Shaping cities for health to contrast the effects of climate change: the CCHURE proposal

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Abstract: Regenerating the existing city and placing health at the center of policies, plans, and projects represents an effect response to contrast the effects of climate change that impact cities and the health of inhabitants. Convinced of this need/opportunity are the World Health Organization (WHO), eminent international researchers, and public administration representatives in many European cities. However, a consolidated "silo approach", which is common to the sectors of scientific research and public administration, does not allow common objectives to be defined, especially in small-medium cities, or integrated design proposals to be formulated. The CCUHRE Research (Climate change and urban health resilience) aims to define a transdisciplinary methodology to evaluate the effects that climate change produces on urban health, to direct policies for adaptation/mitigation through the contribution of many scientific disciplines, interaction with municipalities and local health agencies, and the involvement of local communities. This will be done with the support of new IoT (Internet of Things) technologies and mobile crowdsensing techniques in order to expand knowledge to measure/assess the effects of climate change on health, to involve communities in designing shared plans for development, to empower them when dealing with urban health and wellbeing, and to support public administrations in making decisions.

Keywords: Urban regeneration; urban health and climate change; community participation; IoT and crowdsensing;

1. Introduction

Climate change is often addressed in terms of risk for infrastructures, energy reliability, and ecological concern. Growing evidence shows that the impacts on people's health/well-being are also urgent. The report "Healthy as the Pulse of the New Urban Agenda" (World Organizations Health, WHO 2016) introduced the idea of urban health resilience as the need to promote resilient urban policies to reduce the risk of climate change with respect to human health. The Fifth and Sixth Ministerial Conferences on Environment and Health from 2010 and 2017 declared their commitment to protect health and well-being, natural resources, and ecosystems; and to promote health equity, health security and healthy environments in a changing climate. The commitments made at these two conferences were the result of research activities in recent years (Patz *et al.* 2000; McMichael, 2002; Confalonieri *et al.* 2007; Barata *et al.*, 2011; Smith KR *et al.*, 2014; Watts *et al.*, 2015) and calls by international bodies (IPCC, 2013; WHO, 2015; etc.). All of these studies agree that cities are exposed to the greatest risks, both due to the effects of climate change (Ispra, 2014) and for the social imbalances that these effects can generate (UN-HABITAT,2010; Hughes BB, Kuhn R, Peterson CM, *et al.*2011).

The European "Health 2020" strategy recognizes the important leadership role of cities in developing health urban policies. Reorganizing the existing city by placing health at the center of policies for

urban regeneration represents an answer to contrast the effects of climate change as it impacts cities and the health of inhabitants. Many researchers from different disciplines are convinced of this, although they are accustomed to a silo approach that does not permit common objectives to be defined (e.g., the 2013 “Helsinki Statement” on “Health in all policies”).

Medical science alone is insufficient to address the theme of social and environmental determinants of health, which are explicitly present in the WHO's vision of health (WHO, 1948). Other disciplines must be involved, those dealing with the places where most people live: the cities (Urban Age Hong Kongdel 2011/London School of Economics and Political Science). First among these disciplines is urban planning and design, which is called to respond to the needs of health in cities, in delivering health improvements through reshaping the urban fabric of cities, in the creation of new healthy urban environments, in the sustainable organization of mobility, land use, and green areas. These principles were reiterated by the WHO through the UCL–Lancet Commission of 2012 and the Healthy City Europe Movement (VI Phase 2014- 2018: theme: “creating resilient communities and supportive environments”), in close relation with one of the priorities in the European Health 2020 Strategy. Some research has begun in this field in Europe (UK/ Barton, Tsourou), America (Corburn at UC Berkeley, Columbia University, Mailman School of Public Health), Canada (Canadian Urban Environmental Health Research Consortium-Canue, McGill School of Urban Planning), and Australia (RMIT University, Melbourne with NHMRC Centre of Research Excellence in Healthy Liveable Communities directed by Giles-Corti). In current research, there is a strong focus on the neighborhood scale, which is the most appropriate for involving communities in designing/creating environments favorable to health (D’Onofrio, Trusiani, 2018). London, Rotterdam, Copenhagen, Bratislava, and Almada are being activated with climate-change adaptation plans, beginning to make use of the new information technologies of sensors and mobile apps to monitor phenomena such as the urban heat island (Rotterdam), traffic, atmospheric pollution and respiratory illnesses (Barcelona), the effects of atmospheric precipitation, etc.

