



**Medical Research Council**

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# Research Grant PROPOSAL

Document Status: In Submitter Pool

MRC Reference:

## UKRI-NHMRC Built Environment and Prevention Research Scheme 2019

**Organisation where the Grant would be held**

Organisation	Queen's University of Belfast	Research Organisation Reference:	26779 Hunter
Division or Department	Centre for Public Health		

**Project Title [up to 150 chars]**

A vision of healthy urban design for NCD prevention

**Start Date and Duration**

a. Proposed start date	15 May 2020	b. Duration of the grant (months)	36
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**Applicants**

Role	Name	Organisation	Division or Department	How many hours a week will the investigator work on the project?
Principal Investigator	Dr Ruth Hunter	Queen's University of Belfast	Centre for Public Health	2.63
Co-Investigator	Dr Leandro Garcia	Queen's University of Belfast	Centre for Public Health	2.63
Co-Investigator	Professor Frank Kee	Queen's University of Belfast	Sch of Medicine, Dentistry & Biomed Sci	0.38
Co-Investigator	Professor Geraint Ellis	Queen's University of Belfast	Sch of Natural and Built Environment	0.38
Co-Investigator	Dr Jason Thompson	University of Melbourne	Fac of Arch Building and Planning	6.38
Co-Investigator	Professor Mark Stevenson	University of Melbourne	Fac of Arch Building and Planning	3.75
Co-Investigator	Dr Kerry Nice	University of Melbourne	Fac of Arch Building and Planning	6
Co-Investigator	Dr Jasper Sebastiaan Wijnands	University of Melbourne	Fac of Arch Building and Planning	6
Co-Investigator	Dr Neil Anderson	Queen's University of Belfast	Sch of Electronics, Elec Eng & Comp Sci	0.75

## Objectives

List the main objectives of the proposed research in order of priority

The aim of this project is to generate new evidence from the application of new, accessible tools related to the intersection of urban design and health, understanding and estimating the improvements in noncommunicable diseases (NCD) and health inequalities that can be achieved through tangible alteration in urban design. It aims to place these tools in the hands of urban designers, planners and the broader public so they can advocate and act on their recommendations. It will do this by:

- 1) Utilising new methods in computer vision and artificial intelligence to explore the relation between urban design, city types, and NCD in UK and Australian cities.
- 2) Investigate how inter- and intra-city urban design disparities are associated with inequalities in incidence and prevalence of NCD.
- 3) Combine large cohort and GIS data to prospectively investigate the causal pathway between urban design, NCD risk factors, and NCD incidence.
- 4) Estimate improvements in the burden of NCD that could be achieved through actionable changes to the built environment at different scales.
- 5) Design and develop a comprehensive, accessible, web-based toolkit for action tailored for use by urban designers, planners, policymakers and the broader public.

## Summary

Describe the research in simple terms in a way that could be publicised to a general audience. If awarded, this will be made publicly available and applicants are responsible for ensuring that the content is suitable for publication.

Non-communicable diseases (NCD), such as cancer, heart disease, type II diabetes mellitus, chronic respiratory conditions like asthma, and poor mental health, are some of the most common causes of death in the UK and Australia. The design of our cities play an important role in preventing these chronic diseases and have a significant consequent impact on the quality of life and life expectancy of their citizens. However, in a rapidly evolving urban age, urban designers, urban planners and public health practitioners still know surprisingly little about how best to design our cities in order to prevent NCD and their known risk factors.

This proposal is innovative because we are harnessing perspectives of scientists from a wide range of different disciplines across urban design, public health and computer science. Through novel methods, we aim to provide better understanding of how the design of our cities impacts on NCD and their known risk factors in the UK and Australia, and how we can best effect change for the better.

Our overarching aim is to generate evidence and tools to support the urban planning and health sectors to better understand how to design our cities to prevent NCD. We will also involve local citizens in discussions about our findings so they can effectively and powerfully advocate for change in their own cities. The research project has the following objectives:

1. Use new methods in computer vision and artificial intelligence to explore the relation between urban design and NCD in cities across the UK and Australia.
2. Investigate how different designs within cities impact on health inequalities including NCD.
3. Combine data from different sources to investigate the mechanisms by which the design of our cities causes NCD.
4. Learn lessons about how different ways of designing our cities prevent NCD and their known risk factors.
5. Develop a toolkit for action for local citizens, urban designers and planners, public health practitioners and policy makers, to help inform future policies and lead to powerful, actionable changes in the city.
6. To build a legacy of transdisciplinary research capacity in public health science, urban design and computer science, with clear pathways to impact.

The project involves 3 work packages. The first involves building the evidence base on the relationship between urban design and NCD. This will be comprised of two levels of analysis: the city level and individual level. This acknowledges that people's health is affected by their immediate environment and, at same time, by the way the entire city is organised. This

will help us better understand which features of the built environment are associated with city designs, NCD and their known risk factors, such as not being physically active, having poor diet, smoking, consuming alcohol and being exposed to air pollution. A further work package will then test changes to the design of our cities to analyse how they will help prevent NCD and reduce known risk factors. The findings will help inform future policies and practices leading to actionable changes in the design of our cities to make them healthier places for people to live. Finally, we will develop a toolkit that urban designers and planners, public health practitioners, students, policymakers and local citizens can use to advocate and lobby for actionable healthy changes to their cities. At the end of the study we will meet with experts from different fields of research, to help us further interpret our findings and discover how they might apply to other contexts and cities to prevent NCD.

## Technical Summary

Describe the research in a manner suitable for a specialist reader. If awarded, this content will be made publicly available and applicants are responsible for ensuring that the content is suitable for publication.

This project uses state-of-the-art approaches to (i) generate evidence on the impacts of urban planning in NCD and health inequalities in UK and Australian cities, and (ii) provide stakeholders engaged in the urban planning and health sectors with tools for advocacy and informing decisions to achieve healthier cities for all. In WP 1, we will expand the evidence base on the relationship between urban design and NCD. First, we will sample local-level images of all UK and Australian cities with populations > 100,000 to obtain detailed information of urban characteristics of interest (e.g., road, cycling networks, greenspace). A combined process using convolutional neural networks and self-organising maps will identify cities and locations that can be grouped according to consistencies in urban design both between and within cities. The ecological association between city and area types and NCD risk factors and outcomes will be estimated. Second, we will apply Bayesian networks onto prospective health cohorts with objective built environment data to investigate, at the individual level, the causal pathway between built environment, lifestyle factors, and NCD incidence, and effect modification by socioeconomic position. In WP 2, we will estimate the health impacts of actionable changes, at different scales, in urban design. Using health impact assessment modelling, we will calculate the NCD burden that could be averted if cities were to adopt urban features of healthier counterparts. A similar approach will be applied on finer-grained scale within all case study cities, enabling assessment of health impacts of changes in individual locations. WP 3 will provide an interactive web-based toolkit to enable urban designers, planners, policymakers and the public to engage with our findings and inform the decision-making cycle, co-designed with the intended users through a usability study involving participatory workshops and user-testing of early versions of the toolkit.

## Academic Beneficiaries

Describe who will benefit from the research

The academic beneficiaries of this work span a number of disciplines and domains. A core tenet of the research team is to build and leave a legacy of unique transdisciplinary research capacity in public health science, urban design and computer science both in the UK and Australia. The interdisciplinary team brings together researchers from public health and epidemiology, urban planning, computer science, complexity science, and mathematics, who have expertise in NCD prevention, urban health, environmental justice, computational modelling, and artificial intelligence. Therefore, Queen's University Belfast and University of Melbourne are well placed to lead this programme of research.

As outlined in the Case for Support, studies and interventions targeting health outcomes associated with city design have largely been dominated by research methods drawn from the health (including public health) sciences using experimental, linear designs. However, cities are dynamic, complex systems, which these traditional health methods do not align well with. A core issue facing public health researchers is the need for more sophisticated methods to gain deeper understanding of these complex, dynamic systems influencing NCDs and NCD risk factors. This will enable us to design, develop, implement and evaluate important interventions that span population and individual level change.

Few public health scientists are aware of the empirical developments in Vision Computing and Artificial Intelligence where computer scientists have developed a canon of well-defined experimental methods and mathematical models for simulating the impact of urban design. Experimental designs and mathematical models rooted in Artificial Intelligence offer new ways

to do this that avoid issues of observer dependence, providing opportunity to explore the public health impacts underlying the influence of urban design on NCDs and NCD risk factors using objective, value-free methods and incorporating vast amounts of new data.

This learning has not yet crossed the disciplinary divide. The proposed work can offer public health scientists the opportunity to add a suite of tools that will enable a deeper understanding of potential mechanisms to prevent NCDs and NCD risk factors through urban design. Although NCD prevention researchers are potentially the most relevant to the current work, the provenance of the work is much broader and public health researchers working on other behaviour change targets, including known NCD risk factors such as physical inactivity, alcohol, poor diet, will also benefit. These findings have particular implications for researchers involved in the development and evaluation of complex, multi-level public health interventions where theory-driven approaches have fallen short of complete explanation of phenomena.

Urban designers and simulation modellers will also benefit if they are incentivised to further refine their empirical methods for broader application, bringing scientists out of their silos to form novel multidisciplinary collaborations that will be able to more effectively address broader questions with potential for scientific and societal impact.

This work will also inform the University of Melbourne's existing Masters of Urban Planning Program, as well as a novel Masters in Public Health and Urban Planning which will be launched at Queen's University Belfast in October 2020, building capacity in the next generation of urban planning and public health students.

Finally, research funding panels in the social and public health sciences will benefit by leveraging added value from a suite of trans-disciplinary methods that can offer deeper understandings of the intersection of built environment, urban design and public health, primarily for NCD prevention.

## Communications Plan

Please outline your plans for engagement, communication and dissemination about your research and its outcomes with the research community and, where appropriate, with potentially interested wider audiences

Specific time and financial resources have been identified to support effective engagement, communication and dissemination activities with academics from multiple disciplines and interested wider audiences. We will produce newsletters providing study updates and lay summaries of study findings disseminated through already established networks of the UKCRC Centre of Excellence for Public Health, the School of Natural and Built Environment (Queen's University Belfast), the Northern Ireland Public Health Research Network, Health Data Research-UK, and UK Collaboratorium for Research on Infrastructure and Cities (UKCRIC). Australian equivalent summaries will be made available through municipal association and state-government newsletters and websites, the Planning Institute of Australia and through news services such as The Conversation and University of Melbourne's own magazine, Pursuit. All lay summaries and newsletters will be available on the universities' websites.

We are keen to disseminate the study protocol and findings to academics from a range of disciplines, including public health, computer science, urban design, urban planning, complexity scientists and methodologists (see Academic Beneficiaries). This will be facilitated throughout the publication of a study protocol in a peer-reviewed journal. We aim to publish at least further three papers in high impact academic journals, including the main study findings in *The Lancet Public Health*; an editorial on the application of these novel methods to inform urban design for NCD prevention in public health targeted at the *American Journal of Public Health* and a methods paper targeted at *The Journal of Environment and Health*. Study findings will be disseminated at a range of local (e.g. All-Ireland Public Health conference); national (e.g. The Lancet Public Health conference, Australian Public Health Conference), and international conferences (e.g. International Conference on Urban Health, WHO International Healthy Cities conference). Study findings will be presented to public health practitioners, including those with a remit for NCD prevention through newsletters disseminated via communication and social media channels of Cancer Research UK, the Public Health Agency, Diabetes UK, British Heart Foundation, The Heart Foundation (Australia), Diabetes Australia.

Policymakers will be made aware of our findings via short briefing papers communicated through Knowledge Exchange

Seminars and policy briefings and established collaborations with the Public Health Agency, as well as popular media articles targeted at mainstream press. A plenary workshop of thought leaders (from public health, urban design and computer science) will be brought together for a one-day event in both the UK and Australia. The workshop aims to build the capacity of researchers and practitioners to take a systems perspective on population level public health built environment interventions. It will coincide with a launch event of a journal series - as we have also begun preliminary discussions with The Lancet Planetary Health regarding the publication of a series on urban design and NCD prevention involving an interdisciplinary team of researchers, practitioners and policymakers.

An Impact Advisory Panel will be engaged extensively in the development and testing of the City Vision tool (WP3). This high level of engagement will be from the inception of the project via Impact Advisory Panels in the UK and Australia. We will also engage with our already existing Impact Advisory Panel in Belfast who we have worked with us on previous projects at the intersection of urban design and public health projects, such as the HULAP study (Ellis et al., 2018). The panel, which includes practitioners of mixed backgrounds, will assist with the development and usability testing of the City Vision tool, interpretation of study findings and appropriate dissemination channels for a range of stakeholders.

## Impact Summary

If awarded, this content will be made publicly available and applicants are responsible for ensuring that the content is suitable for publication.

Our partners have identified a range of beneficial impacts. We have designed our communication strategy (see Communication Plan) to maximise these benefits both for our partners and for our wider stakeholder community. Benefits range from a deeper understanding of how urban design and effective urban planning can prevent NCD, how future programmes and policies may be better able to harness the power of the built environment to generate meaningful changes in NCD risk factors and consequent incidence at the population level, and practical pathways for changes using a nearest-neighbour strategy. This range of benefits is briefly discussed below.

Promoting transdisciplinarity and ensuring stakeholder engagement will help us to deliver high-impact research, with multiple beneficiaries in the UK, Australia and beyond, including: the general public; public health practitioners; urban designers and planners; and policy makers across the UK and Australia. A number of academic beneficiaries are detailed elsewhere (see Academic Beneficiaries).

Considerable time and resources have been included in the grant to ensure that key stakeholders are involved throughout the study in order to maximise benefits and that the proposed collaborations are ongoing. Long term, we envisage such benefits to include the development of programmes and policies that utilise the urban environment for NCD prevention and reduced NCD risk factors, leading to better quality of life and life expectancy. Our Impact Advisory Panel will ensure that study findings are disseminated in a meaningful and appropriate manner. Ongoing development of the research series will provide benchmarks and a methodological platform for future researchers to launch additional research efforts from.

The general public will benefit through the practical application of this research and embodiment into planning regimes. We aim to increase public engagement through events undertaken by organisations with a remit for NCD prevention such as the Public Health Agency, the British Heart Foundation, Cancer Research UK, Town and Country Planning Association UK, Heart Foundation Australia, Diabetes Australia, the Australian Local Government Association, and the Planning Institute of Australia.

Urban design and planning practitioners will benefit from a deeper understanding of how urban design and effective planning can prevent NCDs and reduce NCD risk factors.

Public health practitioners will benefit from knowledge gained through the workshops hosted in partnership with our multi-disciplinary stakeholders, and delivered as part of the implementation of the Public Health Agency's Knowledge Management Strategy and the work of the Northern Ireland Public Health Research Forum (of which Kee was the inaugural Director). Parallel workshops will be planned for practitioners in the rest of the UK and Australia in collaboration with our project partners, such as Public Health England and the NIHR's Public Health Policy Advisory Board. These workshops will particularly focus on how best we can incorporate and elicit mechanisms of urban design and planning to inform NCD prevention policy and practice.

Policy makers and funders of research will find the research of value in assessing the public health priorities and novel approaches to NCD prevention and reduction of NCD risk factors. We have engaged with urban design experts from the

outset, to ensure that this work will have long term policy relevance and impact. While the timelines for research and policy may not always be aligned, we will maintain our strong relationships with key decision makers to ensure that they have access to updates on new research and emerging results.

All beneficiaries will come together in a parallel plenary workshop in the UK and Australia of thought leaders (from public health, urban design, artificial intelligence) to build consensus and think about how changes might be effected within complex urban systems.

### **Summary of Resources Required for Project**

#### Financial resources

Summary fund heading	Fund heading	Full economic Cost	MRC contribution	% MRC contribution
Directly Incurred	Staff	184765.00	147812.00	80
	Travel & Subsistence	0.00	0.00	80
	Other Costs	6700.00	5360.00	80
	<b>Sub-total</b>	<b>191465.00</b>	<b>153172.00</b>	
Directly Allocated	Investigators	43457.94	34766.35	80
	Estates Costs	38720.00	30976.00	80
	Other Directly Allocated	0.00	0.00	80
	<b>Sub-total</b>	<b>82177.94</b>	<b>65742.35</b>	
Indirect Costs	Indirect Costs	205744.00	164595.20	80
Exceptions	Travel & Subsistence	0.00	0.00	100
	Other Costs	0.00	0.00	100
	<b>Sub-total</b>	<b>0.00</b>	<b>0.00</b>	
	<b>Total</b>	<b>479386.94</b>	<b>383509.55</b>	

#### Summary of staff effort requested

	Months
Investigator	6.25
Researcher	49
Technician	0
Other	0
Visiting Researcher	0
Student	0
<b>Total</b>	<b>55.25</b>

### **Other Support**

Details of support sought or received from any other source for this or other research in the same field.

Awarding Organisation	Awarding Organisation's Reference	Title of project	Decision Made (Y/N)	Award Made (Y/N)	Start Date	End Date	Amount Sought / Awarded (£)
Public Health Agency Northern Ireland	R Hunter	A vision of healthy urban design for NCD prevention	Y	Y	15/05/2020	14/05/2023	38950

### **Classification of Proposal**

#### **(a) Grant Type**

Research Grant	x								
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## Staff

## Applicants

Role	Name	Post will outlast project (Y/N)	Contracted working week as a % of full time work	Total number of hours to be charged to the grant over the duration of the grant	Average number of hours per week charged to the grant	Rate of Salary pool/banding	Cost estimate
Principal Investigator	Dr Ruth Hunter	Y	100	347	2.6	80418	16912
Co-Investigator	Dr Leandro Garcia	Y	100	347	2.6	65221	13716
Co-Investigator	Professor Frank Kee	Y	100	50	0.4	135079	4093
Co-Investigator	Professor Geraint Ellis	Y	100	50	0.4	129071	3911
Co-Investigator	Dr Jason Thompson	Y	100	0	0	0	0
Co-Investigator	Professor Mark Stevenson	Y	100	0	0	0	0
Co-Investigator	Dr Kerry Nice	Y	100	0	0	0	0
Co-Investigator	Dr Jasper Sebastiaan Wijnands	Y	100	0	0	0	0
Co-Investigator	Dr Neil Anderson	Y	100	99	0.8	80418	4825

### Other Directly Incurred Costs

Description	Total £
2 project laptops (£650 per laptop)	1300
International, European, and UK conferences and events registration fees	5400
Total £	6700

### Research Council Facilities

details of any proposed usage of national facilities

Research Council Facilities are not relevant to this application.

**Project Partners:** details of partners in the project and their contributions to the research. These contributions are in addition to resources identified above.

