STUDY PROTOCOL

REVISED Tackling Root Causes Upstream of Unhealthy Urban Development (TRUUD): Protocol of a five-year prevention research consortium [version 2; peer review: 3 approved]

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Abstract

Poor quality urban environments substantially increase non-communicable disease. Responsibility for associated decision-making is dispersed across multiple agents and systems: fast growing urban authorities are the primary gatekeepers of new development and change in the UK, yet the driving forces are remote private sector interests supported by a political economy focused on short-termism and consumption-based growth. Economic valuation of externalities is widely thought to be fundamental, yet evidence on how to value and integrate it into urban development decision-making is limited, and it forms only a part of the decision-making landscape. Researchers must find new ways of integrating socio-environmental costs at numerous key leverage points across multiple complex systems. This mixed-methods study comprises of six highly integrated work packages. It aims to develop and test a multi-action intervention in two urban areas: one on large-scale mixed-use development, the other on major transport. The core intervention is the co-production with key stakeholders through interviews, workshops, and participatory action research, of three areas of evidence: economic valuations of changed health outcomes; community-led media on health inequalities; and

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routes to potential impact mapped through co-production with key decision-makers, advisors and the lay public. This will be achieved by: mapping system of actors and processes involved in each case study; developing, testing and refining the combined intervention; evaluating the extent to which policy and practice changes amongst our target users, and the likelihood of impact on non-communicable diseases (NCDs) downstream. The integration of such diverse disciplines and sectors presents multiple practical/operational issues. The programme is testing new approaches to research, notably with regards practitioner-researcher integration and transdisciplinary research co-leadership. Other critical risks relate to urban development timescales, uncertainties in upstream-downstream causality, and the demonstration of impact.

Keywords
Urban environments, Non-communicable disease, Planetary health, Inequality, Upstream, Commercial determinants of health, Short-termism, Valuation, Power, Decision-making, Risk, Public involvement, Co-production

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REVISED **Amendments from Version 1**

As suggested, we have: added new information on UK NCDs; shifted the order of the Protocol section; added further details on more recent ethics approvals; updated the Figure 2–Figure 4 as recommended; provided information on the databases used in the literature review; added further detail on the evaluation approach. We have also responded in full to the reviewers comments.

Any further responses from the reviewers can be found at the end of the article

Introduction and rationale

Upstream determinants of urban health

There is substantial evidence linking non-communicable diseases (NCDs, e.g. respiratory illness, cardiovascular disease, diabetes, mental disorder, cancer) to: the quality of urban environments (e.g. air pollution, noise, lack of green space, physical inactivity, obesogenic food 'deserts')[1–3]; socio-economic inequalities[4–6]; and global environmental degradation, mainly caused by the resource consumption in cities[7,8]. NCDs are responsible for 89% of deaths in the UK, most of which are seen as avoidable[9,10]. Responsibility is dispersed across many agents[11,12]. Fast growing cities are the primary incubators of cultural, social, and political innovation, particularly the UK's Core Cities[13], and local and devolved government plays a pivotal role at the interface between multiple private, public and third sector agencies[14]. However, the driving force in urban planning and developed in the UK, and across many industrialised nations globally, are large private sector actors - landowners, investors, developers - and political will focused on short, unsustainable timescales[15,16]. Increasingly, there is a push towards investigating upstream[17], with a particular focus on the 'commercial determinants of health'[6], the role of the private sector[18,19], and to systems of governance[20] - Figure 1. This shift is described as part of a 'fifth wave of public health'[18,21] where key problems and solutions are to be found in the domains of, for example, international finance, trade, investment[22–27].

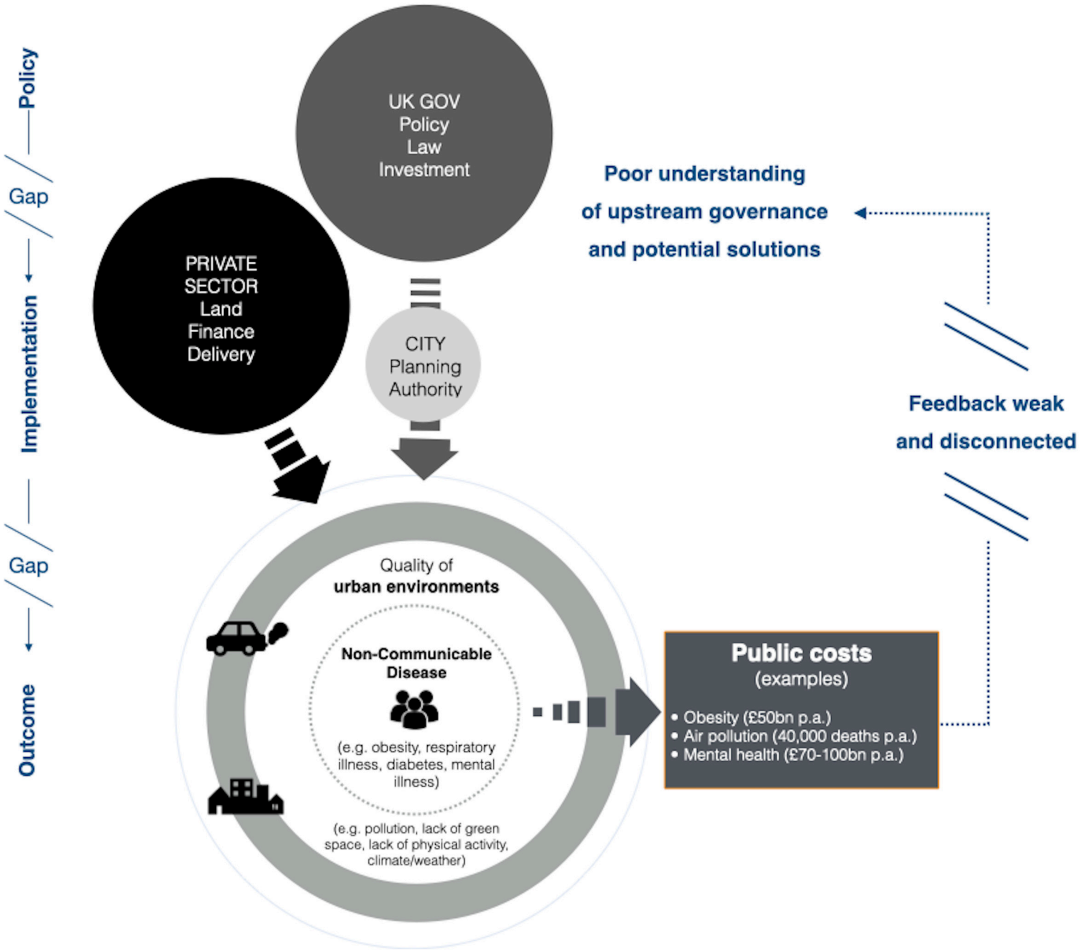

Figure 1. Simplified illustration of Tackling Root Causes Upstream of Unhealthy Urban Development (TRUUD) societal challenge. Public costs from environmental health outcomes downstream are increasingly recognised, but there appears to be a limited understanding of potential solutions.

Economics, valuation, decision-making and risk

Key areas of concern in urban planning are likely to relate to narrow valuation mechanisms, prioritisation, issues of agency and power, short-term horizons, and inequality[18,28–32]. The role of monetary valuation is widely thought to be fundamental; it is a dominant mechanism in decision-making[22,33]. However, opinion as to the efficacy of its use in valuing human and planetary health varies[34–36]. As the UPSTREAM pilot and other projects suggest, decision-makers are aware that these types of valuations are not comparable to standard cost-benefit analysis, and are used to making decisions with limited information[30]. Over and above the challenge of effective valuation of externalities, there appears to be little evidence or understanding on how to integrate such external costs specifically into urban planning and development decision-making[30,37]. There appears to be a need therefore not only to develop and test new means of valuation targeted at key leverage points[38–40], but also determine the strategic, political, ethical and behaviour shifts needed in corporate governance and associated regulation for prevention to be factored routinely in to core decision-making[19,41–47].

Inequality and effective public engagement

Material and power inequalities are primary drivers behind current tensions in society[4]. Investigating disparities in resource distribution and power dynamics is therefore fundamental[48,49], as is the role of values in governance, and their implications for institutional agents[19,44]. Involvement of the lay public in urban planning is already mandatory and has been for many decades, yet societal impact remains limited[50–53]. A further challenge therefore relates to how meaningful and effective communication on health inequalities can take place between the lay public downstream and the complex systems of decision-making upstream[54]. Issues include: the complexity of the problem, the wide range of disciplines involved, the resource needed for effective co-production, the core focus on real-world impact, and the need for effective bridging between academia and practitioner groups. New approaches to research management, clear understanding of context, and the use of the creative arts in surmounting these barriers to communication may be part of the solution[55,56].

Complexity, causation and the need for new approaches

Addressing these highly complex challenge areas requires new approaches to research[18,57] based on strong theory that not only embrace systems approaches[58–60], inter-/trans-disciplinary working and co-production with real world decision-makers and impacted stakeholders[61,62], but also that have societal impact as a strategic goal and critical reflective practice as a central mechanism[57,63]. Systems approaches can enable researchers to navigate complexity, put 'strategic investment of energy in particular parts and processes of the system'[38], and enable navigation of complexity by making 'implicit mental models explicit'[31]. Yet intervening in urban governance 'systems of systems' is not straightforward[64]. It requires us to 'balance between complexity and the reduction of that complexity' and to 'weigh the costs and the benefits'[65]. Research design in this space must look beyond simply the application of systems approaches[29,66]. There is a need for: state and non-state actors to work together[67,68]; governance of multi-actors settings without reverting to command and control ('meta-governance')[25,69]; recognition of local governments' limitations[30] and the dominant roles of the many and varied private sector controlling agencies and the wider political economic landscape[6,19,41,46]. Considerable challenges in better decision-making include not only the inevitable lack of evidence, but also demonstrably linking upstream decision-making with downstream health outcomes[70–72]. This is particularly challenging given the length of time it can take for urban developments to be built, the need for political will to change, and the significant uncertainty around future impact[32,43,73,74]. Researchers must work alongside real-world actors if solutions to these complex global challenges are to be found[75–77]. This has potentially profound implications for research governance and leadership, linked reflective practice and critical theory[78,79].

Protocol

Research setting

This research focuses on two case study areas of major urban development in the UK, Bristol (City) and Greater Manchester (Combined Authority), and their associated national governance systems: i) large-scale mixed-use (housing and commercial) development in Bristol City Council (BCC); and ii) major transport plans and projects in Greater Manchester Combined Authority (GMCA). Within those areas we will focus both on a) the 'keystone' actors and processes that control the primary assets and functions of urban planning and development, working with local government partners, while focusing in particular on the dominant private sector actors, as well as b) the communities and 'lay' publics affected by these keystone decision-makers. At the national level, we will engage with actors from the legal, regulatory and wider policy systems, including the third sector. We will undertake at least 200 interviews and 20 systems focus groups.

Study aims

Our overarching aim is to develop and test a replicable multi-action and adaptable framework intervention in two large-scale case study urban challenge areas (major transport and mixed-use housing development plans and projects) – Figure 2 - in order to enable a paradigm shift in how health is valued and integrated at root-cause decision-making points.

Our work package (WP) aims are as follows:

- WP1 aims to: map and understand the main drivers of urban development and management; test and refine the co-produced multi-action intervention.
- WP2 aims to discover the type of new evidence that can enhance the economic valuation of health impacts associated with the urban environment.
- WP3 aims to maximise societal impact through strategic coordination of the research programme and co-production of the intervention.
- WP4 aims to develop and test professionally produced, citizen-led creative arts projects that will help decision-makers to understand better the challenges of health inequality.

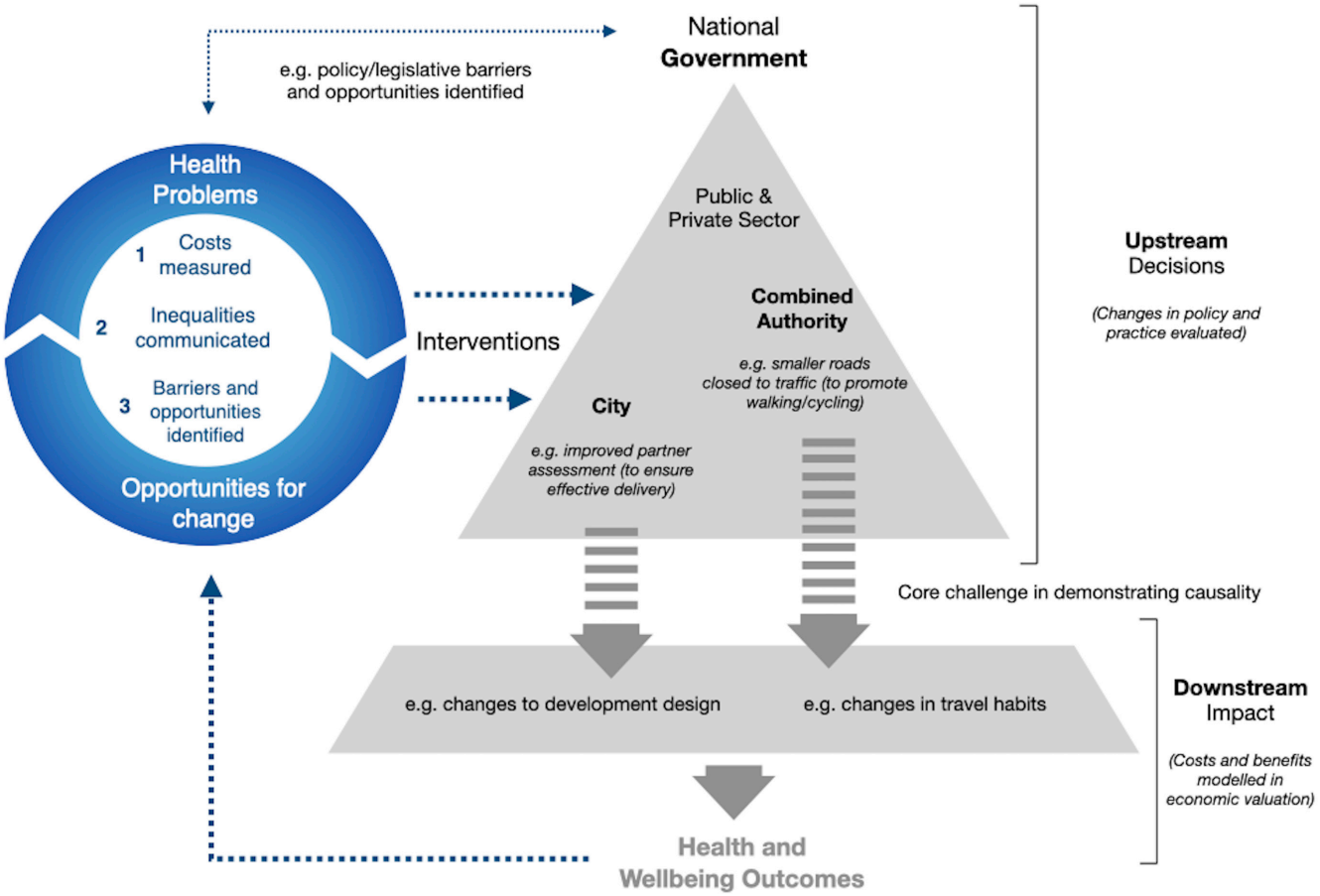

Figure 2. Schematic diagram of the 3-part intervention and potential pathways to impact. Public costs from environmental health outcomes (downstream impact) modelled using economic valuation. Potential solutions – changes in policy and practice (upstream decisions) – mapped and validated with end users. Both combined and communication of health inequalities and presented to decision-makers. Changes in policy and practice evaluated.