What emerges is the need to break down disciplinary fences in research and among the different sectors of public administration; expand knowledge to measure/assess the effects of climate change on health; and involve communities, empowering them with respect to health. Sustainable, low-cost tools to monitor health equity on the local scale are essential to make decisions, allocate resources, and guide interventions for transformations/adaptation (Vlahov D, *et al.* 2011). One aid may come from the Urban Internet of Things (IoT), low-cost technologies capable of real-time collection of information to understand the complex interactions among the urban ecosystem, climate change, the health of inhabitants, and social conditions (Yick, Mukherjee and Ghosal 2008, Kontokosta *et al.* 2016).

2. Materials and Methods

The CCHURE (Climate change and urban health resilience) Research[1] intends to take up the

[1] CCHURE is a research funded in 2018 by the University of Camerino. The members of the group are researchers from different subject areas of the University and some Italian and international researchers. Research UNIT 1: Rosalba D’Onofrio School of Architecture and Design - UNICAM (Italy); Michele Talia School of Architecture and Design - UNICAM (Italy); Chiara Camaioni School of Architecture and Design - UNICAM (Italy); Ilaria Odoguardi PhD Student School of Advanced Studies - UNICAM (Italy);

challenges mentioned above in a transdisciplinary approach, with greater knowledge of the impacts through new technologies, involving local populations in identifying the needs of health and co-designing their neighborhoods.

The research, in particular, aims to define a methodology to evaluate the effects that climate change produces on urban health, to direct policies for adaptation/mitigation through the contribution of many scientific disciplines (urban planning, architecture, medical science, computer science, social science, legal science),the interaction with municipalities and local health agencies, and the involvement of local communities with the support of the new IoT (Internet of Things) technologies and mobile crowdsensing techniques.

A small-medium size city of 50,000 inhabitants, Ascoli Piceno, was chosen for the research as being representative of small and medium European cities with greater criticalities due to the lack of qualitative and quantitative data on the risks for health and the lack of sufficient economic resources. The field of comparison is the neighborhood, where the local community is most present and participatory, specifically the Monticelli Quarter (Figure 1). In addition to involving researchers from different disciplines, CCUHRE also involves local entities, neighborhood associations, local health agencies, and experts. It aims to identify a working method that can be exported to other cities in which traditional means of gathering information on health, the environment, and their interrelationships are combined with collection via IoT devices and mobile crowdsensing techniques. Citizens are called to intervene in the process of gathering data, identifying/resolving problems, and building design hypotheses.

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Figure 1. View of the Monticelli neighborhood; Source: Raniero Carloni