1	Name of partner organisation	Division or Department	Name of contact	
	University of Cambridge	MRC Epidemiology Unit	Dr James Woodcock	
<b>Direct contribution to project</b>		<b>Indirect contribution to project</b>		
	Description	Value £	Description	Value £
cash			use of facilities/equipment	
equipment/materials			staff time	
secondment of staff			other	
other	Contribution with no significant financial value	1	Sub-Total	0
Sub-Total		1	Total Contribution	1

2	Name of partner organisation	Division or Department	Name of contact	
	AIA Australia Limited	Vitality Wellness	Ms Candice Smith	
<b>Direct contribution to project</b>		<b>Indirect contribution to project</b>		
	Description	Value £	Description	Value £
cash			use of facilities/equipment	
equipment/materials	Anonymised clients' health-related data	1	staff time	
secondment of staff			other	
other			Sub-Total	0
Sub-Total		1	Total Contribution	1

Total Contribution from all Project partners

£2

### Human Biological Samples

Does your work involve human Biological samples: research which involves laboratory studies on human material which are specifically designed to understand or treat a disease / disorder? NB: basic biomedical research remote from application to a disease / disorder, such as the use of immortalised human cell lines in model biological systems, is excluded. No

### Technology Development

Does your work involve Technology development for clinical use: development or adaptation of technologies for diagnosis or therapy, e.g. instrument development for diagnostic or surgical use; development of new techniques, such as photodynamic therapy, for clinical use. No

**(b) Research Setting**

Based on direct patient contact, indicate whether the research involves a particular medical setting such as primary care or secondary care.

None	x								

**(c) Stem Cells**

Does the research involve the use of Stem Cells or regenerative medicine?

No	x
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**(ii) Keywords**

Urban planning	Knowledge translation
NCD risk factors	Artificial intelligence
Health inequalities	Epidemiologic studies
Health impacts	Public policy
Co-design	

**Human Participation**

Would the project involve the use of human subjects?	Yes✓	No
If yes, would equal numbers of males and females be used?	Yes	No✓
Would the project involve the use of human tissue?	Yes	No✓
Would the project involve the use of biological samples?	Yes	No✓
Would the project involve the administration of drugs, chemical agents or vaccines to humans?	Yes	No✓
Will personal information be used?	Yes✓	No
If yes, will the information be anonymised and unlinked?	Yes	No✓
Or will it be anonymised and linked?	Yes✓	No
Will the research participants be identifiable?	Yes	No✓
Please provide details of any areas of substantial or moderate severity:		

Primary data collection involving human participants will occur during Work Package 3 only, via a usability study that aims to engage potential users of a web-based toolkit in co-designing it. In each country, 10-12 potential users (e.g., decision-makers and public servants in urban planning and health departments, members of the public, NGOs, researchers) will be identified and contacted with the aid of local collaborators. The study participants will be invited to join in two participatory workshops and to test intermediate versions of the toolkit to provide feedback during its development. Written consent will be obtained from all participants prior to their inclusion in the study. Personal data (e.g., name, country, place of work, job position) will be collected, but information will be anonymised for data sharing purposes in accordance to Queen's University Belfast's and University of Melbourne's research data management policies and guidance. Personal information may be disclosed in discussions during the group workshops, but none of this information will be included for analysis. Some parts of the workshops' audio recordings, transcripts, and minutes can be impossible to fully anonymise; therefore, they might not be suitable for sharing for all uses. Identification codes will be kept allowing linking the data to original records for further information and verification.

Furthermore, we will use secondary, quantitative, unlinked, anonymised datasets from different data providers. See 'Case for support' for a list of sources. In the models, individuals are not identifiable, even by modifying the code.

More details about data management can be found in 'Data management plan'.

## Animal Research

Would the project involve the use of vertebrate animals or other organisms covered by the Animals (Scientific Procedures) Act?	Yes	No <input checked="" type="checkbox"/>
If yes, what would be the maximum severity of the procedures?	Mild or non-recovery	
	Moderate	
	Severe	
Please provide details of any areas which are Moderate or Severe:		

## Animal Species

- |   |     |  |
|---|-----|--|
| Does the proposed research involve the use of non-human primates? | Yes | <input checked="" type="checkbox"/> No |
| Does the proposed research involve the use of dogs?               | Yes | <input checked="" type="checkbox"/> No |
| Does the proposed research involve the use of cats?               | Yes | <input checked="" type="checkbox"/> No |
| Does the proposed research involve the use of equidae?            | Yes | <input checked="" type="checkbox"/> No |

Please select any other species of animals that are to be used in the proposed research.

- |           |              |
|-----------|--------------|
| Fish      | Sheep        |
| Rabbit    | Rat          |
| Amphibian | Poultry      |
| Cow       | Mouse        |
| Reptile   | Guinea Pig   |
| Pig       | Other Rodent |
| Bird      | Other Animal |

## Genetic and Biological Risk

Would the project involve the production and/or use of genetically modified animals?	Yes	<input checked="" type="checkbox"/>	No
If yes, will the genetic modification be used as an experimental tool, e.g., to study the function of a gene in a genetically modified organism?	Yes	<input checked="" type="checkbox"/>	No
And will the research involve the release of genetically modified organisms?	Yes	<input checked="" type="checkbox"/>	No
And will the research be aimed at the ultimate development of commercial or industrial genetically modified products or processes?	Yes	<input checked="" type="checkbox"/>	No
Would the project involve the production and/or use of genetically modified plants?	Yes	<input checked="" type="checkbox"/>	No
If yes, will the genetic modification be used as an experimental tool, e.g., to study the function of a gene in a genetically modified organism?	Yes	<input checked="" type="checkbox"/>	No
And will the research involve the release of genetically modified organisms?	Yes	<input checked="" type="checkbox"/>	No
And will the research be aimed at the ultimate development of commercial or industrial genetically modified products or processes?	Yes	<input checked="" type="checkbox"/>	No
Would the project involve the production and/or use of genetically modified microbes?	Yes	<input checked="" type="checkbox"/>	No
If yes, will the genetic modification be used as an experimental tool, e.g., to study the function of a gene in a genetically modified organism?	Yes	<input checked="" type="checkbox"/>	No
And will the research involve the release of genetically modified organisms?	Yes	<input checked="" type="checkbox"/>	No
And will the research be aimed at the ultimate development of commercial or industrial genetically modified products or processes?	Yes	<input checked="" type="checkbox"/>	No

## Implications

Are there ethical implications arising from the proposed research?

Yes

Provide details of what they are and how they would be addressed [up to 1000 characters]

Our findings are expected to lead to people changing their behaviour or policies. While our goals are towards health promoting changes, adverse behavioural responses are possible. Before presenting results, we will give careful consideration to this and the communication strategy.

## Approvals

Have the following necessary approvals been given by:				
The Regional Multicentre Research Ethics Committee (MREC) or Local Research Ethics Committee (LREC)?	Yes	<input checked="" type="checkbox"/>	Not required	
The Human Fertilisation and Embryology Authority?	Yes	<input type="checkbox"/>	Not required	<input checked="" type="checkbox"/>
The Home Office (in relation to personal and project licences, and certificates of designation)?	Yes	<input type="checkbox"/>	Not required	<input checked="" type="checkbox"/>
The Gene Therapy Advisory Committee?	Yes	<input type="checkbox"/>	Not required	<input checked="" type="checkbox"/>
The UK Xenotransplantation Interim Regulatory Authority?	Yes	<input type="checkbox"/>	Not required	<input checked="" type="checkbox"/>
Administration of Radioactive Substances Advisory Committee (ARSAC)?	Yes	<input type="checkbox"/>	Not required	<input checked="" type="checkbox"/>
Other bodies as appropriate? Please specify.				

# OTHER INFORMATION

## Reviewers

1	Name	Address	Town	Email Address
Dr Aaron Hipp		NC State University	Raleigh	jahipp@ncsu.edu

## Reviewers

2	Name	Address	Town	Email Address
Professor Colin Bell		Deakin University	Geelong	colin.bell@deakin.edu.au

## Reviewers

3	Name	Address	Town	Email Address
Dr Marc Barthelemy		Institute of Theoretical Physics	Saclay	marc.barthelemy@ipht.fr

**Staff****Directly Incurred Posts**

EFFORT ON PROJECT										
Role	Name /Post Identifier	Start Date	Period on Project (months)	% of Full Time	Scale	Increment Date	Basic Starting Salary	London Allowance (£)	Super-annuation and NI (£)	Total cost on grant (£)
Researcher	QUB: Research Fellow	15/08/2020	33	100	AC2 (32)	15/08/2021	35845	0	11026	132405
Researcher	QUB: Research Assistant	15/01/2022	16	100	AC1 (26)	15/01/2023	30046	0	9062	52360
Total										184765

## **A VISION OF HEALTHY URBAN DESIGN FOR NCD PREVENTION**

### **1. IMPORTANCE OF THE RESEARCH**

#### **The city as both a threat and solution to health**

For cities to be at the centre of public health outcomes is far from new; some of civilization's greatest public health tests and triumphs have occurred in cities. However, two novel elements have arisen in the past decades that pose new challenges and opportunities for those seeking to understand the impact of urban design on health:

1. the increase of non-communicable diseases (NCD) associated with lifestyle-related factors from living within contemporary Australian and UK cities, and
2. the availability of large volumes of data and of state-of-the art methods from artificial intelligence, data-science, and complexity science that can be used to both understand and optimise the health of city populations.

We are living in a new urban age with new health risks, but also new ways to understand and alleviate them. It is critical that we improve our understanding of the strengths and weaknesses of existing city designs to ensure they are safe, clean, healthy, and sustainable. This combination of risk identification and mitigation of NCD (cardiovascular disease (CVD), type 2 diabetes mellitus (T2DM), cancers, chronic respiratory conditions, and mental illness) and road injury through the application of state-of-the art methods for analysis and urban re-design is the focus of this application. Specifically, it directly aligns with items 'a', 'b' and 'd' from the call: (a) urban planning and regeneration, (b) city design, including increasing conditions that promote health, and (d) transportation systems.

#### **Background**

The world has seen a rapid increase in population of 1 billion since 2005 and 2 billion since 1993 to a current population of 7.3 billion, with most of the growth in cities<sup>1</sup>. Managing exponential city population growth across high-, middle- and low-income countries is a significant global challenge. Safe and healthy food, clean water, clean air, safe housing, transport, and healthy social relationships are among the most basic of human needs. But even in locations of comparatively high economic development, such as the UK and Australia, large areas exist where urban design contributes to increased incidence of known NCD risk factors such as physical inactivity, air pollution, inequitable access to outlets for tobacco, alcohol and nutrient-poor food, and social disconnection, leading to adverse health and disease outcomes.

As global rates of infectious disease have declined, rates of NCD have moved to take their place. Some of these illnesses are arguably the consequence of an aging population; however, many are a result of the current urban-age<sup>2</sup>. T2DM, CVD, respiratory disease, cancer, mental illness, in addition to road injury, are all partially attributable to city design. Despite their relative wealth, Australia and the UK are not immune, having experienced among the greatest global increases in rates of overweight and obesity leading to the development of T2DM, CVD, cancers, and associated metabolic diseases since the 1980s<sup>3,4</sup>. The combined effect of air pollution, poor diet, high sugar intake, low levels of physical activity, smoking, and other modifiable lifestyle factors, driven in part by the reinforcing influence of low-density, car-dependent cities, poses a serious challenge to attain health-promoting changes. Added to this are recent alarming accelerations in serious road injuries and deaths, especially among active transport users, pedestrians and cyclists who are otherwise acting healthily<sup>5,6</sup>. It is an unjust irony that individuals seeking to reduce NCD risk through walking and cycling should then be exposed to higher risk from road injury due to urban design that does not protect them from motor vehicles, making overall health gains through reductions in total NCD harder to achieve. Optimised urban design should consider the totality of population health gains when designing urban interventions<sup>7</sup>.

Furthermore, NCD are socially patterned. A number of Sustainable Development Goals (SDGs) set targets that relate to the reduction of health inequalities including health and wellbeing for all (SDG 3) and reduction of inequalities within and between countries (SDG 10). The interaction between inequalities and NCD are complex: low socioeconomic status leads to chronic ill health, and NCD reduce income status of households. Compelling evidence from 283 studies supports a positive

association between low-income, low socioeconomic status, or low educational status and NCD<sup>8</sup>. Health is a key driver in the SDGs, and reduction of health inequalities and NCD should become key in the promotion of the overall SDG agenda. A sustained reduction of general inequalities in income status within and between countries would enhance worldwide equality in health. Niessen and colleagues<sup>8</sup> argue that to end poverty through elimination of its causes, NCD programmes should be included in the development agenda. National programmes should mitigate social and health shocks to protect the poor from events that worsen their frail socioeconomic condition and health status. This can be done through better and more equitable urban design (SDG 11). Growing inequalities in access to resources for prevention can be addressed through improved urban design across jurisdictions that eliminate the barriers in the implementation of NCD prevention.

### **Contemporary planning laws for health in a new urban age**

Efforts to design cities for the betterment of population health have a long history. In the 1500's, a set of ordinances known as 'The Law of the Indies', handed down by Spain's King Phillip II, set out 148 rules for construction of new townships to achieve a healthy urban form for settlers emigrating to the 'new world' – patterns still visible in the urban footprint today<sup>9,10</sup>. But what are the contemporary equivalent of these laws? How can we use existing data to understand the rules of healthy urban design for contemporary times? How can we create pathways for positive, healthy change in existing green, grey, or brown-field locations? With new knowledge and methodological tools now at our disposal, it is the right time to determine what modern laws for healthy, productive urban design in the 21<sup>st</sup> century can and should be.

### **The places where urban health risks lie**

The structure and dynamics of cities directly affect their use. And in-turn, the way cities are used directly affects exposure to risks associated with NCD. If cities are to continue their rapid growth while maintaining their attractiveness and position as drivers of prosperity and wellbeing for citizens, we will need to construct them in ways that not only reduces risk exposure but facilitates the easy adoption and maintenance of healthy lifestyles.

The recent Lancet Series on Urban Design and Health, led and co-authored by members of our research team, made explicit the relationships between urban design and health. Specifically, paper 2 of the series<sup>7</sup> modelled the potential health benefits that could be generated in London and Melbourne through adoption of a 'Compact City' approach. It showed that through combined reductions in distances to public transport, increases in residential density, and transportation system design modifications that facilitated a shift toward active transport, improvement in disability adjusted life years (DALYs) per 100,000 population of 581 and 679 DALYs could be achieved for each city, respectively.

The global impact of this landmark series, which has received over 600 citations since publication, has been considerable. However, the authors have now moved forward to develop a set of methodologies that go significantly beyond those used within the series, and what has previously been possible in the exploration of relationships between urban design and health. Now, by avoiding inefficient data collection efforts that use individual city administrative sources, we have harnessed consistently collected global urban datasets using remote sensing containing millions of images related to urban form from cities around the world. We have developed a streamlined process that incorporates big data, artificial intelligence, and methods drawn from complexity science to discern: (i) global city typologies that group cities according to similar urban characteristics<sup>9</sup>, (ii) individual city fingerprints, that create comparable fine-scaled, block-level representations of urban morphologies for individual cities<sup>11</sup>, and (iii) a process for producing urban design solutions using generative adversarial networks, which creates images that combines the structure of existing low performance urban areas with the design of high performance areas, enabling new futures to be imagined<sup>12,13</sup>. Our methods now enable a virtually limitless representation of cities to be included in analysis, and also a fine-grained analysis at the block or neighbourhood level of within-city city morphological differences to determine how they are associated with population health risks and outcomes, methods that scale both up and down in a manner not previously achieved<sup>14</sup>.

Combined, these methods are state-of-the-art, having either only recently been published, or in the throes of publication and dissemination through international conferences and pre-print archives. We have pursued them because to date, studies and interventions targeting health outcomes associated with cities and urban design have been weighted more-so toward research methods from health sciences than city science. This is a point that is leading contemporary city scientists and public health researchers to call for change<sup>2,15-18</sup>. While traditional methods have brought us to the highest point on our current mountain, their origins in experimental health research designs sees them better suited to smaller scale interventions, samples, or problems of defined and simpler natures (e.g., those characterised by 'PICO' frameworks<sup>19</sup>) than interactions between cities, people, and health afford.

Cities are dynamic. Their infrastructure and people change, grow, adapt and develop habits and cultures, healthy or otherwise. Technologies advance and decline or are displaced; creating efficiencies, solutions, bottlenecks, demands, and instigating new challenges. In short, there is no ideal healthy city that is impervious to change nor invulnerable to future, unforeseen, socio-technical changes that come to surround it. It is, therefore, not surprising that the empirical research methods from the last half of the 20th century may be inadequate for grappling with such complexity and that change is advocated<sup>15,18,20</sup>. This project embodies that change.

## 2. PEOPLE AND TRACK RECORD

We are a mix of senior, midcareer, and junior academics with complementary multidisciplinary expertise earned both within and outside academia, well placed to carry out the research we propose. We have extensive research experience as PI and Co-I in international partnerships involving built environment and NCD prevention. We also have a successful record of past collaborations among us, upon which this proposal is built.

UK partners include: *Dr Ruth Hunter* (PI), Reader in Public Health at Queen's University Belfast (QUB) Centre for Public Health with vast experience in the role of social and built environments for health-related behaviour change. She has collaborated with Prof Geraint Ellis for over 10 years in the area of built environment and health. *Dr Leandro Garcia* (PI), Lecturer in Complexity Science in Public Health at the QUB Centre for Public Health, epidemiologist trained in complexity science methods who capitalises on both approaches to understand the multiple determinants of population patterns of health-related behaviours and the consequent health impacts. *Prof Frank Kee*, Director of QUB Centre for Public Health, a public health doctor and epidemiologist with extensive experience leading population-wide NCD prevention research projects and programmes with a focus on complex interventions for public health. He is also co-director of the Northern Ireland and Wales centre of the Health Data Research UK initiative. *Prof Geraint Ellis*, Director of QUB Sustainable Built Environment, urban planner with particular emphasis on planning theory for progressive planning, environmental justice, equality issues in planning, and healthy urban planning. *Dr Neil Anderson*, Senior Lecturer in Computer Science at QUB School of Electronics, Electrical Engineering and Computer Science, computer scientist with extensive experience in website and app development who has been working on public health projects for over 7 years.

Australian partners include: *Dr Jason Thompson* (CIA), Senior Research Fellow within the University of Melbourne's (UoM) Transport, Health and Urban Design (THUD) Research Laboratory, housed within the University of Melbourne's Faculty of Architecture, Building and Planning. After an extensive pre-academic career in clinical psychology, and public health policy, analysis and promotion, Dr Thompson is now an Australian Research Council DECRA Fellow, focused on the development of computational methods for understanding relationships between transport, urban design, population health and health system performance. *Prof Mark Stevenson* (CIB) is an epidemiologist with appointments across the Melbourne School of Design, Engineering and Population and Global Health. He is a current NHMRC Fellow, internationally recognised in the field of transport safety and public health and is the current Director of the THUD Laboratory, comprising a cross-disciplinary research team exploring how the effects of urban form and transportation influence the health of residents in cities. Professor Stevenson was the lead author in the 2016 Lancet Series on Urban Design and Health. *Dr Kerry Nice* (CIC) is a Research Fellow in the THUD Laboratory and an urban climate scientist/modeller at Monash University. Building on an industry background in software engineering, Dr Nice's work now focuses on use of methods of

artificial intelligence to the investigation of urban factors and their influence on population health and wellbeing. *Dr Jasper Wijnands* (CID) is an applied mathematician with expertise in applications of image processing, classification and artificial intelligence. Dr Wijnand's current research focusses on novel applications of artificial intelligence and deep learning using 2D and 3D convolutional neural networks for use in applications related to transport, health and urban design. Dr Wijnands also brings strong industry experience, having previously worked in financial risk management within top-tier international management consultancies.