- WP5 aims to enable a comprehensive programme of knowledge exchange, and monitor and evaluate the impact strategy.
- WP6 aims to maximise the efficacy of inter- and trans-disciplinary working and impact planning.

Research question, primary objectives and study design

Our overarching research question is: how might prevention of risk factors causing NCDs and negative planetary health outcomes be fully incorporated by those with the most control of urban development in the UK? Our primary objectives are:

1. To engage the wide range of actors involved in shaping decision-making in urban planning and development within our two case studies.
2. To map and understand the systems of urban development decision-making across central and city-regional government, and communicate these to identified stakeholders, including the lay public.
3. To co-produce, and test with a wide range of stakeholders an intervention and evaluation framework, embedded in robust societal impact strategy, made up of three areas of evidence, and targeted at critical points of leverage within these urban development systems:
   i. *Health improvements:* Modelled economic valuation of changed health outcomes, linked to those responsible for payment.
   ii. *Opportunities for change:* mechanisms identified and tested with users and stakeholders for improving policy and practice in both private and public sector, at local and national level.
   iii. *Health inequalities:* Citizen-led, professionally curated creative arts outputs that represent the life experience, views and wishes of those suffering from health inequalities.
4. To deliver a highly impactful knowledge exchange programme with our broad range of users and advisors to ensure long-term health improvement beyond the five year TRUUD programme.

The programme comprises six fully integrated and overlapping work packages (WP) delivered concurrently over four sequential programme phases of engagement - Figure 3:

- Phase 1: Mapping and understanding of systems
- Phase 2: Developing and testing of intervention (evidence and approach)
- Phase 3: Refining the intervention
- Phase 4: Translation (final knowledge exchange)

The programme involves substantial co-production and knowledge exchange throughout, via interviews, focus groups, embedded researcher engagement and observations, industry roundtables, annual advisor conferences, parliamentary events and linked ad hoc engagement. End-user testing is central to the design throughout; we will follow an iterative process of co-production, evaluating the changes in attitudes, behaviours, policy and practice amongst our target users, and refining and testing the intervention accordingly.

Programme coordination and work packages

The six work packages are highly integrated and interdependent. WPs 1–4 make up the core research activity: stakeholder engagement, primary data collection and analysis (WP1); economic valuation (WP2); programme integration, intervention co-production and impact-orientation (WP3); lay public engagement, creative arts and health inequalities (WP4). WP5 is responsible for internal and external communications, knowledge exchange and impact evaluation across the programme. WP6 is tasked with supporting and enabling the consortium to reflect upon and improve their research practice.

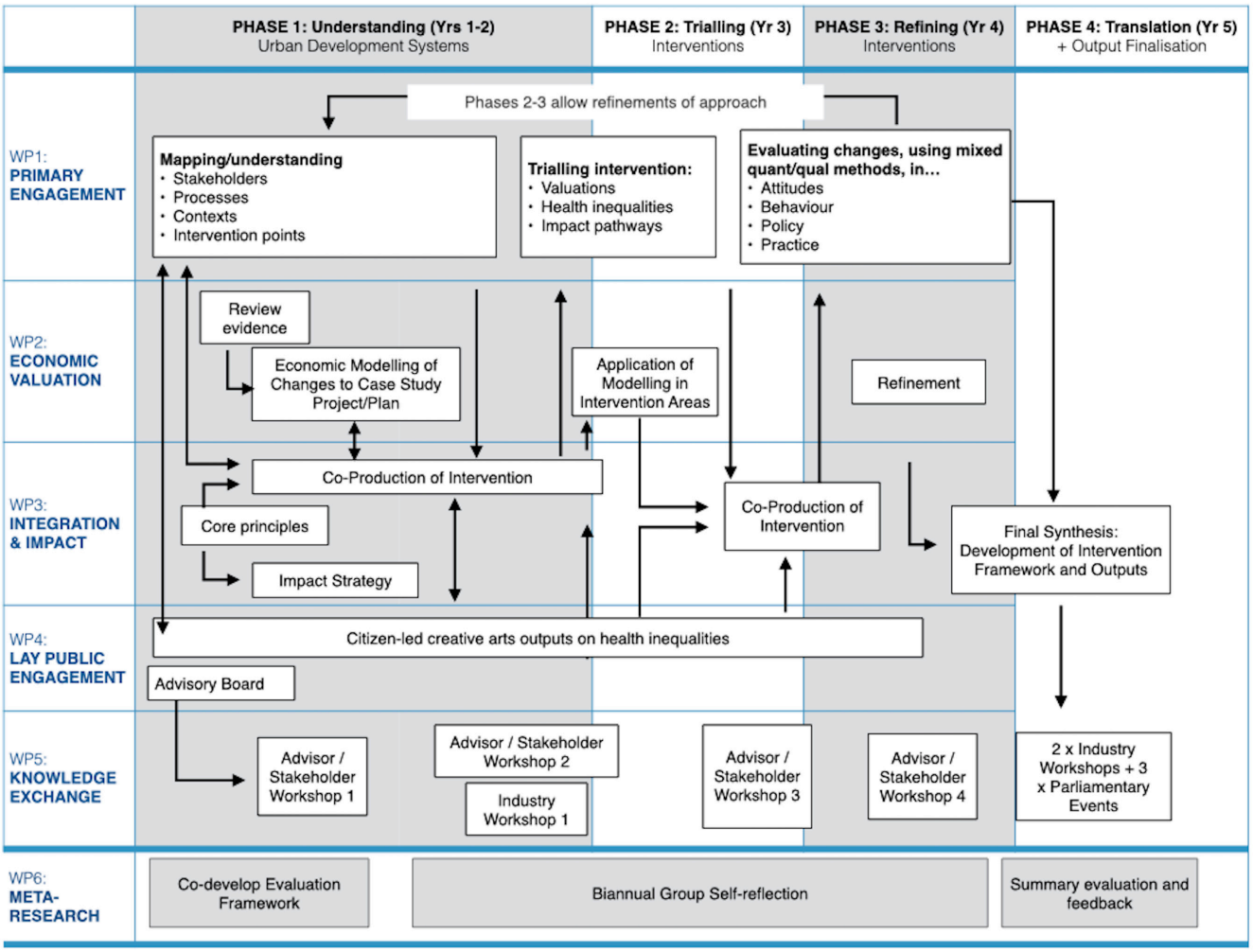

Figure 3. Simplified flow diagram showing work packages (WP), phases and main activities. Main research WPs are WPs 1, 2 and 4. WP3 integrates whole, WP5 externally facing, WP6 to enable group self-reflection and improvement. Programme highly integrated across all WPs – arrow only illustrative of interactions.

WP1: Decision-maker engagement and intervention testing

Methods: Phase 1 data collection will focus on understanding and mapping the case study systems: actors, mechanisms, data used, power dynamics, dominant drivers/incentives, priorities, wider influencers, boundaries, dependencies/interdependencies, barriers, 'tipping' points, and regulations. It will also include the extent to which: a) the public are already involved in decision making at a strategic level, and b) decision-makers understand how their decisions impact on local communities. Methods employed will include:

a) Actor mapping – inclusion criteria: perceived level of influence in large-scale property development and transport planning: public (policymakers, politicians, civil servants, council officers); private (asset owners, financiers, agents, consultants); third sector (social housing providers, NGOs); lay public experientially affected by linked aspects of the urban environment (e.g. lack of access to green space, air pollution, noise).

b) Literature review - search terms based on findings from open investigation across multiple disciplines; ten core concepts: 'power', 'governance', 'institutions', 'change management', 'networks', 'decision-making', 'type/ use of evidence', 'systems thinking', 'value/valuation' and 'risk management'; inclusion criteria in the form of four research questions focused on: robustly defining these ten concepts, key conceptual insights, theories used, and interventions used/suggested. (An initial scoping exercise, the main purpose of this was to enable the newly recruited group to familiarise themselves with each others' knowledge domains; multiple databases from each of the disciplines are used).

c) Semi-structured interviews (>200) – purposive sample recruited primarily through existing networks; additional participants identified through snowball sampling; individuals approached by telephone and in writing to inform them of the project, invite their participation; interviews to be conducted in short term and where necessary (e.g. COVID-19) via video-conference, face to face where possible; interviews conducted by experts in the field matching those of the participant to ensure strong rapport with participants and richest possible data.

d) Observations – undertaken by two full time participant observers (PO) seconded part time to Bristol City Council (Growth, Investment and Infrastructure) and Greater Manchester Combined Authority (Research Division) respectively; data to be gathered constantly, recorded in research diaries (consistent across both case study sites), on ten core concepts; supported where possible by documentary evidence (e.g. meeting minutes).

e) Systems workshops (>20) coordinated via WP3 – participants identified and recruited as with (and following) interviews; identified knowledge holders to discuss and debate the findings, and help to provide additional clarity on data gathered through the interviews, earlier focus groups, and observations; workshop purpose and focus directed by focus area research lead; task management, workshop design and facilitation support provided by group systems engineers; workshops conducted via video conference; timing will vary depending on purpose, but typically will require three hours; various online software will be used (e.g. Miro, Mural) designed for the purpose of collective 'whiteboarding' and generation of systems diagrams.

Regarding private sector engagement, focus on corporate governance will go beyond standard functions - marketing, strategy, and financial reward - to include overarching issues relating to prevention of ill-health: strategic priorities; ownership; distribution of surplus profit; horizon of decision-making; control (instruments and exercise); commitment to 'Environmental, Social, and Governance' (ESG); structure and functioning of the Board of Directors[44,45]. Industry focus groups will be co-coordinated with membership bodies, NGOs and invited senior practitioners.

Outputs: The main outputs from WP1 will be from interview and focus group preparation and outputs, including: literature and policy reviews, graphic visualisations, findings reports and analysis; a public health assessment tool for corporations involved in urban development, which will be of use to public and private sectors to align their own organisational structure to long-term health outcomes, and to improve their procurement and partnership strategies; guidance on organisational models and structures that are better aligned with long-term social and environmental health.

WP2: Economic Valuation

Methods: An extensive critical evaluation of the current literature (focused on quality, uncertainty, validity of method) will enable us to construct a single-source database and modeling tool of the quantitative and economic evidence, building on previous work[80]. It will incorporate academic and grey literature and will utilize a quality-based classification system and grade the associated uncertainty. Principal search terms include: 'Valuation of health disutility', 'willingness to pay', 'cost of illness', 'non-market valuation' and 'health preferences'. Inclusion criteria include: the alignment of the health outcome definition in the valuation study with that in the epidemiological health impact studies; English language; publication in the previous 20 years, and; being a primary research study. Primary databases to be searched include: Econlit, Scopus, Web of Science, and IBSS. These valuations will use a combination of both market and non-market (revealed and stated preference) methods to estimate the cost components of health impacts. It will enable a more comprehensive coverage of health in economic appraisal than that existing to date which has primarily focussed on the air quality context[81]. Existing tools used by decision-makers – primarily spreadsheet models - that utilise the data generated in this WP will be used to generate cost-benefit estimates of individual urban development design decisions

as well as policy-level decisions. Costs associated with urban form will be derived from the range of stakeholders involved in the project, and will be based on publicly available market data (e.g. pollution; noise; modal share; green space).

Output: The main output will be an interactive and adaptable economic database model applicable in a range of core decision areas, which will be a core part of the overarching TRUUD decision support framework.

