Complex Urban Systems for Sustainability and Health (CUSSH): A Structured Approach to Support the Development and Implementation of City Policies for Population and Planetary Health

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Abstract

Context: The multi-disciplinary and multi-partner CUSSH project (Complex Urban Systems for Sustainability and Health) seeks to support cities to take transformative action towards population and planetary health goals.

Rationale: As all cities are complex systems with unique contexts and priorities, our approach is to engage with partner cities in a participatory process to build a shared understanding of relevant systems that will inform the development and implementation of new city policies.

Description: Six partner cities were selected to represent larger and smaller cities from across the global spectrum of income: London (UK) and Rennes (France) in Europe, Nairobi and Kisumu in Kenya, and Beijing and Ningbo in China. In each setting we are engaging stakeholders in a broadly similar structured approach that integrates evidence gathering and modelling, participatory engagement framework, and ongoing tracking and evaluation. In addition, we are developing a working theory of change in each setting to explain how and why the chosen policies may work.

Achievements: Our city engagement to date has focused on indoor air pollution (Nairobi), green infrastructure (London) and GHG emissions (Rennes), where findings highlighted not only multiple pathways by which policy interventions could affect health, but also potential counter-intuitive influences and tensions, and synergistic opportunities for solving both sustainability and health problems.

How it relates to the conference theme: The work is focussed on the dual challenge faced by cities of needing to address local environmental imperatives while also taking action to safeguard planetary health.

Conclusion: The early achievements of CUSSH demonstrate the feasibility of our structured approach and the advantages of bringing together tailored scientific evidence with

participatory methods to achieve urban change. Beyond the CUSSH cities, the work will contribute to a broader understanding of solutions for healthy sustainable urban development via international networks such as C40.

Context

The Sustainable Development Goals place an emphasis on the need to improve the health of our planet and the global population.[1] A key international goal, agreed at the 2015 United Nations Framework Convention on Climate Change (UNFCCC) in Paris, is to limit global warming to 1.5^{o}C by the end of this century.[2] Together, these represent ambitious global priorities which will require transformative action at the level of individual cities. However, global health and sustainability goals may not always align with local priorities.

To date, cities have had limited success in meeting either local or global sustainability and health challenges. For example, household and ambient air pollution contributes to around one-in-five premature deaths worldwide and is increasing in settings experiencing rapid urban development.[3,4] Many urban populations still do not have adequate access to fresh water and sanitation or decent housing and are vulnerable to natural disasters. These problems are exacerbated by the effects of climate change, to with cities substantially contribute: cities produce 70% of global greenhouse gas emissions, and the carbon footprints of many cities are continuing to rise.[5] To meet the target of the Paris Agreement and reduce the risk of dangerous climate change, unless we invoke substantial negative emissions in the future, cities must rapidly reduce their greenhouse gas emissions to close to zero by around 2030.[6] Responses to climate change, air pollution and other challenges will require rapid and transformative action by city governments.

The newly established CUSSH (Complex Urban Systems for Sustainability and Health) consortium seeks to support such action through participatory engagement with six partner cities selected to represent larger and smaller cities from across the global spectrum of income: London (UK) and Rennes (France) in Europe, Nairobi and Kisumu in Kenya, and Beijing and Ningbo in China. In the next sections we describe our rationale, approach, and early achievements.

Rationale

The six CUSSH partner cities have varying environmental and health priorities: broadly, the transition to a low carbon society for the mature, high income economies of London and Rennes; dealing with the adverse environmental legacy, especially air pollution, of rapid economic development in Beijing and Ningbo; and household risks and lack of access to basic services in the lower income settings of Nairobi and Kisumu. In the CUSSH project, we are aiming to test whether transformative change towards these goals can be achieved through the provision of high quality scientific evidence, modelling of alternative development strategies and participatory stakeholder engagement.

Description

The CUSSH project follows a structured approach that has been developed and is being implemented by a multidisciplinary team of researchers, practitioners and stakeholders with expertise in the fields of environmental sciences, epidemiology, urban planning, and behavioural sciences. We aim to bring together complementary qualitative and quantitative research methods through the structured approach, the elements of which include:

1. Evidence gathering and modelling. We assess potential policy interventions for healthy sustainable urban development using best scientific evidence, and wherever possible, by quantifying the health impacts of potential interventions using state-of-the-art modelling methods. These include the use of geographically explicit microsimulation models (which model the behaviour of individual units such as people, cars or households), and other health impact assessment models, to predict the unfolding impacts of a particular policy intervention on outcomes such as mortality or morbidity. This evidence is tailored to inform priority questions in each city, and is intended to help improve the process of decision-making and encourage more ambitious action towards health and sustainability goals.

2. Participatory engagement. Reflecting that policy development and implementation are complex processes, a core part of our approach is to engage with partner cities using participatory system dynamics. System dynamics is a method which captures the causal structure of complex social systems in feedback simulation models that can be used to evaluate potential effects of available policy options and behavioural interventions. We construct system dynamics models of policy challenges facing partner cities in a participatory fashion, through a series of workshops involving wide-ranging discussions with multiple stakeholder groups (e.g. city networks, private sector, civil society, and UN systems). At these workshops, we help stakeholders in building causal loop diagrams which capture pathways of influence and important interconnections between different parts of their city system (e.g. housing stock, energy supply and planning budget), including key behaviours of actors in the system (e.g. recycling or travel behaviour). We are then able to integrate the causal loop diagrams with the findings of our evidence gathering and modelling, in an iterative fashion.