### 3. RESEARCH ENVIRONMENT

QUB and UoM, primary research organizations in this proposal, are, respectively, a member of the prestigious Russell Group in the UK and ranked as The Times Higher Education's leading research institutions in Australia, both holding research excellence as their primary indicator of success. Both universities are committed to tackling major interdisciplinary challenges. QUB has shaped interdisciplinary priorities according to the Global Challenge Themes, including the theme of 'healthy global populations'. UoM includes 'fostering of population health and wellbeing' and 'supporting sustainability and resilience' as two of its three 'grand challenges' to 2025. Urban systems of the future as described in this proposal will play a major role in the key priorities of these two institutions. Both institutions demonstrate with actions their commitment to university-wide challenges. The UoM Faculty of Architecture, Building and Planning has established an interdisciplinary research hub devoted to the study of Transport, Health and Urban Design, of which Co-I Stevenson is the leader and Co-PI Thompson and Co-Is Nice and Wijnands are core research fellows. UoM has specialised computing and data storage infrastructure (MediaFlux and Spartan, respectively) that is purpose-built for sensitive/human subject data and collaboration with internal and external users as set out in this application. QUB Centre for Public Health, of which Co-I Kee is the director and Co-PIs Hunter and Garcia are permanent research staff, is a central component of the Global Research Institute for Health Sciences. The Centre has been one of the five UKCRC Public Health Research Centres of Excellence for the last decade, and most of its work has been transdisciplinary from the outset. The Centre has had over 10 years of active collaboration with the QUB School of Natural and Built Environment, working in the area of built environment and health. Building on this strong foundation, both Dr Hunter and Prof Ellis are leading the development of an innovative Masters' programme of urban planning and public health, which will be the first in the UK. In combination, these groups offer a fertile environment in which to conduct interdisciplinary, systems-focused, action-oriented research of this nature, bringing together researchers from urban design, transport system design, geography, public health and epidemiology, medicine, complexity science, and computer science. Past works of members of this research team have generated great impact in themes of this call in the past (e.g., through leadership on a 2016 Lancet series on the relationship between Urban Design, Transport and Health). Also, these groups have demonstrated their capacity to disseminate and translate research for non-academic audiences and a wide network of policymakers.

### 4. RESEARCH PLANS AND DELIVERABLES

Our research plan is built around three Work Packages (WPs) that aim to (i) investigate the relationship between urban design and NCD at the city- and individual-level using a unique combination of methods and bringing together big data, global image sources, population-based cohorts, and Geographic Information System (GIS) data, (ii) estimate the potential impacts in NCD prevention and health inequalities of actionable changes in urban form, and (iii) develop an interactive toolkit for action according to intended users requirements for their decision-making cycle.

#### 4.1. WP 1 – *Building the evidence base on the relationship between urban design and NCD*

This WP will be comprised of two levels of analysis: cities and individuals. This acknowledges that people's health is affected by their immediate environment and, at same time, by the way the entire city system is organised.

## **City-level analysis**

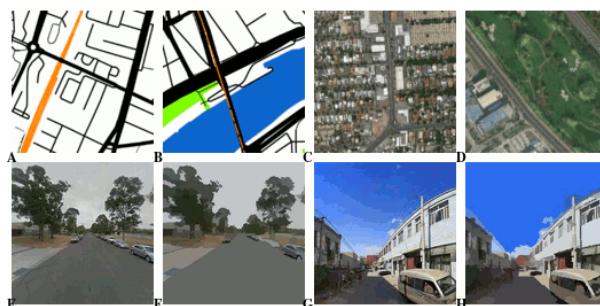
### Sampling

City-level urban design data derived from small-scale maps, consistent with Thompson et al.<sup>9</sup>, will be selected for all UK and Australian cities with populations greater than 100,000. This will capture approximately 90% of the UK and Australian populations.

In the first stage, a circular baseline image sampling area will be calculated for each city with a centroid derived from the United Nations dataset<sup>21</sup> and an initial minimum radius of 1.5 km. The sampling area will increase by a power of 0.85 to the proportional increase in population<sup>22</sup>. Standardising the sampling area in this way will capture differences in urban density between cities while also appropriately adjusting for the largest cities in the dataset (e.g., London, Sydney, Melbourne).

The second sampling stage will involve selecting local-level image representations of each city using a combination of Google Maps, satellite and street-view imagery. These images provide detailed information of urban characteristics of interest such as road networks, rail transit networks, cycling networks, water bodies, vehicles, people, and designated parks or greenspace.

Figure 1 shows typical images previously used by the research team for analysis as proposed, featuring map abstractions, satellite images, street view and sky-view. A grid-based dataset encompassing the entire sampling area for each city will be generated.



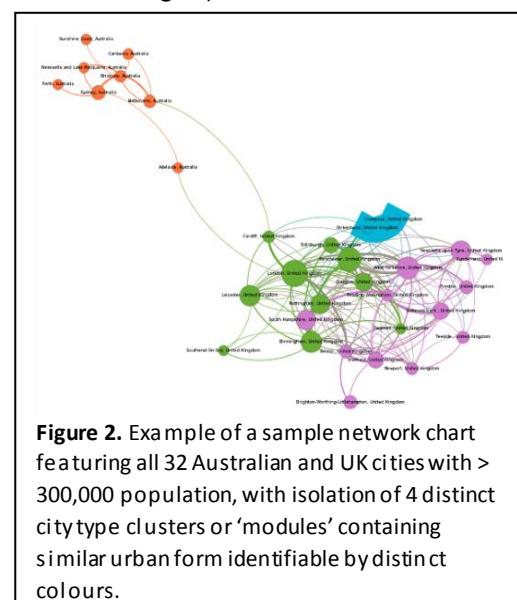
**Figure 1.** Four sample images featuring abstract maps (A,B), satellite view (C,D), street-view (E,F), and sky-view (G,H).

### City image classification

With the map image database for Australian and UK cities established, a convolutional neural network based on ‘Inception V3’ architecture<sup>23</sup> will be used to classify city images (hereby referred to as ‘the model’). The model will be calibrated using a supervised learning procedure that passes through two phases: a training phase featuring 75% of images where it will learn which images are associated with which city, and a validation phase (25% of images), where it tests model performance. During the validation phase, the model will predict the probability that each validation image is from each city, including its actual ‘ground truth’ location. The model will be trained to reach approximately 80% accuracy, where it will be halted and the confusion matrix<sup>24,25</sup> then analysed. The confusion matrix is a table that shows the frequency that images from any individual city are incorrectly predicted (i.e., confused) by the model to be from an alternative city. When images from one city are confused with another, it indicates shared features exist between locations. The more the model confused cities for one another, the more likely they are to share similar urban design features.

### Identification of city types

Graph-based analysis<sup>26</sup> will be applied to all cities in the confusion matrix creating vertices (i.e., ties or relationships) between cities. This will produce a spatially



**Figure 2.** Example of a sample network chart featuring all 32 Australian and UK cities with > 300,000 population, with isolation of 4 distinct city type clusters or ‘modules’ containing similar urban form identifiable by distinct colours.

representative network graph where cities more often confused for one another appear closer together in the network. A modularity analysis<sup>27</sup> will then be performed to identify groups of identifiable city types. Figure 2 shows an example of this process applied to a preliminary dataset for Australian and UK cities, demonstrating four distinct city types, three within the UK and one in Australia, with Melbourne and Adelaide demonstrating similar urban form to Cardiff, Wales and London, England, respectively. It would be expected that these identified city type groups would demonstrate differences in health outcomes on account of differences in urban design between groups.

#### City types, health risk identification, and health outcomes

To investigate the association between city types and NCD risks and outcomes, we will utilise available data from a range of sources aggregated to the city level to calculate risk ratios for each NCD category for each city type, using the lowest risk city type as the benchmark and controlling for city and nation level confounders. For health data, we will utilise available data from similar government sources in respective territories and jurisdictions (see Table 1 for examples). Road injury data will also be included in our analysis for two reasons. Firstly, road injury continues to be a significant global health burden, contributing to over 1.35 million deaths and 50 million injuries<sup>28</sup>, ranking it as the 8<sup>th</sup> leading cause of death for people of all ages and the leading cause for children and young people aged 5-29 years of age. Secondly, our team's previous work modelling the nexus between urban design and health<sup>7</sup> clearly shows that urban design changes place populations at reduced risk of NCD but higher risk of road injury, compromising their total effectiveness. In short, urban design, NCD and road injury are entwined. For additional road transport and injury data, we will therefore access available geo-located road traffic collision and casualty data from state-based road transport authorities in Australia (e.g., Victorian Department of Transport) and in the UK from the Police Service Northern Ireland and Stats19. However, it is unlikely that health risk or outcomes data will be consistently collected across jurisdictions. In circumstances where government or other data is not available on a consistently collected or comparable basis, the research team will utilise its relationship with AIA, an international private health and life insurance provider, to source health risk and outcome data at the local (post-code) level across both countries. This data will include information relating to demographic and health-related factors such as BMI, blood pressure, blood glucose, cholesterol, levels of physical activity, physical energy expenditure, heart rate, and diagnoses related to NCD. The advantage of utilising this data source is that AIA uses consistent data collection methods for over 1 million clients in UK and Australian cities. While the data sources are not representative of the entire population, comparisons of performance between locations will still be possible.

#### **Individual-level analysis**

We will initially use health and GIS data from UK Biobank and from AIA to prospectively investigate, at the individual level, the causal pathway between urban design, NCD risk factors, and NCD incidence, and effect modifications caused by sociodemographic factors. UK Biobank is a cohort of 502,619 adults aged 40-69 years from the general population, recruited between 2006 and 2010. It collects a wide range of sociodemographic (e.g., age, sex, ethnicity, education, and deprivation index) and health data (e.g., diet, physical activity, smoking, alcohol consumption, and NCD incidence) and provides a wealth of objectively assessed built environment metrics from the immediate residential neighbourhood of UK Biobank participants, including building typology, destination accessibility, greenness, land use density, and street network accessibility. AIA data will include information from over one million participants in the AIA Vitality health insurance program, providing information on demographic and health-related factors such as BMI, blood pressure, blood glucose, cholesterol, levels of physical activity, physical energy expenditure, and heart rate for up to five years. GIS data will be linked to AIA Vitality database. Bayesian networks will be used to investigate multiple potential causal paths through which urban design can affect NCD risk factors and NCD incidence and prevalence. Bayesian networks are probabilistic directed acyclic graphs that can be used to compute the conditional probabilities of presenting specific NCD risk factors and of NCD incidence given different aspects of the built environment. Also, we will compute changes in the conditional probabilities according to sociodemographic factors, offering a full and nuanced picture of how social disparities can affect the relationship between built environment and NCD prevention. Each sociodemographic factor, built environment aspect, NCD

risk factor and NCD will be individually represented as a node in the DAGs. The DAGs structure will be obtained applying learning algorithms to the observed data and taking into account prior knowledge (e.g., disallowing an NCD risk factor to be a parent node of sex or age). Local conditional distributions will be derived from data, and parameters will be obtained by performing Bayesian parameter estimation. Bootstrap resampling will be applied to learn a set of 1,000 network structures, which will be averaged to reduce the impact of locally optimal networks on learning and inference. For purposes of validation, we will also utilize k-fold cross-validation.

**Table 1.** Example sources of geo-references health data available to the research team for analysis and comparison.

Country	Source	Data available
UK / AUS	Census	Sociodemographic factors, health-related behaviour, NCD prevalence
UK / AUS	Register of deaths	NCD mortality
UK	Northern Ireland Cancer Registry*	Cancer incidence, prevalence and mortality
UK	Northern Ireland CVD Database*	CVD incidence, prevalence and mortality
UK	Prescription data	Proxy of chronic conditions
UK	UK Household Longitudinal Study	Sociodemographic factors, health-related behaviour, NCD prevalence and incidence
UK	Continuous Household Survey	Sociodemographic factors, health-related behaviour, NCD prevalence
UK	Northern Ireland Neighbourhood Information Service*	Sociodemographic factors, health-related behaviour, NCD incidence, prevalence and mortality
UK	Health Survey Northern Ireland*	Sociodemographic factors, health-related behaviour, NCD prevalence
UK	National Diet and Nutrition Survey	Health-related behaviour (diet)
UK	Stats19 & Police Service Northern Ireland	Geo-referenced road traffic collisions and casualties
AUS	Victorian Local Government Health Survey	Sociodemographic factors, health-related behaviour, NCD prevalence
AUS	Australian Commission on Safety and Quality in Health Care	Procedures, tests, investigations, treatments or hospitalisations in geographic areas
AUS	Australian Institute of Health and Welfare	Sociodemographic factors, health-related behaviour, NCD prevalence
AUS	Melbourne Institute	Health care utilisation, incidence and prevalence, socio-demographic factors, health-related behaviour

\* The other nations in the UK run similar data surveillance systems or surveys.

**WP 1 Outputs:** Identification of UK and Australian city types according to built environment features. Association between city types and NCD risk factors and NCD prevalence. Individual-level probability of presence of NCD risk factors and NCD incidence and prevalence given different aspects of the objective built environment, estimated from large prospective cohorts. Examination of potential effect modification of the relationship between built environment and NCD prevention according to social disparities.

#### 4.2. WP 2 – Estimating health impacts of actionable changes in urban design

Building on the outputs of WP 1, this WP is designed to provide estimates of health impacts achievable via actionable changes in urban design. Again, we divide our work in two streams. First, we will analyse the potential effects of city-wide changes in built environment, benchmarking against healthier cities within the network graph generated in WP 1. Second, we will investigate the range of urban morphology within each one of the sampled cities to provide a fine-grained representation of NCD risks and outcomes associated with unique urban design features, which can be used to suggest healthier solutions for existing areas and locations.

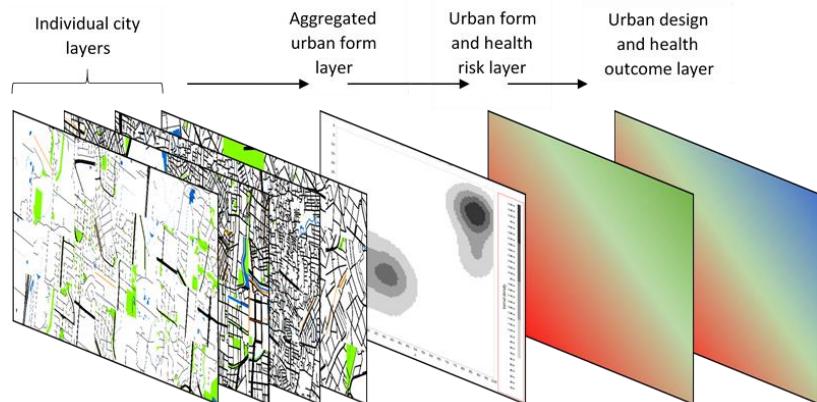
#### Between-cities analysis

Mean number of premature deaths, years of life lost due to premature death (YLL), and disability-adjusted life-year (DALY) will be calculated for all cities and city types based on their country-level disease-burden estimates. Using the conditional probabilities obtained from the individual-level analysis in WP 1 and city populations, we will then estimate the total deaths, YLL, and DALY that could be averted in each city according to two approaches: (i) comparing against the city with the

healthiest built environment in the same country and overall; (ii) between each pair of cities directly connected in the network graph generated in WP 1 (assuming the city with the healthiest built environment as the benchmark), which will also allow the comparison between any two pair of cities indirectly connected (i.e., two or more edges apart). The first approach will allow us to estimate the potential for NCD prevention in the best, but still realistic, case scenario. The second approach enables the comparison between cities with relatively similar urban forms, so informing the potential benefits of more actionable changes in the built environment, but at same time also allows us to estimate the NCD prevention benefits of more ambitious changes (i.e., between cities further way in the network graph and so not very similar in terms of built environment). We will also estimate the aggregate excess in deaths, YLL, and DALY for each city type relative to the risks associated with the lowest-risk city type.

### Within-cities analysis

In the second stage of analysis, data in the form of images from the range of observed urban design from all sampled locations across cities will be represented on a 2-dimensional self-organising map based on an adaptation of the city ‘fingerprint’ method of Nice<sup>11</sup>. This multi-dimensional process that incorporates information of block size and regularity, green space, blue space, public transport accessibility, and road networks will create a standardised representation of the entire range of urban form observed in all cities. Each position on the grid will be matched to its performance across health risk and outcome measures as understood from WP 1, while also controlling for socio-demographic differences between locations. The resulting ‘meta-map’ will provide a fine-grained representation of health risks and outcomes associated with unique urban design features, which can be matched back to any current or planned real-world location (Figure 3). The meta-map will (i) form the definitive set of associations by which urban design can facilitate reductions in all NCD, and (ii) enable comparisons of health impact for populations between and given changes in the characteristics of individual locations.



**Figure 3.** Representation of the city fingerprint and health impact process taking data from individual cities, combining all urban form into an aggregated ‘fingerprint’ map, and associating it with health risk and outcome data.

This process will create metrics that allow city planners to estimate the changes in health outcomes for a population based on changes to existing urban form or benefits from baseline associated with planned construction of new areas (see WP 3). Because each city and geographic region will be identifiable, it will also highlight specific nearest-neighbour locations that can be used as feasible real-world examples to plan pathways for change from current to desired end-states (e.g., a desire to change from a high pollution, car-oriented urban network to the most feasibly achievable low pollution, pedestrian-friendly network). Finally, generative adversarial networks of the type the research team has recently developed to consider shifts in design from areas of ‘unhealthy to healthy’ urban design<sup>12</sup> and “unsafe to safe” cycling<sup>13</sup> will be used to suggest visualised solutions for regenerating existing areas into those resembling identified healthier and safer locations with resultant benefits in NCD prevention. This entire process will also provide means to estimate potential reductions in within-city health inequalities driven by actionable changes in the urban morphology.

**WP 2 Outputs:** Potential NCD prevention benefits of realistic city-wide and local-specific urban design changes. Potential health inequality reductions of realistic local-based built environment actions.

#### 4.3. WP 3 – Developing a toolkit for action

We will develop a web-based tool, called City Vision, in which outputs from WPs 1 and 2 are presented and manipulated in an interactive environment, encouraging exploration of findings, new insights, and evidence-informed decisions. The toolkit will be co-designed with intended users (e.g., decision-makers and public servants in urban planning and health departments, members of the public, NGOs, researchers) to make sure that features required to match their tasks and goals are implemented, and that the tool offers an intuitive use and can support their decisions and actions for NCD prevention. A usability study will be conducted alongside the tool development to identify the tasks and goals of intended users and the features required in the tool to match them and examine the extent to which use of the tool is intuitive and can support their decisions. It is anticipated that a group of 10-12 participants from each country (invited from those living and working in the cities in WP1), representing a variety of potential users, will offer critical insights and feedbacks on the structure, usability, and interface of the platform to meet the requirements of their decision-making cycle. Participants will be involved in three main activities: (i) in early stages of tool development, a one-day participatory workshop will discuss which features are required to meet their tasks and goals; (ii) during tool development, participants will test intermediate versions of the tool and provide feedback to improve features and overall usability; (iii) after completion of tool development, a second one-day meeting for participants to engage with the tool, discuss data gaps and priorities, determine what aspects of the process they found useful (or not) and why, debate next steps to improve the tool and how it can be scaled up and applied to other settings. All activities will be conducted in both countries, totalling four workshops. The research team will conduct the workshops and two people will record the workshop, taking notes and documenting decisions and products.