WP3: Programme integration, impact-orientation and co-production of interventions

Methods: Phase 1 focuses on the development of shared understandings across the newly formed consortium[29,57,78,82]. This includes formalization of: the theoretical foundations underpinning the UK Prevention Research Partnership; how foundational principles – trans-disciplinarity, societal impact, need for new approaches - are embedded in TRUUD's research governance and operationalization; key definitions and understandings (e.g. 'events' in 'complex social systems')[18,58,72,78]. Concurrently, co-production of interventions requires an initial focus on early programme integration and management, through co-development with WP Leads of detailed, interdependent implementation plans for WPs 1, 2, 4 and 5. The detailed WP3 implementation plan will then build on the early theoretical framing and will include strategic considerations in programme integration and detailed steps for co-producing the multi-action intervention at the end of each phase. A core innovation in this WP is the integration of the multiple approaches in to a soft systems framework for evaluating causal links and probabilities between decisions made far upstream and health outcomes downstream based on the hierarchy of research impact[83–86]. The intervention, impact and evaluation strategies will be co-produced and tested iteratively internally and externally with end users. In this way we are in accordance with latest MRC/NIHR guidelines on complex interventions, given we will be working with stakeholders to assess which outcomes are the most important and agree how to deal with multiple outcomes in the analysis[87] Example evaluation methods we will be employing include: group model building, social network analysis, economic modelling, and qualitative interviewing and workshop-based data gathering. The implementation plan will require sufficient flexibility such that intervention design can respond to a wide range of upstream contexts and applications that will be identified during the first and second rounds of engagement (decision tools span multiple actors and sectors and may include, e.g.: corporate strategy, KPIs, risk management, Cost Benefit Analysis, Multi-Criteria Analysis (MCA), Red Book Valuation or Green Book Valuation)[88–90]. Initial development will take place in Phase 1 with refinement in Phases 2–4. The programme as a whole will be underpinned by a strategic impact planning and evaluation framework drawing on Fast Track Impact templates (stakeholder analysis, impact planning, impact monitoring) and Mission-Oriented Research, ensuring integration with our working theory of change and pathways to impact models, and alignment to the UK Prevention Research Partnership (UKPRP)'s broader theory of change – Figure 4. These combined strategies will draw on emerging best practice in the fields of the 'Science of Team Science', including the Four-Phase Model of Transdisciplinary Team-based Research[62,91,92].

Outputs: The main outputs from this work package are: i) a book or monograph aimed at the academic community and taking a critical theory lens to the call for new approaches to researching complex societal challenges, considering governance, operationalisation and structural barriers in particular, using TRUUD as a case study; ii) a Health Valuation and Integration Toolkit (H-VIT) with Strategy Guidance Note aimed at city, region and national level decision-makers in public and private sector, which bridges the economic database model (from WP2) to urban governance contexts, and provides a framework for its application with wider, qualitative valuation techniques; iii) a paper (or papers) reporting on the findings from integrating multiple approaches in the development and evaluation of a multi-action intervention across multiple sectors and systems of decision-making.

WP4: Citizen-led communication of health inequalities through the creative arts

Methods: The creative outputs from WP4 will therefore need to meet two design criteria – they need to be: 1) authentic in terms of articulating the impact of health inequalities on the lives of people living in underserved communities; 2) impactful in terms of relevance to upstream decision makers and their core values. In Phase 1 the WP4 team will focus on developing an understanding of: a) decision-makers' core values and how they think of health inequalities (in collaboration with WP1); b) what creative arts approaches will be most effective in communications. In order to achieve this the WP4 team will co-design the creative outputs with input from both upstream decision makers and community representatives and organisations. Grounding their work in good quality involvement practice (UK Standards for public involvement), the team will work closely with two community-based organizations in Manchester and Bristol, Live Well, Make Art (LWMA) and Knowle West Media Centre (KWMC). The team will: recruit community representatives – initially, two from each location - to help us co-design the creative outputs; develop a brief for the production of the creative outputs, informed by the evidence generated by WP1 and identify and approach upstream decision makers to participate in the co-design of the outputs (based on advice from the External Advisory Board and via WP1 networks). Recruitment will be based on possession of relevant skills and lived experience within the communities we are working with. We will, as far as possible, recruit a diverse group in terms of ethnicity, gender and social class. We will recruit approximately 5–6 public contributors in total from each location, who will then form the TRUUD public advisory group. Applications to carry out the work will be open to organizations with a proven record of accomplishment in this area of work, and will be judged by a management group consisting of the WP4 Lead, SRF, TRUUD Director, two community representatives and representatives of LWMA and KWMC. This group will also oversee the co-production of the outputs and ensure that work meets the specifications laid down in the project brief. The output will be incorporated into the TRUUD intervention, presented to decision-makers as part of the second and/or third

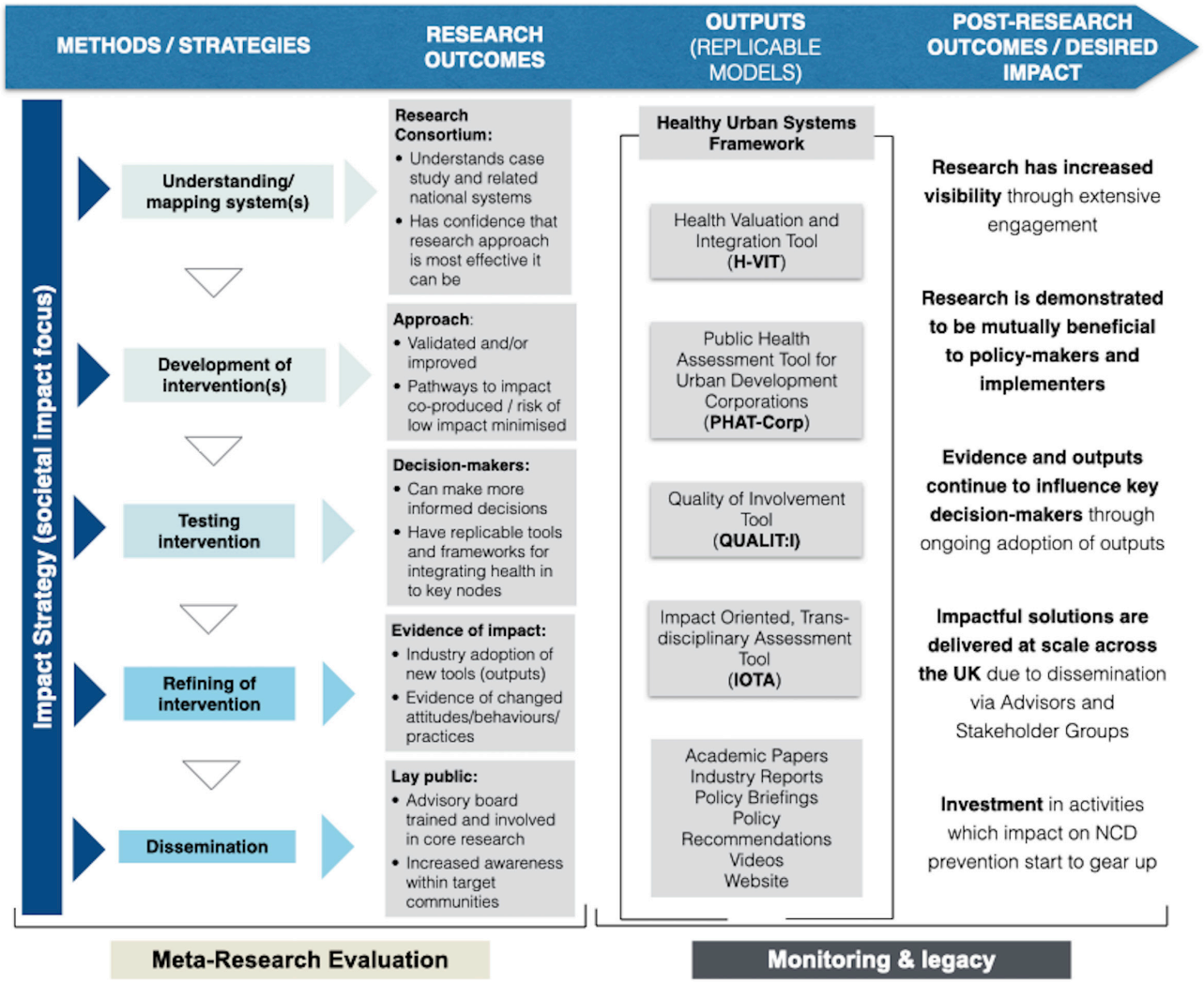

Figure 4. Tackling Root Causes Upstream of Unhealthy Urban Development (TRUUD) theory of change (ToC) modelled on the UK Prevention Research Partnership (UKPRP) ToC. In addition to main outcomes during award period and post-award, the TRUUD ToC addas an explicit impact strategy (focused on societal impact) input across the programme, as well as a meta-research evaluation of methods and award outcomes, and monitoriting and legacy of outputs and post-award outcomes. NCD – non-communicable disease.

phase interviews and focus groups (WPs1 and 3), and evaluated in line with work carried by WP3.

Outputs: WP4 is responsible for the production of: three professionally produced, community-led creative arts outputs on community health inequalities aimed at decision-makers; a Quality of Involvement Tool (QUALIT:I) designed to help researchers, users and lay publics understand which key stakeholders are involved and to what extent.

WP5: Knowledge exchange and impact monitoring

Work Package 5 is split in to two sub-WPs: knowledge exchange (WP5a); impact monitoring (WP5b).

[WP5a: Knowledge exchange]

Methods: In addition to digital and printed communications (website, social media, video, policy briefings), the knowledge exchange programme will employ a broad range of channels of communication designed to maximise two-way flow of information amongst identified stakeholders and advisors. These will include four annual one-day workshops will be held for critical sense-checking and co-production of next steps, including advisory support and Q&A with 100 advisors and stakeholders. There will also be annual meetings with the External Steering Board, and the Lay Public Advisory Board. At least one parliamentary event will be held, targeted at key actors within government and key members

from the advisory groups who have committed to engage at national level.

Outputs: The main knowledge exchange outputs from WP5 will be both internal and externally facing and will include: a knowledge exchange, communications and social media strategy; high quality policy briefing notes and industry reports aimed at key decision-making groups; three (public sector, private and lay public) 3–8 minute videos clearly articulating in lay terms the identified findings, opportunities, and new research areas; website (with all documents and media).

[WP5b: Impact monitoring]

Methods: The impact evaluation framework will be developed from the WP3 impact strategy document and will be likewise co-produced by all consortium members, using the Fast Track Impact templates in the first instance[83]. The impact strategy will have incorporated data from the WP1 stakeholder analysis and will consider both a) users' interests, influence, motivations and needs and b) the lay public engagement work (WP4; e.g. strong/weak publics)[83,93,94]. The effectiveness of the impact strategy will be monitored throughout the programme across all WPs, with particular reference to key stakeholder groups. The impact strategy will be designed to interface with the knowledge exchange strategy, particularly during the final evaluation in year 5, to maximise long-term societal impact of TRUUD.

Outputs: Impact planning outputs will include the impact strategy (programme coordination), stakeholder analysis (WP1) and impact planning/monitoring frameworks.

WP6: Meta-research and group reflective practice

Methods: An initial literature review has drawn on the Web of Science and Scopus databases. Initial search terms were for 'meta-research', 'transdisciplinary', and transdisciplinary - 'research', 'framing', 'impact', 'innovation', 'assessment' and 'evaluation'. Given limited papers in this area, searches also included consideration of salient papers references and journals. Data is being collected through annual qualitative interviewing and ongoing researcher observation, reflection and analysis from and about the research team themselves and other actors in the research by means of reflective learning logs, worldview and research paradigm assessment by way of questionnaire, and methodology, method, tool and process appraisal for points of interaction and diversion. The sample will include researchers and stakeholders active on the TRUUD project. Participants will fluctuate over time as the meta-study evolves in response to participation in the larger project. There will be three key types of participant: 1) academic partners (<30); 2) research staff recruited to work on the project (typically research associates) (<50); and 3) non-academic city partners (<30). Participant inclusion criteria: role in the TRUUD project; relevance to current foci of WP6 meta-research; proportionate across both academic, public and private sectors and levels of seniority; participants agreement to take part. Exclusion criterion: those not working on TRUUD (including academics, and stakeholder practitioners from the public, private and third sectors). Evaluation and recommendations will take place through all phases of the project to ensure reflective practice across all WPs. The learning from WP6 will comprise two areas. Firstly an internal focus on coproducing: learning how to enhance the effectiveness of the TRUUD research processes and impacts, and understanding the degree to which inter- and transdisciplinary approaches support successful research. Secondly there will be an external focus: using the opportunity presented by the diversity of researcher and scale of research activity aiming to make a wider contribution to UK research effectiveness. This will include investigating how to balance between fully transdisciplinary research and using evidence from single disciplines in delivering impactful outcomes.

Outputs: Learning will be captured in an Impact-Oriented Trans-disciplinary Assessment framework (IOTA) designed for those undertaking meta-research of their own complex co-produced research projects.

Public involvement

Our public involvement strategy starts with the question: how can the lay public be meaningfully involved in complex systems of urban decision-making? Instead of undertaking yet more (often mandatory) consultation with citizens on development proposals, we will establish (in addition to the lay public aspect of the intervention in WP4) a Lay Public Advisory Group (LPAG). The LPAG will include 6 to 12 members who reflect the diversity of the lay publics, they will meet twice a year in each case study location. The LPAG will also participate in the annual wider Advisory Group (WP5); two representative LPAG members will sit on our External Advisory Board. Lay training modules on the challenge areas (e.g. urban health issues, urban planning, power structures) and language will be developed to support the lay advisors and enable them to advise on key areas including interview questions, analysis of qualitative data, development of bridging mechanisms and policy recommendations. Where needed training and lay public learning modules will be provided in upstream urban governance.

