. Nevertheless, some environment professionals are still not accepting “responsibility for safeguarding health and sustainability, or improving inequalities, through building and urban design” (Pineo, 2020, p.2). We call here

for more balanced and nuanced approaches towards healthy urbanisms accounting for existing health priorities along with pathogen transmission reduction. This will allow facilitating better preparedness and resilience to future pandemics and crisis. This approach relies on key principles all driven by adaptation and adaptability: flexibility and rhythms, everyday wellbeing, and technological applications.

Flexibility and Rhythms

The pandemic and current responses to recovery have revealed the importance of adaptation and the use of temporary solutions to deliver rapid socio-economic outcomes (Deas et al., 2020; Andres et al., 2021). All are based on adaptable thinking, practices, behaviours, and frameworks of actions (which can include planning and regulations). This requires new strategic thinking involving appreciating micro-level interventions, needs and forms of bricolage triggered as rapid solutions for immediate needs. It also requires new training to build awareness into the usefulness and practicalities of such solutions. Such interventions require localised approaches embedded in specific places enabling people to adapt everyday practices in response to circumstances. By essence adaptability also accounts for a less rigid understanding of urban systems and flows acknowledging the rhythms of the urban which here refers to a wider account of temporary urbanism (Andres and Kraftl, 2021), the importance of improvisation (Bryson et al., 2021) and the strategic application of green infrastructure to enhance well-being and to facilitate air flows intended to enhance dilution of pathogens and pollutants.

Everyday wellbeing

Adaptation needs to occur in shared indoor and outdoor spaces but also in residential units, health care and educational facilities to allow them to function at (financially) viable capacity despite having to accommodate new restricted and more constrained uses during times of crisis. Access to green spaces is extremely problematic in very dense urban areas (Dempsey and Dobson, 2021). This requires novel solutions for incorporating movable gardens or pocket parks into planning schemes. This is about planning in buffer and breathing zones to enhance well-being, but also spaces that are part of a pandemic preparedness approach to urban planning. Such attention given to modularity of spaces and regulations resonates with wider agendas including the decarbonisation of cities and environmental justice. COVID-19 has impacted on the most vulnerable and it is this group that will also be most affected by some of the negative impacts of climate change including more favourable conditions for mould and microbial growth.

Data and technology informed design

Implementing adaptability into the design of cities and buildings has to be strongly connected with the rise of artificial intelligence and the planning of smart cities with sensors providing opportunities to monitor and prompt behavioural changes. This involves expanding the application of real-time data (mostly limited to public transportation) to all modes of movement within urban environments based on limiting opportunities for virus transmission (and other accelerating factors, e.g. air pollution). This is about identifying alternative routes and modes of movement to dilute overcrowding, reduce social encounters and to better understand people flows within and outside buildings. This has two implications. At the neighbourhood and project level, consideration should be given to include in all planning applications a virus transmission and environmental pollutants assessment and related management plan to ensure

that a building and area can easily switch between modes. This would require the application of agent-based modelling to test designs and to model people flows and encounters. This means emphasising the design of cities and buildings for health rather than solely for profit and productivity which has implications for planning practice and planning education. New and refurbished buildings are to be designed to be flexible and permutable (Andres et al. 2021). Overall, due consideration must be given to spatial functions and land uses with the focus shifting from being too deterministic and restricted to more planned but agile approaches intended to enhance not only health and well-being, on a everyday basis, but also pandemic preparedness, over the longer term.

Conclusions

The nineteenth century was associated with limiting gastrointestinal pathogen transmission, while the future of the post-COVID-19 city relies on planning and designing cities and buildings to reduce opportunities for virus transmission and the dilution of environmental pollutants. The latter must be part of the first line of defence against future pandemics. In the design and management of the built environment, value should no longer focus predominantly on profit and productivity, but must be centred on health and overall wellbeing. As we note (Andres et al., 2021), COVID-19 is a wake-up call across all urban and design disciplines for buildings and spaces to become more adaptable, incremental, and not presented as a finished product. Flexibility, adaptability, and changeability are pivotal characteristics that, we argue, should become part of the everyday practice and policy of urban planning and management.

The danger is that the pandemic once controlled will be forgotten as policymakers, the media and citizens focus on recovery and a return to some form of pre-pandemic living and ‘normality’. In this viewpoint, we thus call for planning to focus on preparedness for future pandemics and to develop new national standards that would place health even further at the centre of all planning and building design decisions focusing on reducing opportunities for virus transmission in urban environments. This will add to other health-related measures already in place (Pineo, 2020) and serve resilience to future pandemics but also the climate emergency for which ongoing adaptation and flexibility of the built environment is key.

All cities and their buildings need *respiratory tract pathogen contingency plans*. These plans would include specifying bi-modal approaches to managing and controlling people flows and density. There are of course many challenges here including retrofitting approaches to maximising urban pandemic resilience to existing urban built environments. As such an inclusive approach is here advocated in which all benefit from changing approaches to planning and building design. The time to act is now; we must learn from COVID-19 and adapt. Forgetting the COVID-19 pandemic is not an option; the only option is for cities to become increasingly pandemic resilient and to be able to adapt to further major crisis, including climate change.

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