**WP 3 Outputs:** Freeware, interactive web-based toolkit for evidence-informed decision making (City Vision), co-designed with intended users.

### 5. ETHICS AND RESEARCH GOVERNANCE

The research will comply with the MRC and NHMRC research ethics frameworks. Ethical approval will be sought from the relevant human research ethics committees at both QUB and UoM. Informed consent will be obtained from the usability study participants (WP 3) prior to their inclusion in the study. Due to the nature of the interaction with the stakeholders, it is anticipated that there is minimal risk to participants. The other WPs use already collected data sources. All information will be held according to the UK Data Protection Act 2018, the EU General Data Protection Regulation, and the Australian Privacy Act 1988. No personal level detail will be published.

Dr Hunter, Dr Garcia, and Dr Thompson are co-PIs, with overall responsibility for the study. The team is also composed of senior researchers (Kee, Ellis, and Stevenson) with considerable experience in research management of international, interdisciplinary studies, and development of efficient processes for collaboration agreements and data management plans across institutions in international projects.

### 6. EXPLOITATION AND DISSEMINATION

WP 3 ensures that all the results will be made available through a free, interactive web-based tool, co-designed with the end users to allow intuitive, efficient, and informative use of data to support their decision-making cycle and actions for NCD prevention. Besides the web platform, findings will be published in academic journals and policy briefs for use by a wide range of policymakers, local government officials, and NGOs to help inform and disseminate project findings. All computer codes will be made available under an open-source license, allowing third parties to adapt them to meet their needs and work on improvements. The tool will be adapted for inclusion in curriculum for undergraduate design and post-graduate planning courses within respective institutions. It will also be hosted on the Australian Urban Research Infrastructure Network (AURIN) portal, making it available to all Australian and International registered users of the platform. Dissemination of

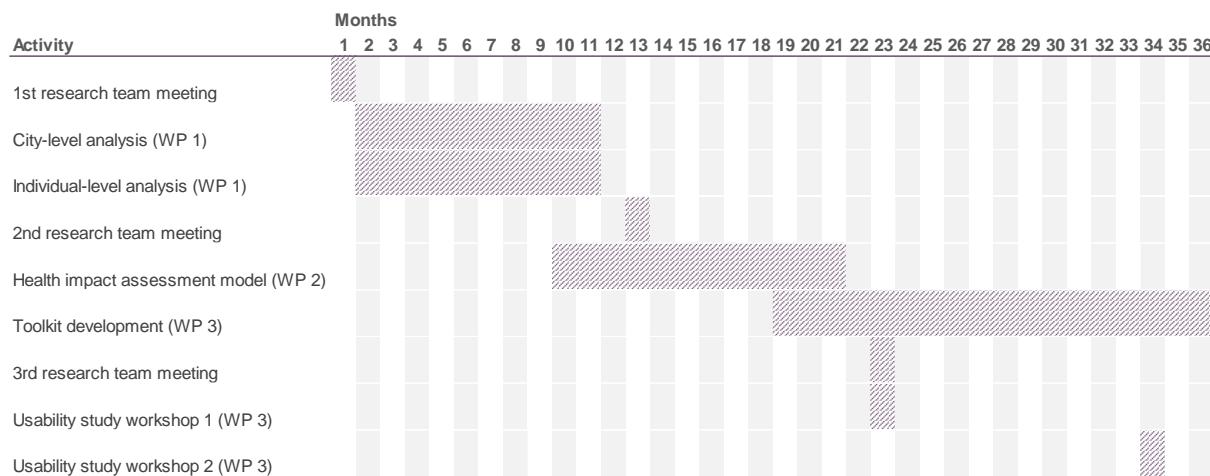
findings and tools in the UK will also seek the support of the UK Collaboratorium for Research on Infrastructure and Cities (UKCIRC, also funded by UKRI). See also the Communication Plan and Pathways to Impact for further details.

## 7. PROJECT PARTNERS

*Dr James Woodcock* is the lead of the Public Health Modelling Programme at the MRC Epidemiology Unit, University of Cambridge. He is an epidemiologist with training in health impact assessment modelling, with extensive experience developing models and tools to quantify the impacts of health-related policy interventions, including previous and ongoing experiences with local and national governmental bodies and international organizations. Dr Woodcock will provide intellectual support for the development of the health impact assessment models in WP 2 (see attached letter of support).

AIA is part of an international group of life and health insurance companies with bases in the UK and Australia, as well as mainland Europe, South Africa, China, United States, Japan and Canada. AIA has over 1 million members across the UK and Australia alone. Their approach is to promote proactive management of health and wellbeing for individuals, while recognising and working to change social and societal barriers to healthy lifestyles. AIA will provide valuable, de-identified, geo-referenced datasets related to individual health and wellbeing metrics of members for use in WP 1 (see attached letter of support).

## 8. WORK PLAN



## REFERENCES

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## JUSTIFICATION OF RESOURCES

### UK – Australia Built Environment and Prevention Research Scheme 2019

#### COMPLIANCE WITH THE DATA PROTECTION ACT 2018

In accordance with the Data Protection Act 2018, the personal data provided on this form will be processed by UK Research and Innovation in accordance with all UK data protection legislation and may be held on computerised database and/or manual files. Further details may be found in the guidance notes and on the UK Research and Innovation Privacy Notice (<https://www.ukri.org/privacy-notice/>).

This template should be completed using: Arial (or an equivalent) and a minimum font size of 11. A minimum of single line spacing and standard character spacing must be used.

**Please note that sections (4) and (5) below have page limits.  
Failure to respect the page limits may result in the proposal being declared ineligible.**

#### **(1) Summary of combined total requested**

*Please complete all boxes*

	<b>In Australian Dollars</b>	<b>In UK Pounds</b>
<b>Australian funding requested</b> <i>(please ensure the total matches the budget submitted to NMHRC)</i>	AUD\$ 608,911	£ 327,570
<b>UK funding requested</b> <i>please ensure the total matches the MRC contribution (80% FEC) total on the Je-s proposal form</i>	AUD\$ 712,894	£ 383,509
<b>Total funding requested</b>	AUD\$ 1,321,805	£ 711,079

#### **(2) UK Applicants – All PIs and Co-Is must be listed below and also added to the UK's Je-S system. Please provide the names, full affiliations and details of all lead and co-investigators.**

<b>Role (PI or Co-I)</b>	<b>Name</b>	<b>Organisation</b>	<b>Division or Department</b>
PI	Dr Ruth Hunter	Queen's University Belfast	Institute for Health Sciences
PI	Dr Leandro Garcia	Queen's University Belfast	Institute for Health Sciences
Co-I	Prof Frank Kee	Queen's University Belfast	Institute for Health Sciences
Co-I	Prof Geraint Ellis	Queen's University Belfast	Institute of Spatial Environmental Planning
Co-I	Dr Neil Anderson	Queen's University Belfast	School of Electronics, Electrical Engineering and Computer Science

**(3) Australian Applicants – All Chief Investigators (CI) must be listed below and also added to the UK's Je-S system. Please provide names, full affiliations and details of all lead and co-investigators.**

Role (CI or AI)	Name	Organisation	Division or Department
CI	Dr Jason Thompson	University of Melbourne	Melbourne School of Design
CI	Prof Mark Stevenson	University of Melbourne	Melbourne School of Design
CI	Dr Kerry Nice	University of Melbourne	Melbourne School of Design
CI	Dr Jasper Wijnands	University of Melbourne	Melbourne School of Design

#### **(4) Justification of UK costs (maximum of 2 pages)**

*Please break down your UK costs, explaining why the resources requested are appropriate for the research proposed, taking into account the nature and complexity of the proposal. It should not be simply a list of the resources required, please refer to the [help text](#) for guidance on what to include.*

*Staff – directly incurred posts:*

- Research Associate (postdoctoral) (33 months, £ 132,405)
- Research Assistant (16 months, £ 52,360)

A full-time Research Associate will be recruited for the entire project to conduct and support activities in all work packages. A person with a background in epidemiology of NCD, experience in analysis of quantitative and GIS data, and willingness to build up modelling skills will be sought for the position. The Research Assistant will be recruited to work full time on the development of the web-based toolkit (Work Package 3). We will recruit a person with a background in software engineering and web development. The salary for both posts is based on appropriate grade (Research Associate: AC2Research. Research Assistant: AC1Research) and increments at the Queen's University Belfast.

*Staff – directly allocated posts:*

- Dr Ruth Hunter (PI, £ 16,912)
- Dr Leandro Garcia (PI, £ 13,716)
- Prof Frank Kee (Co-I, £ 4,093)
- Prof Geraint Ellis (Co-I, £ 3,911)
- Dr Neil Anderson (Co-I, £ 4,825)

Dr Hunter and Dr Garcia (7% FTE each) will plan and monitor the project progress, supervise the research staff activities and career development plans, and contribute in all work packages. Prof Kee and Prof Ellis (1% FTE each) will provide intellectual support to Work Packages 1 and 2 in NCD epidemiology and prevention (Prof Kee) and urban design and health (Prof Ellis). Dr Anderson (2% FTE) will co-lead the toolkit development in Work Package 3 and supervise the Research Assistant activities.

*Other directly incurred costs:*

- 2 laptops (£ 1,300 total): laptops will be provided for the Research Associate and Assistant, and also used for conducting and recording the usability study workshops and for other out-of-office activities, such as research team meetings and outreach and dissemination visits and presentations.
- Conferences and events registration fees (£ 5,400 total): registration fees of international conferences relevant to this application, such as the International Conference on Urban Health and Conference on Complex Systems, are around £ 500. A total of £3,000 was estimated to cover international conference fees (2 person-conferences per year x 3 years x £ 500). Similarly, £1,800 to cover fees

charged by European events (3 person-events per year x 3 years x £ 200) and other £600 for UK events (2 person-events per year x 3 years x £ 100). We will also apply to relevant School and Centre travel funds to support additional registration fees and costs if required.

We have been successful in our application for a leveraged Opportunity-led Award from the Northern Ireland Health and Social Care (Research and Development Division) (based on successful peer-review by the MRC) that will cover the following costs:

- Travels and subsistence (£ 20,400);
- Usability study workshops (other directly incurred costs and impact costs, £ 13,400);
- Toolkit development (other directly incurred costs, £ 1,650);
- UK Biobank access fees (other directly incurred costs, £ 3,500).
- TOTAL: £ 38,950.

### **(5) Justification of Australian costs (maximum of 2 pages)**

*Please break down your Australian costs, explaining why the resources requested are appropriate for the research proposed, taking into account the nature and complexity of the proposal. It should not be simply a list of the resources required.*

#### *Staff – directly incurred posts:*

- Research Fellow A (PSP 3) – (36 months, AUD\$ 233,850)
- Research Fellow A (PSP 3) – (24 months, AUD\$ 155,900)

Two full-time experienced post-doctoral Research Fellows will be recruited for 36 months and 24 months, respectively to develop and deliver Work Packages 1 and 2, and to assist integration of them into WP3. Individuals with expertise in deep learning, computer vision and machine learning will be recruited to the positions, but with an emphasis on real-world applications and user-interfaces. These staff will be located with the Transport, Health and Urban Design Research (THUD) Hub and will work closely with the UK collaborators to ensure transparency and understanding between project partners. They will be directly supervised by CIA (Dr Thompson) and managed in day to day tasks by CIC (Dr Nice) and CID (Dr Wijnands).

#### *Staff – directly allocated posts:*

- Dr Jason Thompson (CIA, AUD\$ 47,876)
- Prof Mark Stevenson (CIB, AUD\$ 27,739)
- Dr Kerry Nice (CIC, AUD\$ 43,273)
- Dr Jasper Wijnands (CID, AUD\$ 43,273)

Dr Thompson (~17% FTE) will plan and monitor the project progress, supervise the research staff activities and career development plans, and contribute in all work packages. Prof Stevenson (~10% FTE) will provide intellectual support to all Work Packages across NCD epidemiology and prevention. Dr Nice and Dr Wijnands (~16% FTE each) will provide specialised technical training, advice and assistance to the research staff and will co-lead the development and delivery of WPs 1 and 2 with Dr Thompson. The allocation of resource for Drs Thompson, Nice and Wijnands will reduce from the first year to the third as the project progresses toward WP3.

#### *Other directly incurred costs:*

- 2 computers with high-performance GPUs containing NVIDIA GeForce GPUs that are specially purposed for image processing of the nature described in this application will be purchased for the Research Fellows' use (AUD \$8,500 total). These machines will be used for all day-to-day work of the research fellows, including prototyping and training models and interfaces contained within WP 3.
- Travel and subsistence to UK partner organisation (AUD\$ 49,500). One visit to the

respective UK partner agency per year for four members of the UoM research team, each year over a one-week period is expected, totalling four periods per year (AUD\$ 10,000 flights per annum ex Melbourne to Belfast, and total accommodation and subsistence AUD\$ 6,500). This item is necessary for building links between members of the research teams and to ensure that project partners maintain close consultation and collaboration, especially during the crucial hand-over of the project from WP 1 to WP 3. Travel of this nature is unable to be funded through alternative, within-UoM sources (e.g., conference travel budgets) so must be allocated within this budget.

<b>Full Name:</b>	<b>Frank Kee f.kee@qub.ac.uk</b>		
<b>Degrees:</b>	Type & Class	Subject	Date & Organisation
	BSc(Hons) 2:1 MB Bch BAO (Distinction) MSc MD BSc (Hons). 1 <sup>st</sup>	Physiology Medicine Public Health Epidemiology Mathematics	1980 QUB 1983 QUB 1987 Edin 1990 QUB 2007 QUB
<b>P-G Qualifications:</b>	Type & Class	Subject	Date & Organisation
	MRCP MPH MFPHM FFPHM FRCP Fellow of the Royal Statistical Society		1986 Edin 1987 Edin 1988 Lond 1996 Lond 1997 Edin 2008
<b>Employment:</b>	<p><b>Clinical Professor</b> of Public Health Medicine (Queen's University Belfast) 1998 – present. <b>Clinically active</b> with the Public Health Agency          Director of Centre for Public Health Research, School of Medicine Dentistry and Biomedical Sciences, QUB          Funding for current post: Queens University (50%); Public Health Agency (50%)</p>		
<b>Selected Other Roles</b>	<p>Chairman of the Research Funding Board of the <b>NIHR</b> Public Health Research Program 2014-2019; Member of the Wellcome Trust Longitudinal Populations Studies Panel; Member of the Advisory Board for the <b>NIHR</b> National School of Public Health (2018-2021); Member of the <b>MRC</b> Public Health Intervention Development Funding (<b>PHIND</b>) Panel 2013-2018. Member of the Methods Advisory Group of the Department of Work and Pensions (2019-2022); Member of the European Research Council panel (LS7) for “Diagnostic tools, therapies and public health” 2015 and 2018. Member of the HEFC REF Sub-Panel 2 (2014) and Deputy Chair of <b>Panel 2 for REF</b> 2021; Member of the <b>ESRC</b> Scientific (funding) Review Panel for <i>Understanding Society</i> 2019-2024. Member of the <b>Department of Health</b> Mental Health and Obesity Policy Research Unit commissioning Panel, 2016 and for the Health Services Research and Cancer Screening Policy Research Units commissioning panel, 2018. Member of the <b>Innovate UK Urban Living Partnership</b> Advisory Board 2016-2018</p>		
<b>Selected recent grant funding</b>	<p><b>MRC PSMB</b>: Using Game Theory to assess the effects of social norms and social networks on adolescent smoking in schools: a proof of concept study. £715,726 (PI); <b>CRUK</b> and Northern Ireland Chest Heart and Stroke Association: (joint funding) The Smoking Cessation in Pregnancy Incentives Trial (CPIT): A Phase III Randomised Controlled Trial: ~£1.3m. Co-Investigator. 2017-2020; <b>NIHR</b>: Is 20 plenty for health? Evaluation of the 20mph speed limit networks in Edinburgh and Belfast on road casualties and other health outcomes; £1,2M (Co-I);. 2017-2019; <b>ESRC</b> Newton-Fund: Healthy urban living and ageing in place: physical activity, built environment and knowledge exchange in Brazilian cities (HULAP); £585,000 (Co-I). 2016-2018; <b>MRC PHIND</b>: PI; 2015-2017. £190,000 (with £40k Enabling Award from the NI HSC Research and Development Office). Using Twitter and Social Media to adapt Public Health mass communications.</p> <p><b>NIHR</b>: Feasibility study of how best to engage obese men in narrative SMS (short message system) and incentive interventions for weight loss, to inform a future effectiveness and cost-effectiveness trial. (Co-I). 2017-2019; <b>NIHR</b>: A woman centred tailored SMS intervention for weight loss and maintenance of weight loss in the post-partum period. Intervention adaptation, pilot and RCT. (Co-I). £350,000. 2017-2019; NI HSC R&amp;D: A cluster RCT pilot of the Good Behaviour Game in disadvantaged areas. £38k. Co-I. 2016-2017; <b>MRC/NPRI</b>: "PARC" Study - Public Health effects of the Connswater Community Greenway. 2010-2019; Principal Investigator. £1.2M.</p>		

**Geraint Ellis BSc, MPhil, PhD, PGCHET, FHEA, FRSA**

<b>Employment history</b>			
<b>Dates (month/year)</b>		<b>Name of organisation and position held (for current position, please include a description of your post and the source(s) of funding for this post)</b>	<b>Type of appointment</b>
<b>From</b>	<b>To</b>		
10.2012	Present	Chair of Environmental Planning, School of the Natural and Built Environment, Queen's University, Belfast	Full-time, permanent
08.2016	09.2018	Director of Research, Sustainable Built Environment, School of the Natural and Built Environment, Queen's University, Belfast	Full-time, permanent
09.2014	08.2016	Director of Research, Inst. of Spatial and Environmental Planning, Queen's University, Belfast	Full-time, permanent
07.1998	09.2012	Lecturer/Snr Lecturer, School of Planning, Architecture and Civil Engineering, Queen's University, Belfast	Full-time, permanent
01.1996	07.1998	Director of Transport Projects, South Bank Employers' Group, London	Full-time, permanent
09.1993	09.1995	Senior Urban Development Officer, Government of Lesotho	Full-time, permanent
09.1990	08.1993	Research Officer, London Rivers Association, 1990 to 1993.	Full-time, permanent

<b>Qualifications</b>			
<b>Dates (month/year)</b>		<b>Universities/colleges attended</b>	<b>Degree</b>
<b>From</b>	<b>To</b>		
09.2002	06.2006	University of Cardiff (Part-time)	PhD, City and Regional Planning
09.1999	07.2000	Queen's University, Belfast (Part-time)	Postgraduate Certificate of Higher Education Teaching
09.1988	09.1990	University of Reading	Master of Philosophy in Environmental Planning
09.1985	06.1988	University of Birmingham	BSc in Geography (1 <sup>st</sup> Class Hons)

<b>Funding history</b>				
<b>Dates (month/year)</b>		<b>Funder and type of grant</b>	<b>Position on the grant</b>	<b>Total amount awarded</b>
<b>From</b>	<b>To</b>			
01.2019	12.2023	European Commission, Innovative Training Network	PI	£3.7m
02.2018	02.2021	European Commission, Research grant: Interreg grant	Co-I	£210,000
03.2016	02.2018	Social Science and Humanities Research Council Canada: Research grant	Co-I	\$230,000
01.2016	03.2019	Economic and Social Research Council: Research grant	PI	£470,000
01.2015	01.2016	Environmental Protection Agency (Ireland): Research grant	PI	£160,000
03.2014	02.2017	Danish Strategic Research	Co-I	€2m

05.2011	04.2013	Economic and Social Research Council: Research grant	Co-I	£214,000
03.2009	02.2014	MRC	Co-I	£777,000

<b>Career breaks</b>		
<b>Dates (month/year)</b>		<b>Reason</b>
<b>From</b>	<b>To</b>	
-	-	None.