Analysis plan

Analysis of WP1 data will help to inform the design of the multi-action intervention through WP3, and in WP4. Data collected in Phases 2 and 3 will evaluate the extent to which the intervention impacts on policy and practice, and help to develop the next iteration of the intervention, and will be analysed using actor, game and network[95], thematic[96–98], and critical, socio-legal and regulatory analysis[99], as well as drawing on approaches from systems science, risk management and scenario modelling[100–102]. At each tier of governance we will need to identify what is within the control of decision-makers involved in the study ('endogenous') and those factors that are largely exogenous (e.g. technological futures, European/global geo-politics)[40]. Under WP3, soft systems methods will be applied as appropriate (in this and other WPs), and graphic mapping will be employed to enable complex system navigation, understanding and communication. These methods may draw on a range of systems tools and processes including: problem structuring, rich pictures, actor constellations, system

dynamics and causal loop models[103–106]. The stated preference, survey-based, research in WP2 will draw upon a range of econometric methods to interrogate data that looks to derive monetary values and the determinants of these values. Parameterization of the attendant uncertainties will inform the ways in which data on monetary valuation is subsequently communicated in the case study interventions. In WP6 data will be analyzed iteratively following a Grounded Theory approach[107,108]. This will be used to develop a map of concepts and hypothesis relating to the research foci of interest for each phase of the TRUUD work programme. This will form the first stage in the inductive and abductive reasoning to link the TRUUD research findings and impact (outcomes) to the TRUUD research assets, people (academic and stakeholder networks), processes (methods and methodologies) and practices (interventions). If required, statistical analysis will be small-scale and present straightforward statistical analyses on specific issues, e.g. the results of polling and surveys.

Ethics and risks

Research ethics has been approved by the Research Ethics Committees at University of Bristol's Faculty of Health Sciences (REFs: 94162 and 10818) and Faculty of Engineering (Ref: 99963), University of Bath's School of Management (Ref: S21-065) and Economics (S21–034). Where other institutions are involved, they have reviewed relevant ethics applications and decisions and provided written approval. All participants in the research will be asked to provide written informed consent before participation in the research. No individual participants will be identifiable from publications resulting from this study. All data provided will be kept confidential and anonymised. Risks include: change in political administration in partner local governments; alignment of research with real world timescales; effective integration of wide ranging disciplines within limited time and resource constraints; academic structures limiting societal impact. We are mitigating these risks through: embedding researchers in residence; high level of co-production with practitioners; highly integrated research design; governance structure with central coordination function responsible for societal impact strategy. Other risks include: loss of key personnel and case study projects being delayed, which we will mitigate through identification of proxies and identifying a range of potential projects, respectively.

Dissemination of findings

The research will be disseminated through academic channels (peer-reviewed publications and conference presentations), but also, to maximise the impact of the research, there will be a strong focus on sharing the results of the research with urban development decision-makers. A primary activity in TRUUD is the co-production, with potential end users and stakeholders (including lay public), of the intervention. Throughout there will be an ongoing programme of knowledge exchange through WP5, the strategy for which will also be coproduced with key stakeholders, decision-makers and lay public. We will use a variety of communication channels to reach a broad range of audiences in order to maximise both the societal and academic impact of the research.

Study status

The research programme started on 1 October 2019.

Discussion and conclusion

Identified challenges relate primarily to: a) the effective integration of (the wide range of) researchers and disciplines, and their collective orientation towards a shared societal goal; b) addressing uncertainties in the evidence base; and c) the design and evaluation of beneficial impact on health outcomes (downstream, resulting from decisions made far upstream and in complex real-world situations). This is a large programme of research that brings together many diverse disciplines alongside multiple stakeholders and sectors. We anticipate practical/operational issues, common to all large, highly interdisciplinary projects. The level of complexity and the core focus on demonstrable real-world impact require new ways of working and justifies an additional level of coordination and structuring[18,57]. As Hall *et al.* (2014) observe, much of the process of creative endeavour and innovation lies at that point of tension and resolution: *"conflicts and related debate can lead to new perspectives and new knowledge, they ultimately may be helpful for making strategic decisions and enhancing team performance"*[62]. Conversely, they also warn that *"these differences can result in conflict and negatively impact team performance, if the conflict is not managed"*. In addition to the meta-research work package, we have pervasive reflexive interests stimulated by a shifting emphasis from "public health research" to the broader disciplinary and practical embrace of "health of the public research"[18], and will draw on new approaches such as those being pioneered in the field of team science[62,109,110]. The challenge relating to uncertainties links not just to the economic valuation, which is based on assumptions and partial data availability, but also to wider decision factors: full information is rarely available to decision makers, future scenarios maybe unknowable, and therefore decision-making with uncertainty is inevitable. With regards the former, we will ensure that the evidence available for the economic valuation is sourced as comprehensively as possible, but are aware too that significant uncertainties will remain. The challenge for the group will be in identifying salient narratives and developing a supporting framework for decision-making that takes these uncertainties in to account. Risk management approaches are likely to play a prominent part. Within a five-year research project, it will not be possible to demonstrate reduction in NCDs. Apart from abrupt shifts in urban management policies (e.g. congestion charging), urban infrastructure changes slowly, over decades and centuries. The complex range of variables mean that demonstrating clear causation is also impossible. Our goal therefore, is to test demonstrable and immediate changes in attitudes and behaviours amongst the target user groups, as well as changes to policy and practice, within the award period; in particular in decision-making within the systems of governance in Bristol, Manchester (and London in relation to national-level mechanisms linked to city development).

Data availability

Underlying data

No data are associated with this article.

References

1. Dannenberg Frumkin H, Jackson RA: **Making healthy places – designing and building for health, well-being and sustainability.** Washington, DC: Island Press; 2011.
Publisher Full Text
2. Cooper R, Boyko CT, Cooper C: **Design for health: the relationship between design and noncommunicable diseases.** *J Health Commun.* 2011; **16 Suppl 2**: 134–57.
PubMed Abstract | Publisher Full Text
3. Feinstein L, Vorhaus J, Sabates R: **Mental Capital and Wellbeing: Making the most of ourselves in the 21st century.** Learning through life: Future challenges. Government Office for Science; 2008.
Reference Source
4. Scambler G: **Health inequalities.** *Sociol Health Illn.* 2012; **34**(1): 130–46.
PubMed Abstract | Publisher Full Text
5. Bartley M, Blane D: **Life-course influences on health at older ages.** In: Graham H, editor. *Understanding Health Inequalities*. Maidenhead: Open University Press; 2009.
Reference Source
6. Kickbusch I, Allen L, Franz CJ: **The commercial determinants of health.** *Lancet Glob Health.* 2016; **4**(12): e895–6.
PubMed Abstract | Publisher Full Text
7. Oncology TL: **Climate change and non-communicable diseases.** *Lancet Oncol.* 2016; **17**(1): 1.
PubMed Abstract | Publisher Full Text
8. Whitmee S, Haines A, Beyrer C, *et al.*: **Safeguarding human health in the Anthropocene epoch: Report of the Rockefeller Foundation-*Lancet* Commission on planetary health.** *Lancet.* 2015. **386**(10007): 1973–2028.
PubMed Abstract | Publisher Full Text
9. Gov: **Select Committee on the Long-term Sustainability of the NHS. The Long-term Sustainability of the NHS and Adult Social Care. Report of Session 2016-17 - published 5 April 2017 - HL Paper 151. Chapter 6: Public health, prevention and patient responsibility**. 2017; Accessed: 26/2/22.
Reference Source
10. TRUUD: **What are Non-Communicable Diseases and why are they an urban problem?** TRUUD Website. Blog. 2022; Accessed 22/6/22.
Reference Source
11. Daly H, Farley J: **Ecological Economics: Principles and Appilcations.** Washington DC: Island Press; 2004.
Reference Source
12. Hardin G: **The tragedy of the commons.** *Science.* 1968; **162**(3859): 1243–1248.
PubMed Abstract | Publisher Full Text
13. Giddens A: **The politics of climate change.** *Policy Polit.* 2015; **43**(2): 155–62.
Publisher Full Text
14. Local Government Association: **Devolution Deals**. 2018.
Reference Source
15. Government Office for Science: **Future of Cities: Foresight for Cities. A resource for policy-makers**. London, 2016.
Reference Source
16. Pain K, Van Hamme G: **Changing urban and regional relations in a globalizing world: Europe as a global macro-region.** Cheltenham: Edward Elgar; 2014.
Reference Source
17. Carey G, Crammond B: **Systems change for the social determinants of health.** *BMC Public Health.* 2015; **15**(1): 662.
PubMed Abstract | Publisher Full Text | Free Full Text
18. Academy of Medical Sciences: **Improving the health of the public by 2040: Optimising the research environment for a healthier, fairer future.** London; 2016.
Reference Source
19. Mayer C: **Firm commitment: Why the corporation is failing us and how to restore trust in it.** OUP Oxford; 2013.
Reference Source
20. World Health Organization: **Health in All Policies: Helsinki Statement.** Framework for Country Action. Geneva; 2014.
Reference Source
21. Davies SC, Winpenny E, Ball S, *et al.*: **For debate: a new wave in public health improvement.** *Lancet.* 2014; **384**(9957): 1889–1895.
PubMed Abstract | Publisher Full Text
22. Jackson T: **The Post-growth Challenge: Secular Stagnation, Inequality and the Limits to Growth.** *Ecol Econ.* 2019; **156**: 236–46.
Publisher Full Text
23. Raworth K: **Donut Economics: How to think like a 21st-century economist.** Sevenoaks. UK: Cornerstone Digitial. 2017.
Reference Source
24. Sniehotta FF, Araújo-Soares V, Brown J, *et al.*: **Complex systems and individual-level approaches to population health: a false dichotomy?** *Lancet Public Health.* 2017; **2**(9): e396–e397.
PubMed Abstract | Publisher Full Text
25. Ayres S: **How can network leaders promote public value through soft metagovernance?** *Public Adm.* 2019.
Publisher Full Text
26. Healey P: **Creating public value through caring for place.** *Policy Politics.* 2018; **46**(1): 65–79(15).
Publisher Full Text
27. Trejo-Nieto A: **Financialising city statecraft and infrastructure.** *Reg Stud.* 2020.
28. Ayres S, Flinders M, Sandford M: **Territory, power and statecraft: understanding English devolution.** *Reg Stud.* 2018; **52**(6): 853–864.
Publisher Full Text
29. Black D, Scally G, Orme J, *et al.*: **Moving Health Upstream in Urban Development: Reflections on the Operationalization of a Transdisciplinary Case Study.** *Glob Chall.* 2018 [cited 2019 Mar 14]; **3**(4): 1700103.
PubMed Abstract | Publisher Full Text | Free Full Text
30. Black D, Pilkington P, Williams B, *et al.*: **Overcoming systemic barriers preventing healthy urban development in the UK: main findings from interviewing senior decision-makers during a three-year planetary health pilot**. *J Urban Health.* 2021. In Press.
31. Edwards N: **How can systems' approaches be optimally used to advance the primary prevention research agenda? UKPRP Workshop**. 2018.
32. Carney M: **Breaking the tragedy of the horizon – climate change and financial stability**. Lloyd's of London: Bank of England. 2015.
Reference Source
33. Kubiszewski I, Costanza R, Franco C, *et al.*: **Beyond GDP: Measuring and achieving global genuine progress.** *Ecol Econ.* 2013; **93**: 57–68.
Publisher Full Text
34. Marmot M: **Michael Marmot (Presentation).** In: *The Health Gap: The Challenge of an Unequal World*. 2015.
Reference Source
35. Stirling A: **Limits to the value of external costs.** *Energy Policy.* 1997; **25**(5): 517–540.
Publisher Full Text
36. Sagoff M: **Some Problems with Environmental Economics.** *Environ Ethics.* 1988; **10**(1): 55–74.
Publisher Full Text
37. OECD, Publishing O: **The Cost of Air Pollution: Health Impacts of Road Transport.** 2014.
Publisher Full Text
38. Hawe P, Shiell A, Riley T: **Theorising interventions as events in systems.** *Am J Community Psychol.* 2009; **43**(3–4): 267–76.
PubMed Abstract | Publisher Full Text
39. Eaton E, Hunt A, Black D: **Economic Valuation of the Health Impacts of Urban Environment.** *Working Paper.* 2020.
40. Meadows DH: **Thinking in Systems: A Primer.** Oxford, UK: Earthscan. 2009.
Reference Source
41. Haldane A: **Who owns a company?** University of Edinburgh Corporate Finance Conference.: Bank of England. 2015.
Reference Source
42. Chapman J: **System failure: Why governments must learn to think differently.** Demos, 2004.
Reference Source
43. Verweij M, Thompson M: **Clumsy solutions for a complex world. Governance, politics and plural perceptions.** Global Issues Series. 2006.
Publisher Full Text
44. Raelin JD, Bondy K: **Putting the good back in good corporate governance: The presence and problems of double-layered agency theory.** *Corp Gov An Int Rev.* 2013; **21**(5): 420–435.
Publisher Full Text
45. Parker MJ: **Shut Down the Business School: What's Wrong with Managment Education**. London: Pluto Press, 2018; **1**(2).
Publisher Full Text
46. Jacobs M, Mazzucato M: **Rethinking capitalism: Economics and policy for sustainable and inclusive growth.** Chichester, UK: John Wiley & Sons, 2016.
Reference Source
47. Bondy K, Starkey K: **The dilemmas of internationalization: Corporate social responsibility in the multinational corporation.** *Br J Manag.* 2014; **25**(1): 4–22.
Publisher Full Text
48. Reed M: **Researching organizational elites: A critical realist perspective.** In: Golsorkhi D CDSJ, editor. *Rethinking Power in Organizations, Institutions, and Markets*. Bingley, UK: Emerald Group Publishing Limited. 2012; **34**: 21–53
Publisher Full Text
49. Scambler G, Higgs P: **'The dog that didn't bark': taking class seriously in the health inequalities debate.** *Soc Sci Med.* 2001; **52**(1): 157–9.
PubMed Abstract | Publisher Full Text
50. Scally G, Black D, Pilkington P, *et al.*: **The application of 'elite interviewing' in**

health research: a record of process and lessons learned during a three-year pilot in urban planetary health research. *J Urban Health.* 2021. In Press.