The means by which scientific evidence and participatory modelling might feed into the complex processes of planning and implementation to achieve urban transformation are yet uncertain. To help us understand how it might work, we will apply a theory of change specific to each city to visualise how program activities might lead to outcomes – desired or undesired – by articulating and testing the connections between them.[7,8] Mapping backwards from goals through mediators and moderators to inputs, we will examine assumptions, weigh the potential benefits of interventions, and consider indicators with which to test hypothetical linkages.[9–12] These theories of change will draw on the results of the participatory system dynamics modelling.

Achievements

The CUSSH project is still in its early phases. Here, we report results from our engagements to date with Nairobi (focusing on indoor air pollution in informal settlements), London (focusing on green infrastructure), and Rennes (focusing on the reduction of GHG emissions). Our engagement with Kisumu, Ningbo and Beijing will be reported in other publications.

Nairobi

We conducted a series of participatory workshops with city government officials, NGOs, academics and the community and had two focus group sessions in informal settlements with 30–40 residents. Stemming from those workshops was a map of interconnections between key factors that was developed into a causal loop diagram that represented the structure around why residents continue using dirty fuels, and a simulation model that was able to show leverage points. These suggested that, with current efforts, indoor air quality improvements would soon come to a halt, unless we saw an increase of orders of magnitude in the provision of subsidised cooking appliances to residents of the informal settlements, where clean cook stove uptake is very low (and unaffordable to households) in contrast to high replacement rates of other major indoor air pollution sources, such as the replacement of kerosene lamps with electric lighting. The process also suggested counter-intuitive results, for example, showing that investing *away* from direct provision of subsidised appliances and towards monitoring and health impact assessment studies on indoor air quality might bring in additional funds to provide more subsidies in the future.

The CUSSH engagement with Nairobi's informal settlements also demonstrated that, even in our most optimistic scenario, where most households obtain clean cooking and lighting appliances in a matter of years, household concentrations of air pollution will remain far above the WHO guidelines. This is because the source of a substantial portion of household air pollution is from outdoor sources, and further improvements in indoor air quality would require a drastic reduction in outdoor pollution. The main sources of outdoor air pollution in the informal settlements of Nairobi are industrial sites and dumpsites in the vicinity. However, these sites are also an important source of livelihoods for the population. In the face of this complex social, economic, and environmental problem which does not lend itself to straightforward solutions, we hope that future work as part of CUSSH will lead to synergy and consensus around new interventions.

London

We conducted an initial participatory workshop at a smaller scale with members of the environment and health teams at the Greater London Authority, aiming to elicit the effects of green infrastructure (natural and semi-natural green spaces) on health. The workshop and further qualitative modelling indicated, for example, that the positive health effects of green space mediated through better air quality and higher levels of physical activity need to be considered in balance with potentially increased property prices, and subsequently, higher opportunity costs for developing further green spaces. Inequality in access to green space was also highlighted as a major issue. Although both public and private green spaces count towards London's target of reaching 50% green space in terms of area, the benefits of private

green spaces only accrue to those who have access, while the disadvantage of increased property prices and therefore higher cost of expanding public green spaces extends to all residents. Moreover, increasing green space coverage in deprived areas may have some unintended negative consequences as gentrification, with rising prices forcing lower-income residents to move to other green space-deprived areas.[13]

Rennes

As part of the Plan for Climate Air and Energy (PCAET; revised version), Rennes is consulting on ten targets aiming to reduce GHG emissions by 50% per capita from 2010 to 2030, whilst also increasing the production of renewable energies by a factor of three. The targets received cross-party political support and enthusiasm, yet the city are aware that implementing the actions requires large-scale engagement across both public and private sectors. Many of the leverage points for GHG emission reduction identified by the city lie outside the metropolitan jurisdiction. Therefore, large-scale engagement and commitment to these targets is essential to accelerate action on both local and global priorities.

A rapid assessment framework is under development, which will be used to assess and quantify the ancillary health and greenhouse gas emission reductions associated with each target. This framework is designed to assist cities in prioritising targets that are both realistic and effective at scale.

By framing the potential health implications linked to the city's strategic objectives, it is hoped the city will be better equipped to gain support and commitment for its targets from the public and other sectors. The results of the rapid prioritization assessment will be shared as part of the 'Plan for Climate Air and Energy' public consultation process, in collaboration with RBUS, the local network for Urban Health.

Conclusion

The CUSSH consortium provides a structured approach to supporting the development and implementation of ambitious city policies to meet sustainability targets and protect global health. Our engagement to date with Nairobi, London and Rennes demonstrates the feasibility of this approach and has highlighted some of the advantages of integrating tailored scientific theory, evidence and modelling with highly participatory methods, capacity building and public engagement. Our findings related to indoor air pollution (Nairobi), green infrastructure (London) and GHG emissions (Rennes) highlight multiple pathways by which potential policy interventions could affect health. They also provide examples of counter-intuitive outcomes and tensions, and synergistic opportunities arising from the dual priorities of addressing local environmental imperatives while also taking action to safeguard planetary health. As well as continuing to carry out research with our partner cities, lessons learnt from the CUSSH project will contribute to a broader understanding of solutions for healthy sustainable urban development via international networks such as C40.

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