<b>Not clinically qualified</b>	X
<b>Clinically qualified</b>	
<b>Clinically active</b>	

#### **Additional information**

In addition to the positions noted above, Ellis acts (since 2012) as Editor of the Journal of Environmental Policy and Planning (ranked 2<sup>nd</sup> in both Urban Planning and Development Studies), has been selected to the Assessment Panel for UoA 13 (Built Environment) for REF2021, and has been appointed by the Taoiseach (Prime Minister) as an Independent Member of the National and Economic Social Council, Ireland (2018-2012), a founding member of the Editorial Board of Cities and Health and has been a Director of Belfast Healthy Cities since 2003.

Full CV available at: [www.bit.ly/ZYkPNM](http://www.bit.ly/ZYkPNM)

## Curriculum Vitae

### Dr JASON THOMPSON

Dr Jason Thompson holds a PhD in Medicine, Masters in Clinical Psychology, and a Bachelor of Science with Honours. His work focuses on the translation of research into practice across the areas of urban design, transportation safety, public health, post-injury rehabilitation, and health system design. Since 2014, Dr Thompson has published over 40 articles at the intersection of urban design, computational modelling, transport safety, and health outcomes. His work has pioneered the use of agent-based models and computational methods in areas of traditional health system design, urban design, and transportation safety.



Dr Thompson is an Australian Research Council Discovery Early Career Award (DECRA) Fellow. His DECRA project surrounds challenges associated with the introduction of autonomous vehicles on the operation and sustainability of Australia's \$5b personal injury insurance market. In particular, how this transition will change injury rates and types, the operation of compensation and rehabilitation systems, and how systems responses will shape the autonomous vehicle market, itself.

#### Academic qualifications

2015	PhD (Medicine) Deakin University, Australia
2005	M.Psych (Clinical) University of Ballarat, Australia
1997	B.Sc (Hons) Deakin University, Australia

#### Present appointments

2016-present	Senior Research Fellow, Discovery Early Career Research Award Appointee, Transport, Health, and Urban Design Research Hub, Melbourne School of Design, University of Melbourne
2013-present	Adjunct Research Fellow, Monash University Accident Research Centre, Monash University, Australia
2017-present	Adjunct Research Fellow, Centre for Human Factors and Socio-Technical Systems Research, University of the Sunshine Coast, Australia

#### Employment history

2014-2016	Research Lead, Institute for Safety, Compensation and Recovery Research
2012-2014	Research Fellow, Monash University Accident Research Centre
2011-2012	Senior Analyst, The Social Research Centre
2009-2011	Senior Analyst, Victorian Transport Accident Commission
2009-2009	Research Fellow, Monash / Alfred Psychiatric Research Institute

#### Awards

2017	Australian Research Council Discovery Early Career Researcher Award
2017	Best Paper – Computational Social Science of the Americas Conference, Santa Fe, USA

#### Competitively won academic and industry grants in past 5 years

2019	University of Melbourne Early Career Research Grant, \$20,000
2018	Australian Research Council Discovery Early Career Award, \$366,000
2018	Development of an ABM for understanding the WorkSafe Scheme - \$53,000
2018	Using SNA within WorkSafe Victoria's WorkWell Program - WorkSafe Victoria - \$97,000
2018	University of Melbourne, Faculty of Architecture, Building and Planning ECR Research Grant, \$15,000
2017	University of Melbourne DECRA Establishment Award, \$25,000
2016	University of Melbourne Early Career Research Grant, \$20,000
2016	University of Melbourne, Faculty of Architecture Building and Planning ECR Grant, \$5000

#### Membership of relevant national & international committees

- Complex Systems Society
- COMSES
- Computational Social Science Society of the Americas
- Australasian College of Road Safety
- American Psychological Society
- Australian Injury Prevention Network
- Australian Health Practitioner Registration Board – Registered Psychologist

## Recent selected conference and invited seminar presentations

- **Injured by design: A global perspective on urban design and road transport injury** – The Complex Systems Society conference, Singapore, October, 2019.
- **Utilisation of computer vision techniques in understanding the relationship between urban design and health** – Re-Visioning Transport and Health Meeting, University of Cambridge, Cambridge UK, July 2019.
- **Potential effects of introducing autonomous vehicles on crash rates among vulnerable road users** – Agent-Based Modelling of Urban Systems Satellite Session, AAMAS, Montreal, Canada, May 2019.
- **Practical applications of artificial intelligence, computational social science, and complex systems analysis for road safety researchers** - Australasian College of Road Safety National Conference, Sydney, 2018.
- **Safety in numbers or safety in density? Empirical validation of agent-based modelling results** - Australasian College of Road Safety National Conference, Sydney, 2018.
- **Using Agent-Based Models for understanding the impact of autonomous vehicle introduction on third-party injury insurance systems** – MSD Industrial Engagement Seminar, University of Melbourne, 2018.
- **Safety in numbers of Safety in Density? Empirical validation of agent-based modelling results** – Agent-Based Modelling of Urban Systems Seminar, Autonomous Agents and Multi-Agent Systems Conference, Stockholm, Sweden, 2018.
- **A complex systems approach for understanding the effect of policy and management interventions on health system performance** – Computational Social Science Society of the Americas Conference, Santa Fe, USA, 2018 (Best Paper)
- **Exploring the relationship between separated infrastructure and behavioural adaptation for improving cyclist safety; a mechanistic paradox** – International congress on Agent-Based Modelling, George Mason University, Washington, November, 2016.

## Peer review in past five years

I have refereed papers submitted to over 30 peer-reviewed health and transport journals in the past 5 years.

## Curriculum Vitae

### Dr JASPER WIJNANDS

Dr Jasper Wijnands has a background in applied mathematics, with extensive experience in quantitative analyses and mathematical methods throughout his education, research and consultancy career. His research has led to publications in various domains, including transportation, climate science, the financial services sector and in mathematical journals. His PhD in mathematics (University of Melbourne) focussed on machine learning algorithms and other mathematical techniques to improve the accuracy of tropical cyclone forecasts in Australia and the South Pacific Ocean. Jasper's research currently focusses on artificial intelligence, especially deep learning using neural networks, in relation to transport, health and urban design. Further, he is delivering an ARC Linkage project that investigates the impact of financial incentives and feedback on driving behaviour. Jasper previously worked as a manager and consultant in EY's Advisory practices in Melbourne, New York, Zurich and Amsterdam, focussing on financial risk management.



#### Academic qualifications

2017	PhD (Mathematics) The University of Melbourne, Melbourne, Australia
2007	Master of Science (Business Mathematics and Informatics), VU University Amsterdam, Netherlands
2005	Bachelor of Science (Business Mathematics and Informatics), VU University Amsterdam, Netherlands

#### Present appointments

2016-present	Research Fellow, Transport, Health, and Urban Design Research Hub, Melbourne School of Design, University of Melbourne
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#### Employment history

2013-2014	Manager, EY Actuarial Services, Melbourne, Australia
2010-2011	Senior Advisor, EY Financial Services Risk, Amsterdam, The Netherlands
2009-2010	Senior Advisor, EY Financial Services Risk Management (FSRM), New York, USA
2008-2009	Senior Advisor, EY Global FSRM, Zurich, Switzerland
2005-2008	Advisor, EY Financial Services Risk, Amsterdam, The Netherlands

#### Awards

2017	Attendance of Global Young Scientist Summit 2017 to interact with eminent scientists including nine Nobel Prize, two Fields Medal and five Turing Award recipients (one of three selected by the University of Melbourne from all PhD candidates) (AUD 3,000)
2014	Melbourne International Research Scholarship (AUD 83,000)
2014	Melbourne International Fee Remission Scholarship (AUD 139,000)

#### Competitively won grants in past 5 years

1. J. Rachele, **J. S. Wijnands**, H. Zhao, B. Bentley, and M. Stevenson (2018). Using machine learning to examine neighbourhood characteristics associated with physical function. ESPRIt Hallmark Initiative (AUD 13,600).
2. M. Stevenson, H. Zhao, **J. S. Wijnands**, J. Guo, and J. Wang (2018). Using high-dimensional data to compare risky driving behaviour across international cities. Key laboratory of road and traffic engineering of the Ministry of Education, Tongji University, China (Y40,000)
3. **J. S. Wijnands**, J. Thompson, and M. Stevenson (2017). Identification of road design characteristics associated with unsafe driving behaviours using in-vehicle telematics. ACT Road Safety Fund Grant (AUD 50,000)
4. M. Stevenson, T. Bliss, and **J. S. Wijnands** (2016). Review and update of the NSW road safety strategy. Transport for NSW Project Grant (AUD 78,000)
5. J. Thompson, **J. S. Wijnands**, and M. Stevenson (2016). From simulation into reality: Calibrating models of interaction between drivers and cyclists in urban environments. Early Career Researcher Project Grant (AUD 5,000)
6. **J. S. Wijnands** (2018). ABP travel grant, MVML 2018, Spain (AUD 3,200)
7. **J. S. Wijnands** (2017). ABP travel grant, ICETA-Fall 2017, Japan (AUD 2,100)
8. **J. S. Wijnands** (2016). ABP travel grant, CCS 2016, The Netherlands (AUD 3,000)
9. **J. S. Wijnands** (2015). PhD travel grant, AOGS 2015, Singapore (AUD 2,600)

## Recent selected conference presentations

1. *Invited talk.* **J. S. Wijnands** (2018). "TensorFlow on mobile devices –A prototype for driver monitoring". In: Tongji University. Oct. 17, 2018. Shanghai.
2. *Invited talk.* **J. S. Wijnands**, J. Thompson, K. Nice, G. Aschwanden, and M. Stevenson (2018). "Action recognition to prevent fatigue-related road trauma using artificial intelligence". In: Symposium on New Research Applications for Tackling Complex Road Safety Issues, 2018 Australasian Road Safety Conference. Oct. 3, 2018. Sydney.
3. *Invited talk.* **J. S. Wijnands** and F. Peppard (2018). "Overview of telematics-related research". In: Workshop on in-vehicle telematics technology –Data Analytics Centre, NSW government. Sept. 14, 2017. Sydney.
4. **J. S. Wijnands**, K. Nice, J. Thompson, H. Zhao, and M. Stevenson (2018). "Using GANs to optimise health outcomes of cities by transforming urban design". In: 4<sup>th</sup> International Conference on Machine Vision and Machine Learning. Aug. 21–23, 2018. Madrid.
5. **J. S. Wijnands**, J. Thompson, K. Nice, G. Aschwanden, and M. Stevenson (2017). "Using deep learning to detect driver drowsiness from video footage". In: International Conference on Engineering, Technology, and Applied Science. Nov. 7–9, 2017. Kitakyushu.
6. **J. S. Wijnands**, J. Thompson, and M. Stevenson (2016). "Influencing driving behaviour through direct feedback using Long Short-Term Memory recurrent neural networks". In: 2016 Conference on Complex Systems. Sept. 19–22, 2016. Amsterdam.
7. **J. S. Wijnands**, J. Thompson, D. Mortimer, A. Harris, A. Tapp, S. Buckis, F. Peppard, and M. Stevenson (2016). "Enhancing road safety with in-vehicle telematics". In: 2016 Australasian Road Safety Conference. Sept. 6–8, 2016. Canberra.
8. *Invited talk.* **J. S. Wijnands**, G. Qian, and Y. Kuleshov (2015). "A mathematical representation of near-surface wind speeds in tropical cyclones". In: Swinburne University of Technology seminar series. Dec. 2, 2015. Hawthorn.
9. **J. S. Wijnands**, G. Qian, and Y. Kuleshov (2015). "Near-surface wind model for tropical cyclones". In: AOGS 12th Annual Meeting. Aug. 2–7, 2015. Singapore.
10. **J. S. Wijnands**, G. Qian, K. L. Shelton, R. J. B. Fawcett, J. C. L. Chan, and Y. Kuleshov (2015). "Seasonal forecasting of tropical cyclone activity in the Australian and the South Pacific Ocean regions". In: AOGS 12th Annual Meeting. Aug. 2–7, 2015. Singapore.
11. *Invited talk.* **J. S. Wijnands**, G. Qian, K. L. Shelton, R. J. B. Fawcett, and Y. Kuleshov (2014). "Seasonal prediction of tropical cyclones with support vector regression". In: Australian Bureau of Meteorology. May 27, 2014. Docklands.

## Curriculum Vitae

### Dr KERRY NICE

I am a research fellow in the Transport, Health, and Urban Design Research Hub in the Melbourne School of Design at the University of Melbourne and an urban climate scientist/modeller at Monash University and with the CRC for Water Sensitive Cities. Building on a background in software engineering and urban climates, my work uses modelling and artificial intelligence to study urban environments. My PhD at Monash University focused on the creation and use of an urban micro-climate model (VTUF-3D) to assess the positive human thermal comfort impacts in urban areas of increased urban vegetation and water sensitive urban design infrastructure. My research currently focuses on the investigation of urban factors impacting the accessibility of active transport, assessing the impacts of urban vegetation on transport, health, and micro-climates, and using artificial intelligence, especially deep learning using neural networks, to assess the influence of urban characteristics on urban environments and ultimately on the people who live there. I previously worked as a senior and consulting software engineer in Colorado, New York, and London focusing on building enterprise scale multi-tiered work flow applications.



#### Academic qualifications

2017	PhD (Urban Climate Modelling) Monash University, Melbourne, Australia
2011	MES (Master of Sustainability) Monash University, Melbourne, Australia
1990	Double BA (English & Film Studies) University of Colorado, Boulder, Colorado

#### Present appointments

2016-present	Research Fellow, Transport, Health, and Urban Design Research Hub, Melbourne School of Design, University of Melbourne
2016-present	Research Fellow, School of Earth, Atmosphere and Environment, Monash University/CRC for Water Sensitive Cities

#### Employment history

2012-2016	Research Assistant, Monash University, School of Mathematical Science, Clayton, VIC.
2011-2016	Environmental Science Assistant, Monash University, School of Geography & Environmental Science, Clayton, VIC.
2009	Software Engineer, InterDev Australia Pty Ltd, Melbourne, VIC.
2000-2008	Consulting Software Engineer/Senior Software Engineer, LexisNexis/Matthew Bender/Reed Elsevier, Colorado Springs, Colorado/Albany, New York/London, UK
2000	Sr Java Programmer, STSHotelnet.com, Denver, Colorado
1999-2000	Java Programmer, Decision Consultants, Inc., Broomfield, Colorado
1997-1999	Professional Services Consulting Engineer/Tech Support Engineer, Rogue Wave Software, Boulder, Colorado
1994-1997	Satellite Broadcast Operator, DirecTV, Castle Rock, Colorado
1990-1994	Broadcast Operations, TCI Cable, Englewood, Colorado

#### Awards

2018	Graham Treloar Fellowship for Early Career Research, University of Melbourne
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#### Competitively won grants in past 5 years

2018	ABP Research ECR Project Grant, University of Melbourne, \$5000 AUD
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#### Membership of relevant national & international committees

2012 - present	International Association for Urban Climate (IAUC)
2014 - present	Australian Meteorological and Oceanographic Society (AMOS)

#### Recent selected keynote lectures

1. Nice, K.A. Urban climatology introduction for Melbourne Cool Line Studio, Monash University, 19 August 2019. Guest lecture

2. **Nice, K.A.** Climate science context around urban cooling. In: 4th Water Sensitive Cities Conference 2019, 26 - 28 March 2019, Brisbane, Australia. *Invited presentation*
3. **Nice, K.A.** Urban Greening for improved human thermal comfort. In: 202020 Vision, The Green Light Tour, 27 March 2018, Adelaide, Australia. *Invited presentation*
4. **Nice, K.A.,** Urban Greening for improved human thermal comfort. In: Guest lecture - Master of urban planning STUDIO, University of Melbourne, 2 October 2017, Melbourne, Australia.
5. **Nice, K.A.,** Microclimate Models and Application in the Urban Environment. In: Guest lecture - ATS3887/APG4887 - Designing Urban Futures: Urban Climate, Water and Adaptation. Monash University. September 2017 - Melbourne, Australia.
6. **Nice, K.A.,** Designing liveable cities through heat mitigation: tools to translate knowledge into design. In: 3rd Water Sensitive Cities Conference, 18-20 July 2017, Perth. *Invited presentation*
7. **Nice, K.A.,** Urban Greening for improved human thermal comfort. In: CRC for Water Sensitive Cities Ideas for Subiaco Water Resource Area, 24 May 2017, Perth. *Invited presentation*
8. **Nice, K.A.,** Microclimate Models and Application in the Urban Environment. In: Guest lecture - ATS3887/APG4887 - Designing Urban Futures: Urban Climate, Water and Adaptation. Monash University. September 2016 - Melbourne, Australia.