51. DCLG: **Environmental Impact Assessment: A Guide to Procedures.** Department for Communities and Local Government. 2006.
52. Quick KS, Feldman MS: **Distinguishing participation and inclusion.** *J Plan Educ Res.* 2011; **31**(3): 272–290.
Publisher Full Text
53. Vanleene D, Verschuere B, Voets J: **Benefits and Risks of Co-production. A preliminary literature review.** IIAS Conf co-production public Serv. 2015; 20.
Reference Source
54. Habermas J: **On the Pragmatics of Communication**. Cambridge, MA: MIT Press, 1998.
Reference Source
55. All-Party Parliamentary Group on Arts, Health and Wellbeing: **Creative Health: The Arts for Health and Wellbeing - second edition.** All Party Parliam Gr Arts, Heal Wellbeing Inq Rep. 2017.
Reference Source
56. Austen KAT: **The Art of Health.**
Reference Source
57. UKPRP: **The UK Prevention Research Partnership (UKPRP): Vision, objectives and rationale**. 2017.
Reference Source
58. Judge K, Bauld L: **Strong theory , flexible methods: Evaluating complex community-based initiatives.** *Critical Public Health.* 2001; **11**(1): 19–38.
Publisher Full Text
59. Bai X, Nath I, Capon A, *et al.*: **Health and wellbeing in the changing urban environment: complex challenges, scientific responses, and the way forward.** *Curr Opin Environ Sustain.* 2012; **4**(4): 465–472.
Publisher Full Text
60. Rutter H, Savona N, Glonti K, *et al.*: **The need for a complex systems model of evidence for public health.** *Lancet.* 2017; **390**(10112): 2602–2604.
PubMed Abstract | Publisher Full Text
61. Lawrence RJ: **Advances in transdisciplinarity: Epistemologies, methodologies and processes.** *Futures.* 2015; **65**: 1–9.
Publisher Full Text
62. Hall KL, Vogel AL, Stipelman BA, *et al.*: **A four-phase model of transdisciplinary team-based research: goals, team processes, and strategies.** *Transl Behav Med.* 2012; **2**(4): 415–430.
PubMed Abstract | Publisher Full Text | Free Full Text
63. Bammer G: **Disciplining Interdisciplinarity: Integration and Implementation Sciences for Researching Complex Real-World Problems**. ANU Press. Sydney. 2013.
Publisher Full Text
64. Gardner G: **The City: A System of Systems.** *State of the World.* Washington DC: Island Press. 2016; 27–44.
Publisher Full Text
65. El-Sayed AM, Galea S: **Systems Science and Population Health**. Oxford University Press. 2017.
Reference Source
66. Tonurist P: **Looking beyond systems thinking to tackle wicked problems.** *Sitra Lab.* 2019.
Reference Source
67. Bryson J, Sancino A, Benington J, *et al.*: **Towards a multi-actor theory of public value co-creation.** *Public Manag Rev.* 2017; **19**(5): 640–654.
Publisher Full Text
68. Crosby BC, 't Hart P, Torfing J: **Public value creation through collaborative innovation.** *Public Manag Rev.* 2017; **19**(5): 655–669.
Publisher Full Text
69. Torfing J: **Metagovernance**. In: J AC& T, editor. *Handbook on Theories of Governance*. Cheltenham: Edward Elgar; 2016; 525–527.
Reference Source
70. Galea S, Riddle M, Kaplan GA: **Causal thinking and complex system approaches in epidemiology.** *Int J Epidemiol.* 2010; **39**(1): 97–106.
PubMed Abstract | Publisher Full Text | Free Full Text
71. Homer-Dixon T: **Strategies for studying causation in complex ecological-political systems.** *J Environ Dev.* 1996; **5**(2): 132–48.
Reference Source
72. Moore GF, Evans RE, Hawkins J, *et al.*: **From complex social interventions to interventions in complex social systems: Future directions and unresolved questions for intervention development and evaluation.** *Evaluation (Lond).* 2019; **25**(1): 23–45.
PubMed Abstract | Publisher Full Text | Free Full Text
73. Diez Roux AV: **Complex systems thinking and current impasses in health disparities research.** *Am J Public Health.* 2011; **101**(9): 1627–34.
PubMed Abstract | Publisher Full Text | Free Full Text
74. Kwakkel JH: **Managing Deep Uncertainty: Exploratory Modelling, Adaptive Plans and Decision-Support**. 2018.
Reference Source
75. Robeson P, Dobbins M, DeCorby K: **Life as a knowledge broker in public health.** *J Can Heal Libr Assoc.* 2008; **29**(3): 79–82.
Publisher Full Text
76. Chew S: **I am a knowledge broker': Exploring the enactment of formalised intermediary roles in an academic/practice collaboration [CLAHRC].** *Bridging the Gap.* University of Edinburgh. 2011.
77. Kislov R, Wilson P, Boaden R: **The 'dark side' of knowledge brokering.** *J Heal Serv Res.* 2017; **22**(2): 107–112.
PubMed Abstract | Publisher Full Text | Free Full Text
78. Coggon J, Black D: **From Critical Foundations to Implementation Strategy: Developing Key Governance Principles for a Five Year Research Programme**. 2020.
79. Andersen J, Toom K, Poli S: **Research Management: Europe and Beyond**. Academic Press, 2018.
Reference Source
80. Eaton E, Hunt A: **Towards a valuation of the urban environment by its potential impact on human health - estimations of societal value in the UK new build context**. 2019.
81. Pascal M, Corso M, Chanel O, *et al.*: **Assessing the public health impacts of urban air pollution in 25 European cities: Results of the Aphekom project.** *Sci Total Environ.* 2013. **449**: 390–400.
PubMed Abstract | Publisher Full Text
82. Scally G, Black D, Pilkington P: **In support of elite interviewing in urban planetary health research: a record of process and lessons learned during a three-year pilot**. Working Paper. 2020.
83. Reed M: **Research Impact Handbook.** *Fast Track Impact.* 2016.
Reference Source
84. Mazzucato M, Dibb G: **MISSIONS : A BEGINNER 'S GUIDE**. 2019.
Reference Source
85. Mazzucato M: **Mission-Oriented in the European Union**. 2018.
Reference Source
86. Breuer E, Lee L, De Silva M, *et al.*: **Using theory of change to design and evaluate public health interventions: A systematic review.** *Implement Sci.* 2016; **11**(1): 63.
PubMed Abstract | Publisher Full Text | Free Full Text
87. Skivington K, Matthews L, Simpson SA, *et al.*: **A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance.** *BMJ.* 2021; **374**: n2061. Accessed 22/6/22.
PubMed Abstract | Publisher Full Text | Free Full Text
88. DCLG: **Multi-criteria Analysis: A Manual**. Department for Communities and Local Government. 2009.
Reference Source
89. RICS: **Red Book: RICS Valuation**. 2018; **2018**.
Reference Source
90. Treasury HM: **Green Book: appraisal and evaluation in central government**. London. 2018.
Reference Source
91. Stokols D, Hall KL, Taylor BK, *et al.*: **The science of team science: overview of the field and introduction to the supplement.** *Am J Prev Med.* 2008; **35**(2 Suppl): S77–89.
PubMed Abstract | Publisher Full Text
92. Committee on the Science of Team Science; Board on Behavioral, Cognitive, and Sensory Sciences; Division of Behavioral and Social Sciences and Education, **Enhancing the Effectiveness of Team Science**. 2015.
PubMed Abstract | Publisher Full Text
93. Gibson A, Britten N, Lynch J: **Theoretical directions for an emancipatory concept of patient and public involvement.** *Health (London).* (United Kingdom). 2012; **16**(5): 531-47.
PubMed Abstract | Publisher Full Text
94. Gibson A, Welsman J, Britten N: **Evaluating patient and public involvement in health research: from theoretical model to practical workshop.** *Health Expect.* 2017; **20**(5): 826–35.
PubMed Abstract | Publisher Full Text | Free Full Text
95. Koppenjan J, Klijn EH: **Governance networks in the public sector**. London: Routledge; 2015.
Publisher Full Text
96. Braun V, Clarke V: **Using thematic analysis in psychology.** *Qual Res Psychol.* 2006; **3**(2): 77–101.
Publisher Full Text
97. Gerson, Horowitz RK: **Observation and Interviewing: Options and Choices in Qualitative Research.** In: May T editor. *Qualitative Research in Action.* London: Sage; 2002;.199–224.
Publisher Full Text
98. Miles, Huberman MM: **Data Management and Analysis Methods.** In: N. Denzin & YL, editor. *Collecting and Interpreting Qualitative Materials.* Thousand Oaks, California: Sage; 1998.
99. Coggon J, Syrett K, Viens AM: **Public Health Law: Ethics, Governance, and Regulation.** Routledge. 2016.
Publisher Full Text
100. Beach LR: **Decision making: Linking narratives and action.** *Narrat Inq.* 2009; **19**(2): 393–414.
Publisher Full Text
101. Brown AD, Stacey P, Nandhakumar J: **Making sense of sensemaking narratives.** *Human Relations.* 2008; **61**(8).
Publisher Full Text

102. Pidgeon N: **Climate Change Risk Perception and Communication: Addressing a Critical Moment?** *Risk Anal.* 2012; **32**(6): 951–6.
PubMed Abstract | Publisher Full Text

103. de Pinho H: **Generation of systems maps**. In: Galea AE-S and S,editor. *Systems Science and Population Health*. Oxford: Oxford University Press. 2017.
Publisher Full Text

104. White L, Burger K, Yearworth M: **Understanding behaviour in problem structuring methods interventions with activity theory.** *Eur J Oper Res.* 2016; **249**(3): 983–1004.
Publisher Full Text

105. Bell S, Morse S: **How People Use Rich Pictures to Help Them Think and Act.** *Syst Pract Action Res.* 2013; 331–348.
Publisher Full Text

106. Williams B, Hummelbrunner R: **Systems concepts in action: a practitioner's toolkit.** Stanford: Stanford University Press. 2010.
Reference Source

107. Timonen V, Foley G, Conlon C: **Challenges when using grounded theory: A pragmatic introduction to doing GT research.** *Int J Qual Methods.* 2018; **17**(1).
Publisher Full Text

108. Glaser BG, Strauss AL: **The Discovery of Grounded Theory.** In: The Discovery of Grounded Theory. 2019.
Reference Source

109. Borner K, Contractor N, Falk-Krzesinski HJ, *et al.*: **A multi-level systems perspective for the science of team science.** *Sci Transl Med.* 2010; **2**(49): 49cm24.
PubMed Abstract | Publisher Full Text | Free Full Text

110. Falk-Krzesinski HJ, Borner K, Contractor N, *et al.*: **Advancing the Science of Team Science.** *Clin Transl Sci.* 2010; **3**(5): 263–6.
PubMed Abstract | Publisher Full Text | Free Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔ ✔

Version 2

Reviewer Report 25 July 2022

https://doi.org/10.21956/wellcomeopenres.19993.r51443

✔ **Keisuke Kuwahara**
Teikyo University Graduate School of Public Health, Tokyo, Japan

At the initial round of peer-review, I provided several comments especially on methodology for clarification. In this revision, the authors have adequately responded to my previous comments and updated their manuscript. Therefore, I have no further comments on the manuscript.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 22 July 2022

https://doi.org/10.21956/wellcomeopenres.19993.r51444

✔ **Sina Azadnajafabad**
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Andisheh Amouzadeh
Urban Planning and Design Department, University of Tehran, Tehran, Iran

Although the changes and responses were not utterly satisfying regarding our comments, we suppose the overall efforts of the authors were acceptable at this stage of their proposed protocol of the mentioned project, and this draft earns the merit for indexing in its current format.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, Non-communicable diseases, Epidemiology, Health policy, Urban design, Urban planning

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 19 July 2022

https://doi.org/10.21956/wellcomeopenres.19993.r51442

Martin McKee
London School of Hygiene and Tropical Medicine, London, UK

In my initial comments, I identified a number of issues but recognised that it would be difficult to address them all within what was an already dense paper. I am content that the authors have addressed them, but mainly in their replies to my paper. Given that the purpose of such comments is to inform the research and my review and the replies are on the website, I believe that this is satisfactory.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public Health.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 04 January 2022

https://doi.org/10.21956/wellcomeopenres.18021.r46171

Keisuke Kuwahara
Teikyo University Graduate School of Public Health, Tokyo, Japan

This is an elaborate and interesting project involving multiple stakeholders, especially those who are responsible for urban planning and development, exchanging knowledge, and creating arts outputs, in my understanding in order to change the practice on urban planning and development. Even though this is a study protocol paper, details of the protocol are not provided (just showing the overall framework). Thus, it was difficult for me to provide comments. I have some additional comments for clarification as shown below:

Protocol:

- Please clarify whether the study protocol approved by the University of Bristol's Faculty of Health Sciences Research Ethics Committee is the same as this paper or not. Did the authors submit to the ethics committee a more detailed protocol? Or, did the authors submit the same, one protocol?

Research setting:

- Please specify the location of the research setting in this section. Bristol and Manchester?

Programme coordination and workplace packages:

- Regarding the literature review, MEDLINE (PubMed) was not included. As related papers might be found, it may be better to use MEDLINE/PubMed.
- The authors show a number of interviews workshops. Adding the unit of the number may help improve readability.
- Will authors examine the quality of eligible papers? If so, how?
- I could not find an explanation about methods for evaluating changes in attitudes, behaviors, policy, and practice (WP1-Yr4 in Figure 3). Please clarify.
- Abbreviation of Lay Public Advisory Board is shown as LPAG. Is this correct?

Figure 2:

- It would be nice if which part indicates "3-part intervention" as there are many arrows.

Figure 3:

- WP1 includes evaluating changes in attitudes, behavior, policy, and practice. I want to know their indicators and study design for assessment (e.g., qualitative study, etc.) in this figure.
- To me, it is difficult to understand what "valuations" mean in WP2 from this figure.
- Including words, Phase 1, Phase 2, Phase 3, and Phase 4 in this figure may help improve the connection between this figure and text.

Figure 4:

- It would be helpful if the meaning of "AWARD" was clarified.
- I am confused about the timing of yielding OUTPUTS.
- It takes some time to understand the relationship between Figure 3 and Figure 4.

Other minor comments:

- 16. What kind of reporting guideline will be used to report case studies?

- 17. The authors emphasize “two case studies”. When reporting in academic journals, will the authors merge them or separately report?

Is the rationale for, and objectives of, the study clearly described?
Yes

Is the study design appropriate for the research question?
Yes

Are sufficient details of the methods provided to allow replication by others?
Partly

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, epidemiology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 04 Jul 2022

Daniel Black, University of Bristol, Bristol, UK

Reviewer 3 comment: This is an elaborate and interesting project involving multiple stakeholders, especially those who are responsible for urban planning and development, exchanging knowledge, and creating arts outputs, in my understanding in order to change the practice on urban planning and development. Even though this is a study protocol paper, details of the protocol are not provided (just showing the overall framework). Thus, it was difficult for me to provide comments.

Authors’ response: We are grateful to the reviewers for taking the time to feedback on our Protocol, and apologies for delay in the response. The reviewers’ concerns are understandable and expected, given the wide range of interconnected knowledge domains involved. One of the challenges inherent in developing new approaches to public health research in areas that span multiple knowledge domains outside public health is the challenge of reviewing articles that seek to bring together so many different areas of specialism (Bammer G, 2013).

I have some additional comments for clarification as shown below:

Protocol:
Please clarify whether the study protocol approved by the University of Bristol's Faculty of Health Sciences Research Ethics Committee is the same as this paper or not. Did the authors submit to the ethics committee a more detailed protocol? Or, did the authors submit the same, one protocol?

Authors' response: The University has its own ethics application form so we did not submit this Protocol itself, but the form sets out, largely, the same details that are in this Protocol. It's less detailed in some areas (e.g. work coordination), but more in others (e.g. risks/sensitivities). There were also multiple ethics applications submitted later across different faculties and institutions, each having different requirements. University of Bath required a separate approval for the interviews, whereas Universities of Manchester and Reading were happy to approve Bristol's ethics application. There were also separate applications for the workshops (University of Bristol's Faculty of Engineering), the economics (University of Bath's Department of Economics) and a separate survey work for the Frome Gateway (University of Bristol). These new references are now supplied in the revised Protocol.

Research setting:
Please specify the location of the research setting in this section. Bristol and Manchester?

Authors' response: Bristol and Manchester are our two case study city-regions, but we are also engaging nationally with Government and with a wide range of private and third sector actors. We will amend the description to make this clearer.

Programme coordination and workplace packages:
Regarding the literature review, MEDLINE (PubMed) was not included. As related papers might be found, it may be better to use MEDLINE/PubMed.

Authors' response: This was not a formal systematic review, but an initial scoping exercise, the main purpose of which was to enable the newly recruited group to familiarise themselves with each others' knowledge domains. We used multiple databases from each of the disciplines. MEDLINE/PubMed was one, but there were many others, and most from outside public health. We hope we have made this clearer in the review.

The authors show a number of interviews workshops. Adding the unit of the number may help improve readability.

Authors' response: We can now add the exact number of phase 1 interviews (127) and workshops (4) now that we have completed them, but we can't yet specify the number of engagements will be undertaking in Phase 2 so suggest we keep it as originally stated in the Protocol.

Will authors examine the quality of eligible papers? If so, how?

Authors' response: We did not undertake a formal assessment in the WP1 literature review (such as PRISMA, which we do use in WP2's systematic reviews) as it was not a formal systematic review. See above comment in response to MEDLINE/PubMed suggestion.

I could not find an explanation about methods for evaluating changes in attitudes, behaviors, policy, and practice (WP1-Yr4 in Figure 3). Please clarify.

Authors' response: In the methods section of WP3 we state: "*The intervention, impact and evaluation strategies will be co-produced and tested iteratively internally and externally with end users*." This echoes MRC's latest guidelines on complex interventions (Skivington et al, 2021), which states: "*A crucial aspect of evaluation design is the choice of outcome measures or evidence of change. Evaluators should work with stakeholders to assess which outcomes are most important, and how to deal with multiple outcomes in the analysis*." They cite as an example group model building and social network analysis, which we are using, but we are also employing health and environmental economic modelling and qualitative interview and workshop data gathering. We have already started evaluating the process through critical reflection and will continue to do so formally through the intervention design and evaluation stages, in order to inform development of programme theory. We are also undertaking 'evaluability assessments' as part of the feasibility work. To respond to this concern, we have added some further descriptive text, but it remains the case that it is yet to be co-designed.

Abbreviation of Lay Public Advisory Board is shown as LPAG. Is this correct?

Authors' response: Thank you for flagging this. It's not consistent and we have changed. We sometimes use the word 'Board' and 'Group' interchangeably.

Figure 2:
It would be nice if which part indicates "3-part intervention" as there are many arrows.

Authors' response: The whole diagram illustrates the intervention given co-production and testing of the intervention with stakeholders is core to the process, but the circle on the left indicates the three main areas of evidence. We have therefore updated the image to indicate that more clearly and hope this addresses the reviewer's concern.

Figure 3:
WP1 includes evaluating changes in attitudes, behavior, policy, and practice. I want to know their indicators and study design for assessment (e.g., qualitative study, etc.) in this figure.

Authors' response: We have yet to detail the evaluation design in detail, which could not be predetermined until it was clear where we would be intervening, not least as a core part of the evaluation needs to be developed with stakeholders. We will likely use a combination of qualitative data gathering through stakeholder engagement (interviews, surveys) alongside the quantitative valuation from the economic modelling, combined with systems approaches (e.g. ripple effect mapping). We have added a few words to that effect in the box indicated, though given there is limited space, it does not describe in full.

To me, it is difficult to understand what “valuations” mean in WP2 from this figure.

Authors’ response: This refers to the health and economic modelling of the two case study plans/projects in Bristol and Greater Manchester, and the development of their real world application in upstream decision-making areas of intervention. We have added this description in to the figure.

Including words, Phase 1, Phase 2, Phase 3, and Phase 4 in this figure may help improve the connection between this figure and text.

Authors’ response: Thank you – that is helpful and we have now updated. We hope this addresses your concern below about the difference between Figures 3 and 4.

Figure 4:
It would be helpful if the meaning of “AWARD” was clarified.

Authors’ response: This is the language used by the funder and it refers to the grant/funding period (i.e. the 5 years from October 2019). We have changed ‘award’ to ‘research’.

I am confused about the timing of yielding OUTPUTS.

Authors’ response: This has now been updated to show the Phases and we agree is now clearer, thank you.

It takes some time to understand the relationship between Figure 3 and Figure 4.

Authors’ response: We hope this addresses this concern above.

Other minor comments:
16. What kind of reporting guideline will be used to report case studies?

Authors’ response: Given the transdisciplinary nature of our research, we have a range of different disciplines, standards and expectations to accommodate. We will use a range of reporting guidelines depending on the research lead, the target audience and the purpose of the reporting. Typically, our public health researchers would use COREQ for our qualitative research, and we will refer to (and promote) the Equator Network to determine which guideline is most suitable. Our economists may use the CHEERS reporting guideline, though it depends on whether it’s a useful fit as the modelling is a integration of approaches.

17. The authors emphasize “two case studies”. When reporting in academic journals, will the authors merge them or separately report?

Authors’ response: Both. Some of the researchers will be reporting on just one (for example, the Researchers-in-Residence at Bristol and Greater Manchester), while others will

merge them to consider common themes and wider systems implications.

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- Skivington et al (2021) A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. Research Methods and Reporting. *BMJ*. Accessed 22/6/22. Available from: https://www.bmj.com/content/bmj/374/bmj.n2061.full.pdf

Competing Interests: No competing interests were disclosed.

Reviewer Report 18 October 2021

https://doi.org/10.21956/wellcomeopenres.18021.r46172

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Sina Azadnajafabad
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Andisheh Amouzadeh
Urban Planning and Design Department, University of Tehran, Tehran, Iran

We are honored to provide an integrated review of this study protocol based on both public health and urban planning points of view. The authors of this protocol introduced their proposed prevention program to address the unhealthy urban development issue as a root cause of non-communicable diseases (NCDs). In brief, the authors tried to fill the gap in knowledge and executive steps of inappropriate urban development with this research protocol. Although the project and the provided protocol are well thought and designed, we found many major concerns regarding the proposed plan, which comments are as follows in this letter. Additionally, we read the previous comments of the reviewer and the responses to those comments and tried not to emphasize duplicate issues; however, in some cases, it is inevitable as the issue is major and could not be neglected.

Overall, the draft is too complicated. We understand the nature of such work necessitates providing this much information. However, scientific writing always comes alongside simplicity besides the right and essential components of science, and in case of complexity, even some simple points could be missed and make the research less advantageous.

Regarding the sections of protocol papers, the format varies based on submitted journals. However, following rational formatting is necessary anyway. Section and subsections of this paper

could be divided into three major sections of “Introduction and rationale”, “Protocol”, and “Discussion and conclusion” for a better understanding. It seems that the authors could not follow the coherent presentation of data in the protocol section and the subsections are out of order and this is where the audience of the paper gets bored and confused. Absolutely a revision of the core of this manuscript which is the “Protocol” section could help the reader of this paper.

“Introduction and rationale”: this section lacks the necessary information about the burden of NCDs in the real world, especially the investigated country, the UK. In fact, similarly, all parts of the paper lack the proper and essential views of public health experts and this is a major shortcoming of the current draft. The provided material is mainly for urban planning experts and policymakers; however, the goal of this project is to reach optimum health among the population. Therefore, adding some details and the language of public health to this manuscript is necessary in this regard, mainly in the introduction and discussion sections, where the importance of this topic and the ultimate results of this project should be highlighted.

“Protocol”: as the major section of this protocol, this section may cause significant confusion in readers. The information presented in each part of the work packages (WPs) is too much and does not follow a coherent format. A revision of this section to make it more understandable and only bringing practical points in this protocol paper could help more.

One major concern about this protocol is about the period of this project. Based on available information about the current project, it is planned for five years of action starting in 2019, and at this time, about two years have passed. Publication of a protocol of such a huge project, while it reached about half the way, is an alarming concern. In fact, protocols are meant to provide a clear vision of a prospective project, and publishing a complicated protocol like this in the current approved and executed format could be less useful for the scientific communities of both public health and urban planning. However, some amendments in this manuscript by providing the report and results of what the investigators did in these two years and the achievements they accomplished may be helpful to enable the audience to judge the feasibility and efficacy of such a program. For example, the state and results of the designed workshops mentioned in the protocol should be provided in this manuscript. Since a major time has passed, a progress report is necessary.

Similar to the previous review, there is still concern about the two cities chosen for the implementation of policies proposed in this protocol. Authors need to clearly state why they chose the mentioned cities for the specific policies. What made the cities special for running the proposed ideas in this project should be elaborated for readers. This point is very important regarding making the study reproducible in other regions and countries of the world.

“Discussion and conclusion”: as mentioned before, an essential part is missing in this section talking about the potential public health effects of this protocol. A logical estimation of the results and impacts of the implemented policies.

Is the rationale for, and objectives of, the study clearly described?

Partly

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?
Partly

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, Non-communicable diseases, Epidemiology, Health policy, Urban design, Urban planning

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Author Response 04 Jul 2022

Daniel Black, University of Bristol, Bristol, UK

Reviewer 2 comment: We are honored to provide an integrated review of this study protocol based on both public health and urban planning points of view. The authors of this protocol introduced their proposed prevention program to address the unhealthy urban development issue as a root cause of non-communicable diseases (NCDs). In brief, the authors tried to fill the gap in knowledge and executive steps of inappropriate urban development with this research protocol. Although the project and the provided protocol are well thought and designed, we found many major concerns regarding the proposed plan, which comments are as follows in this letter. Additionally, we read the previous comments of the reviewer and the responses to those comments and tried not to emphasize duplicate issues; however, in some cases, it is inevitable as the issue is major and could not be neglected.

Authors' response: We are grateful to the reviewers for taking the time to feedback on our Protocol with apologies for delay in response. The reviewers' concerns are understandable and expected, given the wide range of interconnected knowledge domains involved. There is an inherent challenge for journals in assessing research that aims to address complex systemic challenges upstream and brings together many multiple knowledge domains (Bammer G, 2013).

Reviewer 2 comment: Overall, the draft is too complicated. We understand the nature of such work necessitates providing this much information. However, scientific writing always comes alongside simplicity besides the right and essential components of science, and in case of complexity, even some simple points could be missed and make the research less advantageous.

Authors' response: Regarding it being too complicated, we suggest this is because a

number of the knowledge domains lie far outside traditional public health and urban planning (e.g. real estate finance, political science, corporate decision-making, law) so it requires an understanding of these other areas to see the implicit linkages within this brief text. Also, the approach is based fundamentally on co-creation, so as the first reviewer observes, it's not possible to second guess what will emerge. We have been tasked by our funders, the UK Prevention Research Partnership, to develop 'new approaches to population health research'; in other words, this type of research is still new (Skivington et al, 2021). Where there are specific suggestions for how to simplify, we have taken them on board, but we are unable to respond to generalised concerns.