#### **Recent selected conference presentations**

1. **Kerry A. Nice**, Gideon D.P.A. Aschwanden, Jasper S. Wijnands, Jason Thompson, Haifeng Zhao, Mark Stevenson. The Nature of Human Settlement: Building an understanding of high performance city design (a.k.a. Block Typologies). In: UrbanSys2019 satellite session of 2019 Conference on Complex Systems, Singapore, 2 October 2019
2. Meili, N., Fatichi, S., Manoli, G., Burlando, P., Roth, M., Velasco, E., **Nice, K. A.**, Tapper, N. J., Daly, E. and Coutts, A. M. (2018) 'A new Urban Ecohydrological Model to quantify the effect of vegetation on microclimate and water fluxes in cities', In: AGU Fall Meeting 2018, Washington D.C., USA, 10-14 December 2018. American Geophysical Union
3. **Nice, K.A.**, Wang, J, Wijnands, J. S., Thompson, J., Aschwanden, G.D.P.A, Stevenson, M. Mining Google Street View for Urban Climate Micro-Climate Human Thermal Comfort Modelling Parameters. In: ICUC10, 10th International Conference on Urban Climate / 14th Symposium on the Urban Environment, 6-10 August 2018, New York, NY.
4. **Nice, K.A.**, Thompson, J., Wijnands, J. S., Aschwanden, G.D.P.A, Stevenson, M. The 'Paris-end' of town? Urban typology through machine learning. In: AAG 2018, Symposium on New Horizons in Human Dynamics Research, New Orleans, 12 April 2018.
5. **Nice, K.A.**, Coutts, A., Tapper, N., and Beringer, J. A micro-climate examination of the temperature moderating potential of increased vegetation and water in urban canyons using VTUF-3D. In: 29th VUEESC Conference, 3-4 November 2016, Melbourne.
6. **Nice, K.A.**, Coutts, A., Tapper, N., Krayenhoff, S., Duursma, R., and Beringer, J. A micro-climate examination of the temperature moderating potential of increased vegetation and water in urban canyons using VTUF-3D. In: Joint CRC Low Carbon Living & CRC for Water Sensitive Cities Workshop on Urban Micro-Climates and Adaptive Urban Design, 21-22 March 2016, Melbourne.
7. **Nice, K.A.**, Coutts, A., Tapper, N., Krayenhoff, S., Duursma, R., and Beringer, J. A micro-climate examination of the temperature moderating potential of increased vegetation and water in urban canyons using VTUF-3D. In: 2nd International Conference on Urban Tree Diversity, 22-24 February 2016, Melbourne.
8. **Nice, K.A.**, Coutts, A., Tapper, N., Krayenhoff, S., Duursma, R., and Beringer, J. A micro-climate examination of the temperature moderating potential of increased vegetation and water in urban canyons using VTUF-3D. In: AMOS/ARCCSS National Conference 2016. 8-11 February 2016, Melbourne Convention and Exhibition Centre.
9. **Nice, K.A.**, Coutts, A., Tapper, N., Krayenhoff, S. and Beringer, J. VTUF-3D: An urban micro-climate model to assess temperature moderation from increased vegetation and water in urban canyons. In: ICUC9 - 9th International Conference on Urban Climate 2015. 20-24 July 2015 - Toulouse, France.

#### **Peer review in past five years**

I have refereed papers submitted to 8 peer-reviewed climate, sustainability, and built environment journals.

**Leandro Garcia, DSc, MSc, BSc**

<b>Employment history</b>			
<b>Dates (month/year)</b>		<b>Name of organisation and position held</b>	<b>Type of appointment</b>
<b>From</b>	<b>To</b>		
07.2019	Present	Queen's University Belfast, Centre for Public Health, UK. Lecturer in Complexity Science in Public Health with research (80%) and teaching and administrative (20%) roles. Funder: Higher Education Funding Council via the Northern Ireland Department for the Economy	Full-time, permanent (in probation)
06.2017	06.2019	University of Cambridge, MRC Epidemiology Unit, UK. Research Associate.	Full-time, fixed term
03.2016	02.2017	Oswaldo Cruz Foundation, National School of Public Health, Brazil. Postdoctoral researcher.	Full-time, fixed term
05.2011	04.2012	Cruzeiro do Sul University, Brazil. Lecturer in Physical Activity and Health.	Part-time, fixed term

<b>Qualifications</b>			
<b>Dates (month/year)</b>		<b>Universities/colleges attended</b>	<b>Degree</b>
<b>From</b>	<b>To</b>		
03.2012	02.2016	University of Sao Paulo, Brazil	DSc in Public Health Nutrition
03.2009	02.2011	Federal University of Santa Catarina, Brazil	MSc in Sports Science
03.2007	02.2008	Federal University of Sao Paulo, Brazil	<i>Lato Sensu</i> degree in Adolescent Health
03.2002	12.2006	University of Sao Paulo, Brazil	BSc in Sports Science

<b>Funding history</b>				
<b>Dates (month/year)</b>		<b>Funder and type of grant</b>	<b>Position on the grant</b>	<b>Total amount awarded</b>
<b>From</b>	<b>To</b>			
02.2019	01.2024	Sao Paulo Research Foundation, Brazil. Research grant	Co-I	R\$ 1,008,370 (≈ £ 201,670)
06.2016	05.2017	UCL Grand Challenges Small Grants, UK. Research grant	Co-I	£ 5,000
03.2016	02.2017	National Research Council, Brazil. Early career fellowship	PI	R\$ 54,500 (≈ £ 12,600)
07.2015	06.2017	Sao Paulo Research Foundation, Brazil. Research grant	Co-I	R\$ 151,260 (≈ £ 33,300)
07.2014	06.2015	National Research Council, Brazil. International training fellowship	PI	US\$ 19,500 (≈ £ 12,220)
03.2012	02.2016	National Research Council, Brazil. DSc fellowship	PI	R\$ 105,600 (≈ £ 31,700)
03.2010	02.2011	Coordination for the Improvement of Higher Education Personnel, Brazil. MSc fellowship	PI	R\$ 14,400 (≈ £ 5,400)

<b>Career breaks</b>		
<b>Dates (month/year)</b>		<b>Reason</b>
<b>From</b>	<b>To</b>	
-	-	None.

<b>Not clinically qualified</b>	X
<b>Clinically qualified</b>	
<b>Clinically active</b>	

#### **Additional information**

Co-authored commissioned works for various international and national health and development policy organizations, including the Pan-American Health Organization, World Health Organization, United Nations Development Programme, C40 Cities Climate Leadership Group, Brazilian Ministry of Health, and Colombian Ministry of Health and Social Protection.

Article Reviewing: Journal of Physical Activity & Health, Preventive Medicine, American Journal Preventive Medicine, PLOS One, Scientific Reports, PLOS Neglected Tropical Diseases, Journal of Artificial Societies and Social Simulation, Journal of Epidemiology and Community Health, Epidemiology, Journal of Transport & Health, BMC Medicine, and International Journal of Social Research Methodology

Relevant grants under review:

- EU H2020. RESURGE4HEALTH - RESearching URban Green space interventions for a healthier and more equitable Europe. Jan 2021-Jun 2025; £4,650,000; Co-Investigator.

## Curriculum Vitae

### Professor Mark Stevenson

I am an epidemiologist and Professor of Urban Transport and Public Health at the University of Melbourne. My appointment is across the Melbourne Schools of Design, Engineering and Population and Global Health. I have worked on numerous national and international projects that have directly influenced transport policy and worked with both Federal and State Governments in Australia and internationally. I have led many research groups and am internationally recognised in the field of transport safety and public health. I am the director of the Transport, Health and Urban Design Research Laboratory comprising a cross-disciplinary research team exploring how the effects of urban form and transportation influence the health of residents in cities.



School of Design  
School of Engineering  
School of Population and Global Health

#### Academic qualifications

- 1994 PhD (with Distinction), the University of Western Australia  
1988 Master of Public Health, Curtin University  
1987 Postgraduate Diploma in Health Science (Epidemiology and Biostatistics), Curtin University

#### Present appointments

2015 – present Professor in Urban Transport and Public Health and Director, Transport, Health and Urban Design Research Hub, Faculty of Architecture, Building and Planning/ Melbourne School of Population and Global Health/ Melbourne School of Engineering, the University of Melbourne

#### Employment history

- 2010 – 2015 Professor and Director, Accident Research Centre, Monash University  
2003 – 2010 Professor of Injury Prevention, Sydney Medical School, the University of Sydney  
2006 – 2010 Senior Director, Research and Development, The George Institute for Global Health, Sydney  
2003 – 2006 Director, Injury and Trauma Care Division, The George Institute for Global Health, Sydney  
2001 – 2003 Associate Professor, Director and Founder of the Injury Research Centre, School of Population Health, The University of Western Australia

#### Awards & honours in past 5 years

- 2018-2022 National Health and Medical Research Council (Australia) Research Fellowship.  
2013-2017 National Health and Medical Research Council (Australia) Research Fellowship.  
2008-2017 Appointed a member of the WHO Expert Advisory Panel on Injury and Violence Prevention and Control.

#### Competitively won grants in past 5 years

- 2018-2019 ¥40,000 CNY (1 year). Support grant for research collaboration between the University of Melbourne and Tongji University, Shanghai. Using high-dimensional data to compare risky driving behaviour across international cities.  
2018-2021 \$707,000 (5 years). Competitive grant funded by the National Health and Medical Research Council. Research Fellowship titled: Cars and Cities: Reducing road trauma and enhancing population health.  
2018-2019 \$55,600 USD (1 year). Competitive CAPABLE grant funded by the Asia Pacific Network for Global Change Research (APN). Integrating health into urban planning towards sustainable development goals in developing countries.  
2017-2020 \$560,000 (3 years). Competitive ARC Linkage Grant (LP160100701). Driver performance and self-regulating practice in drivers with mild dementia.  
2017-2021 \$5 million (4 years). Competitive grant funded by the Chinese Government's 111-Program. International Research Laboratory on Transportation Safety. Tongji University, Shanghai.  
2017-2018 \$50,000 (1 year). Competitive grant funded by the ACT Governments 2017 Road Safety Community Grants Program. Identification of road design characteristics associated with unsafe driving behaviours using in-vehicle telematics.  
2015-2019 \$1.8 million (4 years). Competitive ARC Linkage Grant LP150100680. The effects of feedback and incentive-based insurance on driving behaviour.  
2015-2018 \$586,000 (3 years). Development and trial of a co-benefit calculator. Low Carbon Living Cooperative Research Centre.

## Journal editorship

2019 – present International Journal of Environmental Research and Public Health.  
2019 – present Journal of Transport & Health.  
2019 – present Accident Analysis & Prevention - Editorial Advisory Board.  
2013 – present Health Promotion Journal of Australia.  
2013 – present International Journal of Traffic and Transportation Safety.  
2011 – present ISRN Epidemiology.  
2005 – present Traffic Injury Prevention - Associate Editor since 2006.  
2001 – present Injury Prevention - Associate Editor since 2007

## Committees

2017 -2021 Appointed Scholar of International Eminence, Joint International Research Laboratory of Transportation Safety (Chinese Government 111-Program), Tongji University, Shanghai, China  
2016 – present Appointed member, Board of the Independent Council for Road Safety International (IRCoSI), New Delhi, India  
2015 – 2016 Appointed as a member of the National Health and Medical Research Council's Partnership Project Review Committee  
2014 -2017 Member of the Coronial Council of Victoria, 2014-2017 (Appointed by the Attorney General, 2014)  
2013 – 2016 Appointed Advisor to the Saudi Aramco Chair in Traffic Safety, University of Dammam, Saudi Arabia  
2013 – 2018 Member, Expert Advisory Panel on Violence and Injury Prevention, World Health Organization

## Recent selected keynote lectures

1. **Stevenson M.** *Decision platforms for healthy future cities.* Tongji Prestigious Speech, Shanghai, China, 31 May 2019.
2. **Stevenson M.** *Understanding the complex city: urban design, transport and the health of future cities.* Eleventh TRIPP Annual Lecture, Indian Institute of Technology Delhi, Delhi, India, April 25, 2019.
3. **Stevenson M.** *Land-use, Transport and Population Health: Estimating the Health Benefits of Compact Cities.* UITP Global Public Transport Summit, Montreal, Canada, May 15 – 17, 2017.
4. **Stevenson M.** *Reduced car dependency and health gains in cities.* Keynote Speaker, 24<sup>th</sup> World Traffic Medicine Association Congress, Doha, Qatar, November 16-18, 2015.
5. **Stevenson M.** *Urban design, transport and the population health.* Transforming Transportation 2015: Smart Cities for Shared Prosperity, World Bank, Washington DC, January 16-17, 2015.

## Recent selected conference presentations

1. **Stevenson M.** *The influence of urban design on the health of future cities.* Drexel University - Dornsife Urban Health Symposium, Philadelphia, USA. September 5-6, 2019.
2. **Stevenson M.** *Towards sustainable cities: Integrating land-use and transport systems.* The 24th International Clean Air and Environment Conference (CASANZ Conference), Queenstown, New Zealand, September 16-18, 2019.
3. **Stevenson, M.** *Understanding the complex city: decisions for healthy future cities.* Urban Transitions 2018: Integrating Urban and Transport Planning, Environment and Health for Healthier Urban Living, Barcelona, Spain, November 25-27, 2018.
4. **Stevenson M**, Giles-Corti B, Sallis JF. *Urban Design, Transport, and Population Health: Presentation from 2016 Lancet Series.* The 6<sup>th</sup> International Congress on Physical Activity and Public Health (ISPAH), Bangkok, Thailand, November 16-19, 2016.
5. **Stevenson M**, Sallis JF, de Sa T. *The Lancet series on Urban Design, Transport, and Population Health.* 5<sup>th</sup> UCLG Congress – World Summit of Local and Regional Leaders, Bogota, Colombia October 12 -15, 2016.
6. **Stevenson M**, Giles-Corti B, Sallis JF. *An integrated approach to SDG attainment in Cities: Urban Design, Transport and Population Health* – Launch of a new series by the Lancet. A high-level scientific event hosted by the SDSN, The Lancet, The Government of Germany and The Permanent Mission of Singapore to the United Nations, United Nations, New York, USA, September 23, 2016.

## Peer review in past five years

I have refereed papers submitted to 21 peer-reviewed medicine/ health or transport journals and have refereed grant proposals and fellowship applications for the US National Institutes of Health, Australian Research Council and the Australian National Health and Medical Research Council and the New Zealand Health Research Council.

**Neil Anderson, PhD, BSc**

**Employment history**

Dates (month/year) <b>From</b> <b>To</b>		Name of organisation and position held <i>(for current position, please include a description of your post and the source(s) of funding for this post)</i>	Type of appointment
03/2013	Present	Queen's University Belfast, School of Electronics, Electrical Engineering and Computer Science, UK. Senior Lecturer in Computer Science and Software Engineering. Institutional funding 100%.	Full-time, permanent
01/2010	03/2013	PhD Candidate, Knowledge and Data Engineering, Queen's University Belfast, School of Electronics, Electrical Engineering and Computer Science, UK. Department for Education and Learning funding 100%.	Full-time, fully funded by Department for Education and Learning
10/2008	01/2010	Northgate-IS, Managed Learning Environment Specialist, Educational Technology. Corporate funding 100%.	Full-time, permanent
09/2008	10/2006	Heriot-Watt University, Technology Adviser, Disability Service. Institutional funding 100%.	Full-time, permanent
05/2006	09/2006	Real Time Engineering, Web Technology Design and Management. Corporate funding 100%.	Full-time, permanent

**Qualifications**

Dates (month/year) <b>From</b> <b>To</b>		Universities/colleges attended	Degree
01.2010	06.2015	Queen's University Belfast, UK	PhD in Computer Science (Knowledge and Data Engineering)
09.2002	06.2006	Heriot-Watt University Edinburgh, UK	BSc (Hons) in Computer Science

<b>Funding history</b>				
Dates (month/year) <b>From</b> <b>To</b>		<b>Funder and type of grant</b>	<b>Position on the grant</b>	<b>Total amount awarded</b>
06.2018	05.2019	NI Department for the Economy Grant, UK. Network analysis of stakeholders involved in the development of national action plans to tackle NCDs. Research Grant.	Co-I	£34,860
08.2018	12.2019	CME Group Foundation, USA. Procedural and Object-Oriented Software Development GCSE Teacher Upskilling. Development Grant.	Co-I	\$192,000 (circa £155,562)
03.2014	04.2016	NI Department for the Economy Grant, UK. Procedural and Object-Oriented Software Development A-Level Teacher Upskilling. Development Grant	Co-I	£156,500
03.2016	08.2016	Caterpillar Foundation, USA Code Camps Development. Seed Grant	Co-I	\$18,000 (circa £14,562)

<b>Career breaks</b>					
Dates (month/year) <b>From</b> <b>To</b>		<b>Reason</b>			
-	-	None.			

<b>Not clinically qualified</b>	X
<b>Clinically qualified</b>	
<b>Clinically active</b>	

## **Dr Ruth Hunter, BSc, PhD, MCSP**

### **Employment history**

2019-Present	<b>Reader</b> in Physical Activity and Public Health, UKCRC Centre of Excellence for Public Health Research, Queen's University Belfast, UK
2015-2019	<b>Lecturer</b> in Physical Activity and Public Health, UKCRC Centre of Excellence for Public Health Research, Queen's University Belfast, UK
2015 – 2018	<b>National Institute of Health Research (NIHR) Career Development Fellow</b> , UKCRC Centre of Excellence for Public Health Research, Queen's University Belfast, UK
2017	<b>Visiting Research Fellow</b> , Human Nature Lab, Yale Institute for Network Science, Yale University, US (2 months)
2015	<b>Visiting Research Fellow</b> , Keck School of Preventive Medicine, University of Southern California, US (3 months)
2010 – 2014	<b>Postdoctoral Research Fellow</b> , Centre for Public Health, Queen's University Belfast, UK

### **Educational qualifications**

**Sep 2005-Dec 2009:** Doctor of Philosophy (Ph.D) Public Health (no corrections), Ulster University  
**Sep 2001-Jun 2005:** BSc (Hons) Physiotherapy; First Class Honours (Best Overall Student); Ulster University

### **Selected Professional Activities**

2019 – Present	Funding panel member, National Institute for Health Research (NIHR) Public Health Research programme
2019 – Present	Associate Editor, International Journal of Behavioral Nutrition and Physical Activity
2017 – Present	Expert consultant for the World Health Organization (Europe) re: NCD prevention and control interventions for migrant and displaced populations
2016 – Present	Expert consultant for the World Health Organization (Europe) re: urban green space interventions and NCD prevention
2016 – Present	Editorial board: WHO Europe Policy Briefing on Urban Green Space Interventions for Health, Environmental and Equity Impacts

### **Current/relevant grants**

- UK Prevention Research Partnership (UKPRP) (PI Prof Moore, University of Glasgow). **PHASE: The Population Health Agent based Simulation nEwork**; Jun 2019-May 2023; £513,228; co-investigator.
- UK Prevention Research Partnership (UKPRP) (PI Prof Woodside, Queen's University Belfast). **Opportunities for intervention and innovation in the UK School Food System: the GENIUS (Generating Excellent Nutrition In UK Schools) network**; Jun 2019-May 2023; £367,460; co-investigator.
- Medical Research Council (MRC). **Using Game Theory to assess the effects of social norms and social networks on adolescent smoking in schools in Colombia and Northern Ireland: a proof of concept study**. Apr 2018-Mar 2021; £750,000 (co-Principal Investigator).
- Department for Economy, Global Challenges Research Fund [GCRF]). **Network analysis of stakeholders involved in the development and implementation of a national action plan in Turkey to tackle non-communicable diseases (NCDs) among Syrian refugees**. Apr 2018 – Mar 2019; £34,860; Principal Investigator).
- ESRC Cross Council Mental Health Network Plus Call. **Transdisciplinary Research for the Improvement of Youth Mental Public Health (TRIUMPH) Network**. Sept 2018-Aug 2022; £1,200,000; co-investigator (PI Prof Lisa McDaid, University of Glasgow).
- Invest Northern Ireland. Derry/Londonderry as the nexus for food, education, trust and health. Mar 2018 – Feb 2021; **£749,906**, co-investigator (PI Prof Jayne Woodside, QUB).
- National Institute for Health Research (NIHR) (PI Dr Hunter). Career Development Fellowship. **Social network interventions for physical activity behaviour change**. Jan 2015-Dec 2017; £421,000 (Principal Investigator).