Reviewer 2 comment: Regarding the sections of protocol papers, the format varies based on submitted journals. However, following rational formatting is necessary anyway. Section and subsections of this paper could be divided into three major sections of "Introduction and rationale", "Protocol", and "Discussion and conclusion" for a better understanding. It seems that the authors could not follow the coherent presentation of data in the protocol section and the subsections are out of order and this is where the audience of the paper gets bored and confused. Absolutely a revision of the core of this manuscript which is the "Protocol" section could help the reader of this paper.

Authors' response: We contest that presentation is not coherent, and are sorry to hear that you became bored and confused. We do follow the Wellcome Open Access guidelines, which says too that it is 'flexible'. However, in order to respond to this concern we have moved 'Research Setting' to the top, and moved the section on 'Ethics and Risks' to after the 'Analysis Plan'.

Reviewer 2 comment: "Introduction and rationale": this section lacks the necessary information about the burden of NCDs in the real world, especially the investigated country, the UK. In fact, similarly, all parts of the paper lack the proper and essential views of public health experts and this is a major shortcoming of the current draft. The provided material is mainly for urban planning experts and policymakers; however, the goal of this project is to reach optimum health among the population. Therefore, adding some details and the language of public health to this manuscript is necessary in this regard, mainly in the introduction and discussion sections, where the importance of this topic and the ultimate results of this project should be highlighted.

Authors' response: We agree that information on the burden of NCDs is limited, but this is necessary/intentional, and for two main reasons: i) a key requirement is that these protocols are brief so we are restricted in the level of detail of each of the knowledge domains we are uniting (not just information on NCDs); ii) we anticipate that those who read these publications will already be largely familiar with the now relatively well-known population health issues (issues of pollution, mental health, obesity, diabetes are well understood, even by the public in the UK). The material is not provided for urban planning experts alone, but a much wider range of experts. In fact, we are aiming that this is read by those outside of public health. That said, we have added a small amount of additional information on the burden of NCDs in the UK and we have signposted the reader to further information on our public-facing blog, which simplifies the NCD challenge area.

Reviewer 2 comment: “Protocol”: as the major section of this protocol, this section may cause significant confusion in readers. The information presented in each part of the work packages (WPs) is too much and does not follow a coherent format. A revision of this section to make it more understandable and only bringing practical points in this protocol paper could help more.

Authors’ response: See above.

Reviewer 2 comment: One major concern about this protocol is about the period of this project. Based on available information about the current project, it is planned for five years of action starting in 2019, and at this time, about two years have passed. Publication of a protocol of such a huge project, while it reached about half the way, is an alarming concern. In fact, protocols are meant to provide a clear vision of a prospective project, and publishing a complicated protocol like this in the current approved and executed format could be less useful for the scientific communities of both public health and urban planning. However, some amendments in this manuscript by providing the report and results of what the investigators did in these two years and the achievements they accomplished may be helpful to enable the audience to judge the feasibility and efficacy of such a program. For example, the state and results of the designed workshops mentioned in the protocol should be provided in this manuscript. Since a major time has passed, a progress report is necessary.

Authors’ response: This protocol was published just over a year into the programme of research, not two: it was published very early in 2021 and the project formally started late in 2019. 2020 was also the year Covid first hit so there have been understandable delays to the programme due to (e.g.) university recruitment freezes. As such, it was still in the very early stages of the 5-year programme when it was published and could not have been published any sooner. The proposal also went through a form of peer review via the application process itself; the protocol therefore is a formalisation of the application form, which was approved by a large advisory group of public health and linked experts. With regards amending the manuscript by providing a report on our first two years of activity, we provide comprehensive annual reports to our funders annually (each around 30 pages in length), which is reviewed each year by that same advisory group and a separate External Advisor Board, made up of leading experts in a wide range of areas both academic and practice based, who we meet with on a quarterly basis. It’s possible we could provide a short summary from these reports – the executive summaries – to add to this Protocol, but it’s not clear, given the complexity, how this information would provide the reviewer with substantive additional information, nor whether the reviewer would expect the same for all future annual reports. It's also not clear why the reviewer specified the state and result of the designed workshops specifically, as the bulk of the data from Phase 1 is derived from the interviews and these are all being written up and published separately. We also have several more detailed design protocols for specific aspects of the evolving research, including the phase 2 intervention design and evaluation, which will be published separately. We will also be providing short and accessible progress reports on our website alongside the range of papers described.

Reviewer 2 comment: Similar to the previous review, there is still concern about the two

cities chosen for the implementation of policies proposed in this protocol. Authors need to clearly state why they chose the mentioned cities for the specific policies. What made the cities special for running the proposed ideas in this project should be elaborated for readers. This point is very important regarding making the study reproducible in other regions and countries of the world.

Authors' response: We agree that the rationale for the city selection is important and indeed it was a key area that the UKPRP review panel probed us on in the application in 2019, so can repeat our response to them: "*The size, level of resource, urban health challenges and political denomination of Bristol and Greater Manchester are highly representative of the UK's other Core Cities - Birmingham, Cardiff, Newcastle, Sheffield, Liverpool, Nottingham, Leeds and Glasgow - the combined population of which is over 20 million (only Glasgow has currently a Lib Dem Leadership; all others are Labour-Led). We are partnering on this project with the Town and Country Planning Association who established the New Communities Group in 2009 with the Department for Communities and Local Government which is made up of 23 'ambitious local authorities and development corporations planning and delivering exemplary large-scale new communities". We agree it is important that we understand the differences between the various urban authorities and have included representatives from those authorities on our stakeholder groups*." A final point on this is that we focus on global regions similar to the UK (e.g. OECD nations) as a filter in our search criteria given certain contextual parallels, while also acknowledging the limitations of such broad comparisons.

Reviewer 2 comment: "Discussion and conclusion": as mentioned before, an essential part is missing in this section talking about the potential public health effects of this protocol. A logical estimation of the results and impacts of the implemented policies.

Authors' response: The final paragraph of the discussion and conclusion section addresses this as much as is possible given the research is based fundamentally on co-production: "*Within a five-year research project, it will not be possible to demonstrate reduction in NCDs…Our goal therefore, is to test demonstrable and immediate changes in attitudes and behaviours amongst the target user groups, as well as changes to policy and practice, within the award period; in particular in decision-making within the systems of governance in Bristol, Manchester (and London in relation to national-level mechanisms linked to city development).*" We appreciate this may sound far less specific than a traditional public health intervention (where intervention areas may already be pre-determined), but the first phase of our programme is focused on mapping and understanding the system, and intervention selection forms the first part of our co-production process, so we are not able to predict up front where exactly we will be intervening, and therefore we can only state in broad terms what kinds of impacts we are expecting (e.g. instrumental, conceptual vs capacity-building). Even the target sectors are unknown: we may focus our interventions into a range of decision-making contexts: e.g. procurement, spatial planning, law, land disposal. We are now in the process of starting that selection process, after which we can start to specific more narrowly the intervention areas, actor constellations and likely impacts.

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- Bammer G (2013) Disciplining Interdisciplinarity: Integration and Implementation Sciences for Researching Complex Real-World Problems. ANU Press. Sydney.

- Skivington et al (2021) A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. Research Methods and Reporting. *BMJ*. Accessed 22/6/22. Available from: https://www.bmj.com/content/bmj/374/bmj.n2061.full.pdf

Competing Interests: No competing interests were disclosed.

Reviewer Report 02 March 2021

https://doi.org/10.21956/wellcomeopenres.18021.r42640

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Martin McKee
London School of Hygiene and Tropical Medicine, London, UK

I find it very difficult to provide a meaningful review of this protocol. First, the project has already been through an extensive process of peer review. Almost inevitably, additional reviewers will have their own preferences about what might be emphasised, added, or subtracted, but given the extensive planning that has already gone into such a complex project, it is difficult to see how this will be particularly helpful to the research team. This is even more so when I read that the research programme started on the 1 October 2019.

Second, as this particular proposal places a very great emphasis on co-creation with local communities, it is difficult for an external reviewer to second guess what will emerge. There are many questions which one might wish to ask but, realistically, may not be answerable at this stage in the research. I am also conscious of the importance of brevity and I consider it unrealistic to expect the authors to provide the mass of detail that I'm sure they already have. As a consequence, I have limited my comments to those aspects of the proposal that I felt could usefully be clarified, as seen from the perspective of someone reading about the project for the first time.

My first impression is that there are an awful lot of ideas packed into this protocol, and not always as clearly structured as I felt they might be. Commercial determinants of health feature prominently and, linked to that, power asymmetries. If space permits, it would be helpful to elaborate on this a little further. For example, we know that developers have been very effective in lobbying to influence the planning rules in England. Perhaps something more could be written on this. Linked to this, as we have seen during the pandemic with pressures to reopen office space, the meaning of property in certain discourses has changed. Once, it was about providing shelter, in which people could live or work. Now, for many people, it is an investment vehicle. Again, the consequences of this change, while implicit in some of what is written, could be developed further. For example, they mention how the problems and solutions are to be found in areas such as

international finance and investment. This will be very clear to anyone reading the property pages of, for example, some Asian newspapers where the UK property market features prominently as an investment opportunity, something that has contributed to the high level of empty properties in some parts of the country, coinciding with high levels of homelessness. These considerations and others take us to the crucial issue of power. I'm sure that the research team have thought a lot about this, but it would be good to know more of their thinking.

Given the centrality of power, I wonder if the team have ways of capturing the relevant dynamics, particularly when some aspects of the decision-making are likely to be hidden, either in informal meetings or shielded behind commercial in confidence restrictions? We also know that major capital developments are often an invitation to corruption, favouritism, or to coin a contemporary popular term the "chumocracy". Has this been considered?

A related issue is the political dimension. Both Manchester and Bristol are held by Labour, while central government is Conservative. As was seen in the midst of the pandemic in disputes between Manchester and London, this can be problematic. Has this been taken into account? And how?

The section on valuation was tantalising but brief. I accept that the proposal envisages a substantial body of work to develop thinking on this issue, but again it would be good to have a little more detail of their thinking. Some contemporary thinking is referenced, such as the work of Raworth and Mazzucato, but at present we simply have a list of references to their work without any discussion of what ideas have emerged from their reading of it.

Public involvement is crucial. However, the public is far from homogeneous and the sorts of interventions that are being considered will bring winners and losers. Put bluntly, policies and housing developments that create more heterogeneous communities, however measured, will be welcomed by some but not by others. How will they address the inevitable tensions that may arise with an advisory board of 6 to 12 members?

I did feel that the section and dissemination of findings could be elaborated a little more. There is now a wealth of opportunities for communicating the findings of research going far beyond the traditional outlets of peer-reviewed journals. Given the importance of community engagement in this project, it would be interesting to know if the team have come up with any innovative ideas for making this work.

In summary, this will be a very interesting project and, given the iterative nature of its development, it is unrealistic to expect too much detail at this point. However, I hope that my comments help in pointing to areas where the protocol could be clarified a little more.

Is the rationale for, and objectives of, the study clearly described?

Yes

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Partly

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public Health.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 02 Apr 2021

Daniel Black, University of Bristol, Bristol, UK

Reviewer comment: I find it very difficult to provide a meaningful review of this protocol. First, the project has already been through an extensive process of peer review. Almost inevitably, additional reviewers will have their own preferences about what might be emphasised, added, or subtracted, but given the extensive planning that has already gone into such a complex project, it is difficult to see how this will be particularly helpful to the research team. This is even more so when I read that the research programme started on the 1 October 2019. Second, as this particular proposal places a very great emphasis on co-creation with local communities, it is difficult for an external reviewer to second guess what will emerge. There are many questions which one might wish to ask but, realistically, may not be answerable at this stage in the research. I am also conscious of the importance of brevity and I consider it unrealistic to expect the authors to provide the mass of detail that I'm sure they already have. As a consequence, I have limited my comments to those aspects of the proposal that I felt could usefully be clarified, as seen from the perspective of someone reading about the project for the first time.

Authors' response: We appreciate the time taken by the reviewer to consider our study protocol and very much welcome his comments below. Given the wide-ranging complexity of the subject matter, we have limited ourselves to responding to these reviewer comments here rather than amending the Protocol, which could become unwieldy if we expand on all points touched upon.

Reviewer comment: My first impression is that there are an awful lot of ideas packed into this protocol, and not always as clearly structured as I felt they might be.

Authors' response: We agree that the Protocol is packed full, and that there is a good deal sitting behind it. We have sought to describe as simply as possible the complex range of interacting factors influencing these multiple urban systems, but appreciate that it provides only a highly superficial overview encompassing a wide range of areas, and that, as a result, some aspects may appear disparate and disconnected due to the many links that are implicit only to those familiar with the context. We do not have a ready solution to the challenge of structuring the protocol more clearly: the complex nature of the societal

challenge is such that, we would argue, it won't allow for that easily within the limited space available, though we would be pleased to respond to specific areas of change needed. The method and findings papers from the UPSTREAM pilot, which are due for publication at the beginning of April 2021, should provide considerable additional context. A quote from that paper's abstract, which struggles with the same issue, echoes the points made here: "*the value of this broad, systems-wide approach is not in the depth of disciplinary investigation, but in its breadth, and the opportunity to draw together multiple strands from multiple systems, thereby balancing complexity and the reduction of that complexity*" (De Pinho, 2018).

Reviewer comment: Commercial determinants of health feature prominently and, linked to that, power asymmetries. If space permits, it would be helpful to elaborate on this a little further. For example, we know that developers have been very effective in lobbying to influence the planning rules in England. Perhaps something more could be written on this.