- National Institute for Health Research (NIHR) (PI Dr Jepson, University of Edinburgh). **Is 20 plenty for health? Evaluation of the 20mph speed limit networks in Edinburgh and Belfast on road casualties and other health outcomes.** Apr 2017-Aug 2020; £900,000; Co-investigator and work package leader for Belfast site.
- ESRC/Newton Fund. **Healthy urban living and ageing in place: physical activity, built environment and knowledge exchange in Brazilian cities (HULAP).** Jan 2016-Dec 2018; £1,000,000; co-investigator and work package leader.
- National Institute for Health Research (NIHR). **Effectiveness and cost-effectiveness of a Physical Activity Loyalty Card to maintain physical activity behaviour: A cluster RCT.** Sept 2014-Feb 2018; £1,039,000; co-Principal Investigator.
- ESRC Knowledge Exchange. **Knowledge Exchange, Spatial Analysis and Healthy Urban Environments: Integrating Walkability Models into Practice.** May 2012-Jul 2013; £120,000; co-investigator.

**Relevant grants under review:**

- EU H2020. **RESURGE4HEALTH - RESearching URban Green space interventions for a healthier and more equitable Europe.** Jan 2021-Jun 2025; £4,650,000; Principal Investigator.

<b>Career breaks</b>			
<b>Dates (month/year)</b>		<b>Reason</b>	
<b>From</b>	<b>To</b>		
-	-	<b>None.</b>	

<b>Not clinically qualified</b>	X
<b>Clinically qualified</b>	
<b>Clinically active</b>	



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Polaris House  
North Star Avenue  
Swindon SN2 1ET

8 October 2019

**UKRI-NHMRC Built Environment and Prevention Research Scheme 2019: A vision of healthy urban design for NCD prevention**

To whom it may concern,

As Pro-Vice-Chancellor for Research and Enterprise on behalf of Queen's University Belfast (QUB), I am pleased to express full support for the above proposal to the UKRI-NHMRC Built Environment and Prevention Research Scheme 2019 call. The aim of this three year interdisciplinary project – to generate evidence and tools to support the urban planning and health sectors to understand and estimate the impacts in non-communicable diseases (NCD) and health inequalities resulting from the urban form and from changes in urban design – will certainly inform and encourage actionable, sustainable and cost-effective ways of preventing NCD that are influenced by the urban environment, to improve population health and reduce health inequalities in the UK and Australia.

The research objectives are well-aligned with key priorities within Vision 2020, the QUB Corporate Plan (2016-2021) and the QUB Research Strategy (2016-2021). In particular, the Corporate Plan focuses on building our reputation as an internationally recognised university, conducting leading edge education and research, focused on the needs of society. Our research is delivered through Core Disciplines, Pioneer Research Programmes and Global Research Institutes, all of which involve collaboration between researchers at all career stages, from different research disciplines, and linking with partners at other institutions from various sectors and countries. We have shaped interdisciplinary priorities according to three Global Challenge Themes, including the theme of 'Healthy Global Populations', which is of particular relevance to this call.



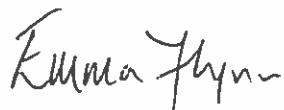
QUB is ranked 16<sup>th</sup> in the world for international outlook and is in the top 25 of the world's most international universities. Research activity for this project will be led by Dr Ruth Hunter and Dr Leandro Garcia through the Institute for Health Sciences at QUB – a flagship interdisciplinary research hub with world-class facilities. This project provides an opportunity for Dr Ruth Hunter and Dr Leandro Garcia to sustain and enhance relations with national and local policy makers and a number of community groups, and to form new research collaborations in Australia. We have a proven track record in urban health and NCD prevention and control, and this project has the potential to further strengthen our research outputs and societal impact in the field generating new knowledge through co-design of research activities, delivering joint outputs, capacity building, and training provision. The project will run for 3 consecutive years from 15 May 2020.

The programme of research proposed by Dr Ruth Hunter and Dr Leandro Garcia, alongside Dr Jason Thompson (co-PI from University of Melbourne), brings together an interdisciplinary team of UK and Australian researchers with complementary background and expertise, capable of applying modern methodological approaches to generate evidence that can be translated in actionable ways of preventing NCD and reduce health inequalities. The interdisciplinary team brings together researchers from public health and epidemiology, urban planning, computer science, complexity science, and mathematics, who have expertise in NCD prevention, urban health, environmental justice, computational modelling, and artificial intelligence. Therefore, QUB, in partnership with University of Melbourne, is well placed to lead this programme of research.

More than 80% of the UK and Australia population live in cities, equivalent to more than 75 million people. Approximately 90% of the deaths and 85% of the DALYs in these countries are caused by NCD. This research has the potential to provide robust evidences and tools to inform urban planners and health practitioners and policy makers in their work designing healthier cities for all. Furthermore, the research strongly aligns with the New Urban Agenda and is of direct relevance to the Sustainable Development Goals 3 (good health and well-being), SDG 10 (reduce inequalities) and SDG 11 (sustainable cities and communities).

I wish the team every success with this exciting and innovative proposal, which I believe has the potential to inform actionable and sustainable changes in the urban design for preventing NCD.

Yours sincerely,



Professor Emma Flynn  
Pro-Vice-Chancellor Research and Enterprise





11 October 2019

Professor Fiona Watt  
Executive Chair  
Medical Research Council  
Polaris House  
North Star Avenue  
Swindon  
SN2 1FL  
United Kingdom

Professor Anne Kelso AO  
Chief Executive Officer  
National Health and Medical Research Council  
16 Marcus Clarke St,  
Canberra ACT 2601  
Australia

Dear Professor Fiona Watt and Professor Anne Kelso AO,

**RE: UKRI-NHMRC Built Environment and Prevention Research Scheme  
NHMRC ID: APP1194959: "A vision of healthy urban design for NCD prevention"**

For cities to be at the centre of public health outcomes is far from new; some of civilization's greatest public health tests and triumphs have occurred in cities. However, two novel elements have arisen in the past decades that pose new challenges and opportunities for those seeking to understand the impact of urban design on health:

1. the increase of non-communicable diseases (NCD) associated with lifestyle-related factors from living within contemporary Australian and UK cities, and
2. the availability of state-of-the art methods from artificial intelligence, data-science, and complexity science that can be used to both understand and optimise the health of city populations.

We are living in a new city era with new risks, but also new ways to understand and alleviate them. It is critical that we improve our understanding of the strengths and limitations of existing city designs to ensure they are safe, clean, healthy, and sustainable. This combination of risk identification and mitigation of NCDs including cardiovascular disease, type 2 diabetes, some cancers, chronic respiratory conditions, mental illness and road injury, through the application of state-of-the art methods for analysis and urban re-design is the focus of this application. Specifically, it directly aligns with items 'a', 'b' and 'd' from the call: (a) urban planning and regeneration, (b) city design, including increasing conditions that promote health, and (d) transportation systems.

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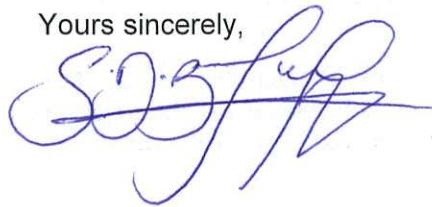
The University of Melbourne strongly supports this research agenda. For this project, the University's participation will be led by Dr Jason Thompson, a leading researcher at the Transport, Health and Urban Design Research Hub (THUD) in the Faculty of Architecture at the University of Melbourne. With a background in Psychology and Medicine, Jason's work is focused on the translation of research into practice across the areas of transportation, heavy-vehicle safety, public health, post-injury rehabilitation, and system design.

Jason has expertise in methods of computational social science for the modelling of urban, social, organisational, safety, rehabilitation, and active transport networks (e.g., cycling and walking) and has pioneered their use and publication in areas of traditional medical and transportation research. Statistical analyses and computational social modelling he conducted for State of Victoria (Victorian Transport Accident Commission) has contributed to tens of millions of dollars in savings for the Victorian community since its development in 2010.

In this project, Jason will be supported by fellow researchers in THUD, including Prof Mark Stevenson (as CIB) who is an epidemiologist that currently holds a NHMRC Fellowship and is lead of the Lancet Series on Urban Design and Health. Both CIs Dr Kerry Nice and Dr Jasper Wijnands are experts in the use of artificial intelligence to assess the influence of urban characteristics on urban environments and the residents. Collectively, the researchers have worked as a team in previous successful projects before. In addition, the team will work closely with the UK Investigators, lead by Dr. Ruth Hunter. The University of Melbourne strongly believes the research team will be able to successfully conduct and complete the research of this project.

I certify that the University of Melbourne, as well as our Australian collaborators on this grant, will meet the requirements outlined in the Grant Agreement. This project will combine state-of-the art methods in computer vision and artificial intelligence alongside co-creation of a web-based toolkit for action for use by city planners and urban designers that demonstrate practical pathways Improving our understanding of the strengths and limitations of existing city designs to ensure they are safe, clean, healthy, and sustainable.

Yours sincerely,



14/10/2019

Shaun Blaeker  
Acting Director, Major Initiatives,  
Contracts and Grants  
*The University of Melbourne*

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14 October 2019

Our Ref: R Hunter

Dear Dr Hunter

**Re: MRC Built Environment and Prevention Research Scheme**

I am pleased to confirm the support of HSC R&D Division for your application to the MRC Built Environment and Prevention Research Scheme. The aims of this scheme are very much in keeping with the priorities of both HSC R&D division and the Public Health Agency in Northern Ireland.

Dependent on a successful outcome of your application, support will be made available through the HSC R&D Division Opportunity-led Award Scheme of £38,950, to cover the costs requested in your outline.

Yours sincerely



Dr Janice Bailie  
Assistant Director HSC R&D Division



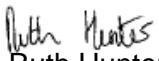
10 October 2019

**Re: Human participation letter**

As part of Work Package 3, a usability study involving human participants has been proposed to co-design the web-based toolkit. We anticipate 10-12 participants from each country (UK and Australia), representing a variety of potential users (e.g., decision-makers and public servants in urban planning and health departments, members of the public, NGOs, researchers). The UK and Australian research teams will be responsible for recruiting people as research participants in their respective countries. Participants will be invited in two 1-day workshops, one at the early stages of the tool development and the other at the end of the process. Between workshops, participants will be asked to test intermediate versions of the tool and to provide feedback. It is anticipated that there is minimal risk to participants due to their involvement in the study.

We confirm that we will comply with the MRC and NHMRC policies and guidance for research with human participants. Ethical approval will be sought in the UK and Australia prior to the study. Informed consent will be obtained from the usability study participants prior to their inclusion in the study.

Yours sincerely,

  
Dr Ruth Hunter (UK PI)

  
Dr Leandro Garcia (UK PI)

  
Dr Jason Thompson (Australian CI)

## **Pathways to impact**

Engagement with multiple stakeholders has been ongoing since the inception of the research programme – further detail is provided in the Impact Summary. From the outset, stakeholders have influenced study development and management, with multi-sectoral participation, as detailed below. The impact strategy is built upon a strong record of engagement with impact advisory partners in the conduct, delivery and dissemination of research. The UK and Australian teams will collaborate with stakeholders from respective state government departments and municipal associations, beginning new relationships and continuing those established during previous projects (e.g., respective Departments of Health, Transport, Local Government Associations, Departments of Environment and Land-use Planning). This will help refine priorities and opportunities for purposeful urban design and planning for NCD prevention and further dissemination across the UK and Australia.

***Short term (during study):*** The study draws on well-established partnerships in the UKCRC Centre of Excellence and School of Natural and Built Environment (QUB) to ensure collaboration with the public and members of the Impact Advisory Panels in previous studies in the UK (e.g. the PARC study, HULAP study). Our regular discussions with these important stakeholders highlighted the need for the research and confirmed that this study is a high priority in these organisations and beyond. Regular discussions with these organisations and in Australia through existing relationships with state government planning, health, and transport departments will facilitate the development and further refinement of the study design and protocol. These organisations are key partners in this project and organisational representatives will sit on the Impact Advisory Panels. The Impact Advisory Panel in Belfast and Melbourne will ensure the active engagement of important stakeholders in the conduct of the study and help ensure wide dissemination of outputs tailored for various audiences with the capacity to act on recommendations. The panel, will include multiple stakeholders of mixed backgrounds, will meet three times per year over the course of the study, and will assist with the development and piloting of the City Vision tool, interpretation of study findings, and appropriate dissemination channels to a broad range of audiences. The Impact Advisory Panel will be key to developing a broad dissemination strategy and will comment on and approve summaries prepared for the public. Regular study updates will be disseminated to participants and partners via newsheets and ezines.

A plenary workshop at the end of the study will involve experts from different fields of research, to help us further interpret our findings and discover how they might apply to other contexts and to other built environment interventions to prevent NCD. In particular we anticipate that adopting similar novel methods has the potential to improve future NCD prevention and public health outcomes.

***Medium term (up to 1 year post study-completion):*** Study findings will be disseminated to non-academic audiences through study newsheets and lay summaries which are prepared for participants and partners as well as through on-line portals related to health and urban design as have previously been produced by the Australian team (e.g., <https://crcprecintanalyser.com.au/>). In the UK, we will use already established fora to engage directly with policymakers and users of research, for example, events such as the "Politicians' Breakfast" where we have shared results of the previous NPRI funded research (the PARC study) directly with Members of the Northern Ireland Assembly and with community-based organisations in a stakeholder forum. Further engagement with policymakers will be facilitated through a bespoke Knowledge Exchange Seminar (KESS) and policy briefings through engagement with RalSe (Research and Information Services) in the Northern Ireland Assembly, showcasing the results and implications of the research. A joint workshop in partnership with the Public Health Agency will aid future involvement and implementation with interested public health practitioners and those involved in NCD prevention. Results will also be showcased via seminars with the School of Natural and Built Environment (QUB); and the research will be included in the newly developed Masters' in Public Health and Urban Planning, a collaboration between the Centre for Public Health and School of Natural and Built Environment. Prof Ellis has strong links in England and Scotland (he is a member of the Belfast Healthy Cities high level advisory board) and will

engage with relevant stakeholders there throughout the study. The study will be introduced to this committee and their feedback sought as the work progresses. Australian forums for dissemination will include those conducted through state and national peak municipal associations covering all states and territories (e.g., The Australian Local Government Association) as well as city-focused development groups such as respective Committees for Melbourne, Sydney, Perth, Brisbane, Adelaide and key regional centres (e.g., Geelong, Newcastle). The tool and associated datasets will also be made available through the Australian Urban Research Infrastructure Network (AURIN), a multi-million-dollar research platform, supported by government and multiple university partners to act as an online repository for important urban infrastructure datasets in Australia.

**Long term (greater than 1 year after study completion):** We will seek funding for knowledge exchange activities, with named partners, to further the dissemination and impact of this work. A key output will be a better understanding of how we can utilise urban design to inform NCD prevention research and action. We will explore with partners and in the workshops key issues to consider and the most appropriate ways to proceed with this. We anticipate that Kee's and Hunter's membership of the NIHR Public Health Funding Board and the board of the new UK Prevention Research Partnership will bring it to the attention of relevant UK research funders and a national workshop with their members on the subject will be proposed. In Australia, our association with the Faculty of Architecture, Building and Planning will enable incorporation of the learning toolkit into educational tools and curriculum for students in Bachelor of Design, Masters of Architecture, and Masters of Urban Planning subjects. Embedding the tool into curriculum in this manner will enhance the likelihood that lessons learned through the projects continue to be disseminated into industry and the public space through our urban planning leaders of tomorrow.

**Economic and Societal Impact:** Primary beneficiaries of this research will be the end users (see also Academic Beneficiaries), public health and urban design and planning practitioners, and public health systems who might otherwise deal with costs and illness associated with poor urban design. With a deeper understanding of how urban design and effective planning can prevent NCD, future programmes may be better able to harness the power of the built environment in built environment interventions and generate meaningful changes to NCD risk factors and consequent incidence at the population level. This would translate into significant public health benefit and healthcare cost savings in the UK and Australia. More broadly, there is little reason why the methods developed in this project could not be applied globally for additional population health benefit.

**Managing Impact:** Knowledge translation is most effective when part of a two-way process, and a range of stakeholders have been present from the conception of the study and their early involvement helped shape the research questions. This will ensure that the knowledge that arises from the research will have maximal impact on policy and practice. A knowledge co-production approach has been used to establish a project partnership with a broad range of non-academic stakeholders with an embedded translational culture. Key elements include: a) training for impact; b) partnership working with stakeholders; and c) prioritisation of translational activities. Researchers will undertake training in writing for non-academic audiences with contributions to study newsheets and lay summaries which are prepared for participants and partners, and training in approaches for public involvement in research that can help maximise impact.

**Maximising Impact:** Study impacts will be maximised through a dissemination strategy (see Communication Plan) that will be finalised following further discussions with the Impact Advisory Panel and Project Partners. The Project Management Team will provide infrastructure for partners to interact and create a forum for sharing research findings and offer the opportunity for immediate feedback on implementation and implications of the findings. The Project Management Team, Project Partners and plenary workshop attendees will ensure that efforts are made to maximise impact and that the dissemination materials are appropriate.

14<sup>th</sup> October 2019

UKRI-NHMRC Built Environment and Prevention Research Scheme 2019

To whom it may concern,

**Re: A Vision of Healthy Urban Design for NCD Prevention**

We are pleased to submit the attached application to the UKRI-NHMRC Built Environment and Prevention Research Scheme for funding commencing in 2020.

As this application will show, we have brought together a team of both established and emerging researchers from across Australian and UK institutions with extensive and complementary skills in exploring the nexus between the built environment and health, including analysis of reductions in NCD that modifications to the built environment can achieve.

Our team includes researchers with experience across public health, epidemiology, health promotion, computational modelling, artificial intelligence, complexity science, software engineering, climate modeling, urban planning, mathematics and computer vision. This project will combine state-of-the-art methods in computer vision and artificial intelligence alongside health-impact assessment framework and co-creation of a web-based toolkit for action for use by city planners and urban designers that demonstrates practical pathways to ensure future cities are safe, clean, healthy, and sustainable.

The proposal will help build transdisciplinary capacity in public health science and urban design to prevent NCD, with clear pathways to impact. By invoking new approaches from urban design, computer vision and artificial intelligence, the project will leave a legacy of interdisciplinary skills in both the UK and Australian settings. It will be a first step in creating a network of researchers using these approaches that builds upon existing international links. For these reasons we believe that it fits with the aspirations of the UKRI-NHMRC funding mechanism for supporting prevention research. Our research can have real traction and make a difference in both settings, and how this will happen is well described in the *Pathways to Impact*.

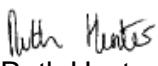
Our programme of work is undertaken at an unprecedented scale, involving multiple cities across the UK and Australia, and our analyses conducted at both the city and individual level. We believe this is an ambitious yet feasible proposal, building on a strong foundation of previous relevant research undertaken by both teams.