Authors' response: We find that the 'commercial determinants of health' framing resonates well with the world of urban development, as it appears to do with unhealthy commodities. The recognition of the dominance of the private sector in UK urban development, and specifically in large-scale property and infrastructure development, is one of the central features of this study. While lobbying and power were not specific themes investigated in the UPSTREAM pilot, commercial factors relating to urban health, and associated aspects of power (and control - e.g. access to land), were revealed across a number of areas: e.g.

- the implications of short-termism on quality of urban environments (estate management, stock market investor interest);
- the challenge of front-loading essential infrastructure investment for long-term health in the face of narrow and short-term viability appraisal;
- the lack of equity stake-holding (which ultimately dictates control) by public agencies and citizens
- justifying public space management budgets within existing models of urban development, planning and management

Power and power asymmetries are central themes within the project. For instance, in Phase One, we are creating our samples from individuals who are deemed to be influential within and knowledgeable about the system. Our focus is thus to talk to the power elite in an effort to understand the system, but also to make these power structures, and thus the asymmetries they create explicit so that they can be understood and challenged. We are also currently recruiting a PhD to look specifically at understanding the power structures of the system, but also how to best intervene at individual, group, and institutional levels.
In WP4 (lay public engagement) we are interested explicitly in issues of inequality and 'citizen voice', which also overlaps substantially with issues of power.
It's perhaps worth flagging that the TRUUD programme is the focus not just on large-scale property development, but also city-region transport, where the role of the private sector is arguably less visible, and yet regardless there are significant economic pressures alongside questions of inequality, which relate to commerce and power (e.g. the challenge of tackling congestion due to the inevitable tensions between winners and losers).
We also recognise the different and hybrid forms of commercial power exerted by a range of actors in a neo-liberal political economy: e.g. professional architects, planners, designers, marketing, facilitating the circulation and accumulation of capital via built development; city authority collaborations with developers to attract inward investment to cities through the

commodification and ‘branding’ of urban space; property, public and private, and pension funds in an investor society.
In WP4 (lay public engagement) we are interested explicitly in issues of inequality and ‘citizen voice’, which also overlaps substantially with issues of power. In particular we will explore how traditional hierarchies of evidence marginalise the knowledge of local people, which is nevertheless crucial to understanding how the built environment, human agency and health interact. We will exploring creative ways of presenting lay evidence to decision makers as a way of challenging this form of epistemic inequality

Reviewer comment: Linked to this, as we have seen during the pandemic with pressures to reopen office space, the meaning of property in certain discourses has changed. Once, it was about providing shelter, in which people could live or work. Now, for many people, it is an investment vehicle. Again, the consequences of this change, while implicit in some of what is written, could be developed further. For example, they mention how the problems and solutions are to be found in areas such as international finance and investment. This will be very clear to anyone reading the property pages of, for example, some Asian newspapers where the UK property market features prominently as an investment opportunity, something that has contributed to the high level of empty properties in some parts of the country, coinciding with high levels of homelessness. These considerations and others take us to the crucial issue of power. I’m sure that the research team have thought a lot about this, but it would be good to know more of their thinking.

Authors’ response: With regards the shift from property as shelter to property as investment, this too is a highly complex area with a range of development, investment and delivery issues to bear in mind. The reviewer rightly flags issues caused by recent more rapid changes in global real estate investment - enabled in large part through digitisation of real asset trading (e.g. via Real Estate Investment Trusts (REITs)), the linked internationalisation of investment capital - and the associated flows of global capital into major cities, especially London in the UK, which is having considerable impact on property prices and issues of affordability. The return to public and private investors on property – high-value commercial offices, residential and mixed-use – is extending to niche residential suburban area, e.g. elderly, special needs and social housing. This overseas investment in UK property - as investment vehicles - is driven in large part by the UK's persistent current account deficit. We require overseas investment into the UK and the sale of UK assets to close the gap in our current account caused by deindustrialisation. On the other hand, property investment with a longer-term view (e.g. patient capital) is also seen as critical if we are to enable medium-high density development that can promote walking, cycling and public transport.
With regards political narratives, property investment is mostly justified in political discourse by housing supply imperatives - i.e. the need to build to meet demand. Political struggles then take place at a local or city level over the affordability of that supply, social segregation in developments, and unmet wider housing needs - rather than questioning the imperative to build more, per se. However, the dominant housing or property discourse is being increasingly challenged by those who argue that affordability problems are caused by the financialisation of housing, not excess demand over supply. The UK's housing supply model is also shaped by a political assumption that the public sector should have a minimal role in delivery of urban infrastructure, and yet the state has nonetheless a major role in

supporting the balance sheets of the volume property developers and in maintaining house prices, through policies such as Help to Buy and Stamp Duty holidays.
A deeper point being made by the reviewer - which is also of real interest to our group and is now part of a wider societal discussion across multiple sectors related to urban development - relates to cultural norms about what is acceptable business practice in hybridized stakeholder assemblages – local authorities, quasi-public sector developer-housing management associations, consultancies, brokers, promoters, landlords, owners, etc. Again, as per the discussion section of the UPSTREAM findings paper, the use of land as a means of generating “unearned income” was decried by none other than Adam Smith and Winston Churchill. The extent to which we can get to grips with all these highly complex areas is to be seen. As above, we are consciously spreading ourselves relatively thinly in order to take a more comprehensive systems view, and in so doing we will be limited in terms of how deeply we can dive in to any given area.

Reviewer comment: Given the centrality of power, I wonder if the team have ways of capturing the relevant dynamics, particularly when some aspects of the decision-making are likely to be hidden, either in informal meetings or shielded behind commercial in confidence restrictions? We also know that major capital developments are often an invitation to corruption, favouritism, or to coin a contemporary popular term the “chumocracy”. Has this been considered?

Author’s response: This is an important question for a tricky areas that we are very mindful of. Of particular interest is actor-network centrality and the ‘black box’ intermediation spaces where largely ‘off the record’ negotiations take place, e.g. discretionary planning pre-applications, planning agreements for large investment reduced planning risk, CIL, s106 and development viability analysis. Over and above our work on economic valuation, the bulk of our data gathering is focused on qualitative interviews (200+), workshops and industry roundtables (20+) with a wide range of stakeholders. We also have two participant observers working with the relevant councils. We will use the interviews to map actor networks, as far as possible to include those that are hidden within informal settings. But we will also need to use documentary evidence where it exists, including public records (e.g. of Ministerial meetings, registers of interests, donations to parties.) In our experience, using multiple, and different, data sources, tends to mean that at least some of these hidden areas are hinted at, giving us an opportunity to follow up as best as possible. These hidden areas can be challenging to uncover, but it is also the case that some participants, typically in interviews or participant observer work, can be quite candid, giving us glimpses of the hidden world. Combined with an experienced team who already has some knowledge of hidden discussions and negotiations, we hope to be able to dig deeper, making them explicit. In terms of the tools to do this, they include well thought through sampling principles for our starting purposive sample and a snowball sample focused on identifying influential people and structures, detailed field notes, open questions enabling participants to speak freely, creation of safe spaces for communication, and by aggregating and analysing the information across multiple stakeholders. This of course while ensuring that findings made public do not compromise those wishing to be more outspoken. Through this approach, we aim to bring to the surface as many of the barriers and opportunities as possible.

Reviewer comment: A related issue is the political dimension. Both Manchester and Bristol are held by Labour, while central government is Conservative. As was seen in the midst of the pandemic in disputes between Manchester and London, this can be problematic. Has this been taken into account? And how?

Authors' response: While writing the research proposal we were aware of the potential political divergence between cities and national government, and across local authorities in large, combined authority areas, (illustrated by CA strategic spatial plan fractures), and it is something we are taking in to account. Our justification for the focus on major urban centres was purely practical. Firstly, they are where most property infrastructure development and transport management takes place. Secondly, we are interested specifically in what cities can do for themselves themselves with devolved powers and budget (but with central government still 'holding the strings'). Despite the focus on what cities can do for themselves, the role of central government is inevitably critical. Those leading our national level engagement are aware of potential tensions and inevitable obstacles, as they are of the symbiosis between city and state (given they are of the UK's major economic engines) and the need to work across party lines. Ensuring representation across parties is of course a critical component of the engagement strategy. We will utilise insights from studies of Multi-Level Governance to capture the distribution of power and influence across different tiers of government, and the political tensions to which it can give rise (i.e. when policy priorities diverge, or public spending is cut by central government). Political short-termism in central government, voting system battle lines, government restructuring and centralisation, add layers of complexity to our realm of enquiry.

Reviewer comment: The section on valuation was tantalising but brief. I accept that the proposal envisages a substantial body of work to develop thinking on this issue, but again it would be good to have a little more detail of their thinking. Some contemporary thinking is referenced, such as the work of Raworth and Mazzucato, but at present we simply have a list of references to their work without any discussion of what ideas have emerged from their reading of it.

Authors' response: With regards valuation there is another paper forthcoming from the UPSTREAM pilot, in addition to the two on interview method and findings, which is devoted purely to the economic valuation. As above, we appreciate that the information provided in the Protocol is superficial. The approach we are taking has been developing across a number of prior studies, including two commercial feasibility studies (on climate risk valuation) funded by InnovateUK and the Natural Environment Research Council. Legally required social valuation in public sector commissioning is a specific relevant area of enquiry, in the affordable housing sphere. The challenges of quantification and monetisation of qualitative data are very much on our radar. No academic papers were required for the commercial feasibility studies, but they provided us with important lessons in enabling decision-making that places value on socio-environmental (and health) outcomes, which are not easily quantified: e.g.

- Single issue risks must be considered as part of a comprehensive risk mapping (e.g. welfare reform a more pressing risk than climate change)
- Individual beliefs of decision-makers are fundamental (e.g. climate denial)

- Timescales of decision-making are critical (e.g. NHS works to 1-2 year time horizons)
- Quantifiable evidence is highly uneven (e.g. lots on air pollution, limited on overheating)

A final point is that we are aware of the inherent limitations of purely quantifiable economic valuation, and we are hoping in TRUUD to expand our approach beyond quantum, to include more qualitative assessment of value, whether that's a consideration of political risk, or moral and ethical considerations, for example). There is a rapidly growing industry in the field of social valuation, which this approach will feed in to, and we hope improve.

Reviewer comment: Public involvement is crucial. However, the public is far from homogeneous and the sorts of interventions that are being considered will bring winners and losers. Put bluntly, policies and housing developments that create more heterogeneous communities, however measured, will be welcomed by some but not by others. How will they address the inevitable tensions that may arise with an advisory board of 6 to 12 members?

Authors' response: We agree that the public is indeed far from homogenous and the idea of winners and losers is never far from our minds. These tensions will inevitably arise in the advisory board, but even more so within WP4, which is focused on public engagement with the system of decision making. Our advisory board is only one aspect of our public involvement which is designed to ensure that the public have a voice in the governance of TRUUD. In addition to this we will be working with local community organisations in Bristol and Manchester to help us identify and work with underserved communities. The precise selection of which communities to work with will be determined by the emerging focus of our work. Inevitably there will be conflict but our guiding principal would be to act, where possible, to reduce inequality, including inequality in terms of political voice. It is also important to clarify the meaning of representation in these circumstances. In developing detailed plans for our public involvement in WP4, we've put forward four types of representation, of which our focus is on the latter two:

1. *statistical* (e.g. quant. research/citizen assemblies);
2. *political* (councillors);
3. *geographical* (e.g. locals, those impacted by specific development proposals)
4. *experiential* (i.e. those affected by a specific aspect of the built environment, such as air pollution)

Thus, we do not envision the advisory board being the only place where concerns, challenges and differences of opinion will come to the attention of the team. The research design, implementation and outputs are being co-produced. It is our hope that we can continue to work with relevant constituents through the process to ensure that our interventions have more lasting and meaningful impact on NCDs and health inequalities. Co-production is not without its challenges, and in WP4 in particular, a great deal of thought has gone into what co-production means, and how it can be practically achieved. We fully anticipate differences of opinion and are aware that there are inevitable winners and losers – see above example on congestion charge - and indeed they are crucial in ensuring any potential conflicts are aired in order for them to be resolved enabling potential interventions to be tested for their efficacy. We're not yet at a stage in the programme where we can identify the details of the intervention or specific potential changes in policy

and practice and so can not foretell either the stakeholders or the possible tensions, but we will seek to ensure, as much as possible within the constraints of the programme, that representation is met and opportunities for discussion fully provided.

It's also worth underlining perhaps that the rationale for our approach to public engagement was based in large part on the understanding that very significant amounts of public engagement and involvement already takes place in urban development, and so the core purpose of the public engagement work is to develop a method of disrupting existing means of public engagement, with a focus on inequality and the use of the creative arts.

Reviewer comment: I did feel that the section and dissemination of findings could be elaborated a little more. There is now a wealth of opportunities for communicating the findings of research going far beyond the traditional outlets of peer-reviewed journals. Given the importance of community engagement in this project, it would be interesting to know if the team have come up with any innovative ideas for making this work.

Authors' response: We agree that far more needs to be done within academia to better communicate findings, and not just via blogs, conferences and the limited social media work. A key part of our strategy in this area is the nature of the research itself: co-production of the research with a wider range of stakeholders, not just local government partners, but private sector practitioners, third sector membership bodies and the lay public. Beyond that, we are seeking to develop our in house capacity in this area, bearing in mind that research communications tend to be relatively reactive, slow and focused primarily on the academic network. A key focus will be on linking our Theory of Change and emerging impact strategy to the emerging communications, engagement and impact strategies, the objective being to demonstrate what is being done differently to make a positive change.

Reviewer comment: In summary, this will be a very interesting project and, given the iterative nature of its development, it is unrealistic to expect too much detail at this point. However, I hope that my comments help in pointing to areas where the protocol could be clarified a little more.

Authors' response: Very helpful indeed, thank you, and likewise, we hope that our answers here are satisfactory. Your time input is greatly appreciated.

Competing Interests: N/A