We believe that the proposal offers value for money, for we are also bringing to the table cash commitments, contingent upon successful peer review. If successful, the study will be supported through an Opportunity Led Award (£40k) by the HSC Research and Development Office (Northern Ireland). Their letter of support is attached.

Our unique combination of skills and backgrounds heeds recent calls to incorporate systems science into the study of cities and population health<sup>1-3</sup> – an approach we embrace. Our collaboration is built upon discussions that pre-date the call for submissions, resulting in what we regard as a mature and considered application, which we are excited to commence for the betterment of Australian and UK cities and their populations.

We will be happy to address any further queries and look forward to peer review.

On behalf of all contributors,

  
Dr Ruth Hunter (UK PI)

  
Dr Leandro Garcia (UK PI)

  
Dr Jason Thompson (Australian CI)

1. Diez Roux AV. Health in cities: is a systems approach needed? *Cadernos de Saude Publica* 2015; **31**: 9-13.
2. Pongsiri MJ, Gatzweiler FW, Bassi AM, Haines A, Demassieux F. The need for a systems approach to planetary health. *The Lancet Planetary Health* 2017; **1**(7): e257-e9.
3. Horton R, Lo S. Planetary health: a new science for exceptional action. *The Lancet* 2015; **386**(10007): 1921-2.

10 October 2019

**Re: Support to UKRI-NHMRC Environment and Prevention Research Scheme 2019  
application “A vision of healthy urban design for NCD prevention”**

To whom it may concern,

I am pleased to be a partner and express my full support for the above proposal. The project is very well aligned with my research interests and with the goals and activities of the Public Health Modelling Programme, which I lead at the MRC Epidemiology Unit, University of Cambridge.

The complexity of public health issues continuously pushes the boundaries in terms of how to integrate and make sense of disparate sources of data and utilize models to inform actionable policies and practices. I believe that this project has great potential to deliver impactful, high-quality outputs to inform actionable changes in built environment for NCD prevention.

My contribution to project will be mainly on Work Package 2, where I will advise on the designing of models to provide estimates of health impacts achievable via changes in urban design.

I would like to reiterate my strong support for this project and that I look forward to working with the project team.

Yours sincerely,



Dr James Woodcock  
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Public Health Modelling Programme  
MRC Epidemiology Unit  
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11 October 2019

**Re: Support to UKRI-NHMRC Environment and Prevention Research Scheme 2019 application “A vision of healthy urban design for NCD prevention”**

To whom it may concern,

I am writing in support of the research project led by Dr Jason Thompson, Dr Leandro Garcia, and Dr Ruth Hunter for the UKRI-NHMRC Environment and Prevention Research Scheme 2019.

The proposed work is timely and highly relevant not only for the UK and Australia but also for the global agenda on NCD prevention and on urban designs that can help people to live healthier, longer, better lives, one of the commitments of our company.

Our company will be able to provide access to anonymised health-related data from our clients in the UK and Australia to support the analyses planned for Work Package 1, which integrated with the other data sources that will be obtained by the research team will allow the investigation of the relationship between urban design and NCD risk factors and NCD incidence in an unprecedented scale.

Yours sincerely,

**Candice Smith**

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**Frank Kee's publications list (selection of most recent and relevant)**

Hunter R, Kee F, McComb K, Baker G, Milton K, Craig N, Kelly P, Jepson R, Williams AJ, Cleland C, Nightingale G, Kelly M. Effects of 20 mph interventions on a range of public health outcomes : a meta-narrative synthesis. *J Transport and Health* 2019 (*in press*)  
<https://doi.org/10.1016/j.jth.2019.100633>

Ruth F.Hunter, Toker Ergüder, Abdulkadir Bolat, Pavel Ursu, Gareth Robinson, Kremlin Wickramasinghe, Joao Breda, Bente Mikkelsen Paul Connolly, Frank Kee, Mike Clarke. Development and implementation of national coordination mechanisms to tackle non-communicable diseases (NCDs) globally: The role of network analysis  
BMJ 2019; 365 doi: <https://doi.org/10.1136/bmj.l1871> (Published 20 May 2019)

Mohan G, Longo A, Kee F. An evaluation of the economic effect of a post-conflict area-based regeneration policy in deprived urban neighbourhoods in Northern Ireland. In press with *Regional Studies* (2019) <https://doi.org/10.1080/00343404.2019.1644450>

Nicholas Steel; John A Ford; John N Newton, Adrian Davis; Theo Vos; Mohsen Naghavi; Scott Glenn; Andrew Hughes; Alice Dalton; Diane Stockton; Ciaran Humphreys; Mary Dallat; Jurgen Schmidt; Julian Flowers; Seb Fox; Ibrahim Abubakar; Rob Aldridge; Carol Brayne; Traolach Brugha; Simon Capewell; Josip Car; Cyrus Cooper; Majid Ezzati; Felix Greaves; Roderick Hay; Simon Hay; Frank Kee; Heidi Larson; Ronan A Lyons; Azeem Majeed; Martin McKee; Salman Rawaf; Harry Rutter; Sonia Saxena; Aziz Sheikh; Liam Smeeth; Russell Viner; Stein Emil Vollset; Hywel Williams; Charles Wolfe; Anthony Woolf; Chris Murray. Changes in health in the countries of the UK and 150 English Local Authority areas 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016 Lancet Volume 392, Issue 10158, 3–9 November 2018, Pages 1647-1661

Peter Craig Erica Di Ruggiero, Katherine L. Frohlich, Eric Mykhalovskiy, Martin White, Rona Campbell, Steven Cummins, Nancy Edwards, Kate Hunt, Frank Kee, Charlotte Loppie, Laurence Moore, David Ogilvie, Mark Petticrew, Blake Poland, Valéry Ridde, Jeannie Shoveller, Sarah Viehbeck. Taking account of context in population health intervention research: guidance for producers, users and funders of research. NIHR Journals Library 2018.  
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<https://academic.oup.com/abm/advance-article/doi/10.1093/abm/kay012/4972881?guestAccessKey=d3cea333-a4fe-407e-8f67-17922b9a6fc2>

Mohan G, Longo A, Kee F. Evaluation of the health impact of an urban regeneration policy Neighbourhood Renewal in Northern Ireland. JECH 2017;71:919–927. doi:10.1136/jech-2017-209087

Murray J, Patterson C, French D, Brennan S, Kee F, Hunter R. Are effects of interventions to increase physical activity behaviour maintained and why? A systematic review, meta-analysis and meta-regression. Soc Sci Med 2017 vol. 192, 2017, p. 125-133.[DOI](#).

## **Geraint Ellis' publications list (selection of most recent and relevant)**

- Ellis, G, Hume, T, Barry, J & Curry, R 2019, *Catalysing and Characterising Transition: EPA Research Report 287*. EPA Research Reports, Environmental Protection Agency, Dublin.
- Cleland, C, Reis, R, Hino, A, Hunter, R, Fermino, R, Koller de Paiva, H, Czestschuk, B & Ellis, G 2019, 'Built environment correlates of physical activity and sedentary behaviour in older adults: A comparative review between high and low-middle income countries.', *Health & Place*, vol. 57, pp. 277-304.
- Kelly, C, Ellis, G & Flannery, W 2019, 'Unravelling Persistent Problems to Transformative Marine Governance', *Frontiers in Marine Science*. <https://doi.org/10.3389/fmars.2019.00213>
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- Muinzer, T.L. and Ellis, G., 2017. Subnational governance for the low carbon energy transition: Mapping the UK's 'Energy Constitution'. *Environment and Planning C: Politics and Space*, p.2399654416687999.
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- Ellis, G. Barry, J. and Robinson, C. (2007) Many Ways to Say "No" – Different Ways To Say "Yes": Applying Q-Methodology To Understand Public Acceptance Of Wind Farm Proposals, *Journal of Planning and Environmental Management*, Vol. 50, No. 4, pp. 517-551.

## **Jason Thompson's list of publications (selection of most recent and relevant)**

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J. Thompson, M. Stevenson, **J. S. Wijnands**, K. A. Nice, G. D. P. A. Aschwanden, J. Silver, M. Nieuwenhuijsen, P. Rayner, R. Schofield, R. Hariharan, and C. N. Morrison (2019). "Injured by Design: A Global Perspective on Urban Design and Road Transport Injury". In: *The Lancet Planetary Health* (Under review), Available at SSRN: <https://ssrn.com/abstract=3307635>

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Tatjana Todorovic, Geoffrey London, Nigel Bertram, Oscar Sainsbury, Marguerite A. Renouf, Steven J. Kenway and **Kerry A. Nice**, Models for Water-sensitive Middle Suburban Infill Development, In: *State of Australian Cities Conference 2019, 3-5 December 2019*, (Under Review) Conference Paper.

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Naika Meili, Gabriele Manoli, Paolo Burlando, Elie Bou-Zeid, Winston T.L. Chow, Andrew M. Coutts, Edoardo Daly, **Kerry A. Nice**, Matthias Roth, Nigel J. Tapper, Erik Velasco, Enrique R. Vivoni, and Simone Fatichi, An urban ecohydrological model to quantify the effect of vegetation on urban climate and hydrology (UT&C v1.0), *Geosci. Model Dev. Discussions*

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## **Leandro Garcia's list of publications (selection of most recent and relevant)**

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- Carvalho MS, Honório NA, **Garcia LMT**, Carvalho LCS. *Aedes aegypti* control in urban areas: a systemic approach to a complex dynamic. *PLoS Negl Trop Dis*. 2017;11(7):e0005632.
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## **Mark Stevenson's publications list (selection of most recent and relevant)**

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## **Neil Anderson's publications list (selection of most recent and relevant)**

**Use of Wearable Technologies with Machine Learning to Understand University Student Learning Behaviours to Predict Students at Risk of Failing.** McGowan, A., Hanna, P., Greer, D., Busch, J., Anderson, N., Collins, M., Cutting, D., Stewart, D. & McDowell, A., 25 Jul 2019, In : Advances in Intelligent Systems and Computing. 1018, p. 325-331 6 p.

**Early student access to automated summative marking tools for self learning.** Cutting, D., McDowell, A., Allen, A., Anderson, N., Collins, M., Sage, P. & McGowan, A., Jul 2019. 6 p.

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## **Relevant Reports**

- WHO Regional Office for Europe (2017). [Urban green space interventions and health: a review of impacts and effectiveness](#). Copenhagen: WHO Regional Office for Europe. WHO Regional Office for Europe (2017). [Urban green spaces: A brief for action](#). Copenhagen: WHO Regional Office for Europe.

## DATA MANAGEMENT PLAN

<b>0. Proposal name</b> A vision of healthy urban design for NCD prevention
<b>1. Description of the data</b>
<b>1.1 Type of study</b> Analysis of secondary datasets (imagery, geographic information system (GIS), and health (including road traffic collisions and casualties) datasets), usability study with qualitative data collection, and health impact assessment modelling.
<b>1.2 Types of data</b> A range of imagery, quantitative, and qualitative data will be used: <ul style="list-style-type: none"><li>a) Imagery data: Map images for each city obtained using a customised version of Google Static Maps. Each image provides a high-level abstraction of the urban characteristics of interest, such as road networks, rail transit networks, water bodies, and designated parks or greenspace. All images will be requested through appropriate request mechanisms and the terms of provision will be adhered to.</li><li>b) Quantitative data: secondary geospatial and population-based health data. It is expected the data will be fully anonymised by the provider when released, subject to appropriate consent, contractual terms and security requirements. All datasets will be requested through appropriate request mechanisms and the terms of provision will be adhered to.</li><li>c) Qualitative data: detailed minutes of the group workshops and interviews, and photos taken from relevant outputs produced by workshop participants. Workshop participants will be asked to consent to their contributions being used in this research through anonymised mechanisms.</li></ul>
Data published in peer-reviewed, grey literature and official sources will be retrieved and compiled to inform the health impact assessment model.
<b>1.3 Format and scale of the data</b> As for imagery (approximately 2,000 images per city, 120,000 in total) and quantitative data (900,000 individuals in the UK and Australia and accompanying GIS data), we will accept data files in the format received from the data providers (e.g., .csv, .tab, .shp, relational databases), subject to the requirements specified in each data release requirements. Data from group workshops and interviews (10 participants per country) will be collected and stored using digital audio recording (e.g., .wav, .mp3) and minutes. Recordings will be transcribed and, alongside the minutes, will be saved into Microsoft Office Word files (.docx). All file formats are consistent with ensuring data sharing and the long-term validity of the data. The freeware software R and Python will be used to analyse data, build the health impact assessment model, and design the data visualisation tool. All study code and accompanying documentation will be stored in an appropriate online hosting site, such as Open Science Framework ( <a href="https://osf.io/">https://osf.io/</a> ).
<b>2. Data collection / generation</b>
<b>2.1 Methodologies for data collection / generation</b> Imagery and qualitative data will be collected by our team. Google Static Maps will be used to obtain maps images of approximately 400 x 400 m at a resolution of 256 x 256 pixels. Appropriately trained assistants will record and document the group workshops taking notes of the discussion (minutes) and photos of the outputs. Some information required for the health impact assessment modelling will be obtained from published peer-reviewed and grey literature and official sources. If required, systematic approaches will be applied to search and review the literature. Geospatial and population-based health data will be provided by project partners.
<b>2.2 Data quality and standards</b> All personnel will receive training appropriate to the data collection tools and methods they will be using, and protocols will be devised and tested to ensure consistent and complete data collection. The quality of imagery and qualitative data collection will be 'spot checked' by those with responsibility for data quality. Quality control of data will consist of both manual/visual and computerised checks on a random sample of data entered on a database against the original electronic formats, and comprehensive edit checks will be organised. Consistency and quality of secondary data will be validated by appraising data collection procedures, double-checking

algorithms to prepare and create variables, and inspecting summary statistics. Data queries will be generated for missing data and addressed. Computer models will be built following standard programming protocols for code documentation (e.g., commenting the code) and testing (e.g., stress tests).

### **3. Data management, documentation and curation**

#### **3.1 Managing, storing and curating data**

All secondary data and data generated during the study will be stored in the Queen's University Belfast and/or University of Melbourne secure networks, which standard operating procedures cover arrangements for backup, storage and security, and will be adhered to. These systems are run by professional staff, with data handling and backup processes equivalent to MRC and NHMRC standards. In the University of Melbourne's, collected data will be held in secure [Mediaflux](#) storage facility.

#### **3.2 Metadata standards and data documentation**

Metadata will be recorded as an integral process to (a) catalogue and index the data in a searchable manner, (b) document provenance of the data, (c) document the data collection and modelling methods. All essential documents and study records will be version controlled and archived.

#### **3.3 Data preservation strategy and standards**

Subject to appropriate consent and permissions, all secondary data and data generated throughout the study will be stored in the Queen's University Belfast and/or University of Melbourne secure networks. Data will be stored in line with MRC and NHMRC policies, with strict compliance of the General Data Protection Regulation (GDPR), and as described in section 4.1.

### **4. Data security and confidentiality of potentially disclosive information**

#### **4.1 Formal information/data security standards**

All data will be held securely and analysed within the Queen's University Belfast and University of Melbourne or through process agreed with these organisations, where these meet data provision constraints. Both universities are compliant with ISO27001 or manage the systems to an equivalent standard. Specific policies applying to the data are described in the universities research governance policies on management of physical research data and on working with electronic data, which abide by the MRC and NHMRC Research Data Policy.

#### **4.2 Main risks to data security**

Confidentiality and disclosure risk are controlled through the application of information security and data handling policies contained in relevant system level security policies. Data from group workshops and interviews will be temporarily stored on laptops and/or audio recording devices, particularly during data collection. The major risk to data security is if a laptop or audio recording device is lost or obtained by someone outside the study. In order to protect against this, use will be made of fully encrypted and password protected devices, prepared by the universities' IT department, to ensure all data is safely collected from the workshops and interviews and will be transferred and stored in the universities secure network as soon as possible. Another risk is the unauthorised access to data. All secondary data and data generated during the study will be transferred and stored on secure servers that are protected against unauthorised access by user authentication and firewall. A full audit trail will be available to trace the nature of any changes to data, dates of these changes, and the person responsible for any changes made. Access to the room where the servers are kept is restricted to designated IT staff. All members of the study will receive a data security induction regarding the use and processing of data, as well as about its management, by the appropriate departments in each university.

### **5. Data sharing and access**

#### **5.1 Suitability for sharing**

Imagery and secondary data are suitable for sharing subject to contractual terms arranged with data providers. Transcripts and minutes from group workshops and interviews will be redacted for anonymisation and can be shared according to intended use. Photographs of outputs produced in the workshops will be suitable for sharing, guaranteeing that participants or their names cannot be identified on the images. Computer codes to analyse data, create models, and build the online toolkit will be developed following open-source standards and access will be allowed to third parties.

## **5.2 Discovery by potential users of the research data**

An interactive online toolkit will be developed to share results. Code to build the online toolkit and to run the analyses, processed summary data, accompanying documentation, alongside with metadata will be publicly available via an appropriate online hosting site with DOI, such Open Science Framework. Availability of the online toolkit will be mentioned in all publications and presentations arising from this research. Users can also make inquiry for data access contacting the study Pls.

## **5.3 Governance of access**

The Pls will make the decision on when and what to upload to the online hosting site (publicly available, see above) and whether to supply research data to a new user.

## **5.4 The study team's exclusive use of the data**

To ensure data quality, access to primary data collected as part of this research, models, online toolkit, and all codes and accompanying documentation will be limited to internal use while these are completed, verified, and results published in peer-reviewed journals. Access to these materials will be made available at the time of publication, at the latest. Depending on the nature of the data, it may be made available earlier to interested researchers and/or potential new collaborators. Secondary data is suitable for sharing subject to contractual terms arranged with data providers.

## **5.5 Restrictions or delays to sharing, with planned actions to limit such restrictions**

We intend to only obtain anonymised data from data providers and to ensure only anonymised data from that generated by the project to be transferred for sharing. Imagery and secondary data are suitable for sharing subject to contractual terms arranged with data providers. Requests to access the group workshops and interviews recording and minutes will be considered in a case-by-case basis as it might not be possible to adequately anonymise them for all uses. Explicit consent from workshop participants will be gained to ensure approved access to the gathered information. Restrictions to sharing of data and accompanying material (e.g., computer codes) will be in place where necessary to ensure novelty for publication, but otherwise they will be shared as widely as possible.

## **5.6 Regulation of responsibilities of users**

Data sharing agreements will be developed as needed following universities' data sharing policy and advice from the appropriate departments. Computer codes will be released under an open source licence, which allows third parties to use and modify the code with no delays or restrictions but requires them to cite the original contributors.

## **6. Responsibilities**

Along with the Pls, members of the project team will have responsibility for data management, metadata creation, data security, and quality assurance of data.

## **7. Relevant institutional, departmental or study policies on data sharing and data security**

Policy	URL or Reference
Data Management Policy & Procedures	QUB research and governance policies on management of physical research data; QUB research and governance policies on working with electronic data. University of Melbourne Information Security Policy, MPF1270. <a href="https://policy.unimelb.edu.au/MPF1270">https://policy.unimelb.edu.au/MPF1270</a>

## **8. Author of this Data Management Plan (Name) and, if different to that of the Principal Investigator, their telephone & email contact details**

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