3.1 Features of the Monticelli district

The Monticelli quarter is one of the most populous in the city of Ascoli Piceno, with about 10,000 inhabitants. It is located only a few kilometers from the historical center, but "... you can't get to Monticelli on foot", as the local news reported a few years ago. Until the beginning of the 1970s, the land where the quarter is located was practically open country. In 1972, the city was endowed with its first local plan. This called for linear development along the east-west expanse of the city and defined a broad area to the east of the city (Monticelli) where the greatest residential volumes, built new, would be concentrated, in order to house 21,600 inhabitants (compared to the roughly 75,000 inhabitants expected in the entire municipal territory for the year 1975). It was quickly realized that the forecast for an increase in population from 50,000 to about 75,000 inhabitants was entirely unlikely, and that the nucleus of expansion in Monticelli was oversized in relation to the effective demographic trends. Despite this, the city administration proceeded to partially realize the housing and main roads as established by the plan. This was done in consideration of the fact that the earthquake of 1972 had caused serious damage to the building heritage in the historical center, with the consequent abandonment of uninhabitable buildings and the fact that the zones for social housing in Monticelli could take advantage of significant economic subsidies. Today, the quarter contains the hospital, a supermarket, offices, various types of shops, two churches, and, until a short time ago, a fast-food restaurant. Today, for most of Ascoli Piceno's residents, Monticelli is simply a dormitory, a quarter situated between a road axis and the Tronto River, a small town in and of itself with respect to the rest of the city of Ascoli Piceno (Figure 2). The quarter lacks infrastructure and equipped green areas, it lacks meeting points and places that identify the quarter, and some residential buildings are degraded. The city news reports stories of drug addiction, aggression, and accidents due to dangerous cross traffic — both on the central axis and the internal streets — smog, and noise. Despite this, there are signs of liveliness and action by the local population in the presence of sports associations, social gardens, and a very busy senior center. Attention for the quarter has re-emerged in recent years

following urban regeneration projects financed with national public funds and local interest holders, such as the Neighborhood Contract 2 – Extraordinary Program for Peripheries (Contratto di Quartiere 2- il Programma Straordinario per le Periferie-PRASI), which establishes a budget of €86 million, of which €18 million is financed by the State with some interventions on the roads, green areas, and degraded buildings.

Figure 2. View of the Monticelli neighbourhood; Source: Raniero Carloni

3.2 Objectives and products expected

CCUHRE, in particular, proposes to:

1) Build a methodology to investigate the relationships between the impacts of climate change and the health/well-being of inhabitants on the urban scale of the neighborhood, which contributes to selecting actions and combinations of actions for mitigation and adaptation with citizens' active role.

Outputs:

a) Climate and Health Profile (CHP): to construct the neighborhood CHP, reference will be made to qualitative/quantitative indicators that assess the effects of climate change on the health and well-being of the population. These indicators will be selected based on existing public health data, as products of international research, and with the contribution of inhabitants by administering questionnaires and activating focus groups.

b) Climate and Health Actions (CHA): the selection of actions and combinations of actions for adaptation and mitigation, already present in international best practices, with reference to the "fundamental themes" of urban design — land use, mobility, housing, open spaces, and meeting spaces, the natural environment — and some themes of technological design —temporariness and flexibility, etc.

2) Proposing a methodology for public administration to select scenarios for adaptation to/mitigation of the effects of climate change, through the use of real-time analytics and data feedback mechanisms and non-instrumental interaction with local communities. Outputs:

a) Climate Health Lab (CHL): construction of a platform of sensors and automation technologies (Urban Internet of Things, IoT), which will provide real-time information/measurement of the physical/environmental conditions of the neighborhood and its inhabitants. This platform will be implemented with citizen contribution through the use of mobile crowdsensing techniques, which will allow smart-phone users to interact with IoT devices.

With the CHL, it will be possible to:

- analyze and assess the difference between subjective and objective measurements of quality-of-life indicators to understand how the perception of different environmental conditions varies across the neighborhood;
- verify and compare, with the help of researchers, technicians, and citizens, the "health" performance of the scenarios identified and their evolution in time, thereby assisting public administrations in the decision-making process.

The research objectives will be measurable: 1) in the number of citizens involved in the experimentation in the field and in the focus groups; 2) in the number of planning proposals for adaptation/mitigation that will be designed with the support of IoT technologies and citizens and from which the administration can choose based on the quarter's needs.

3.3 The current phase and the next steps of research

The research started at the beginning of 2019 with the presentation of the theme and objectives to the local community. Up to date, the research group is involved in construction of the methodology to investigate the relationships between the impacts of climate change and the health/well-being of inhabitants on the urban scale of the neighborhood, which will help to select actions and combinations of actions for mitigation and adaptation with citizens' active role. At the base of this methodology there is an approach that foresees the fundamental involvement of the community and the preparation of preliminary data with particular reference to: a) The construction of the Community Health Profile and b) the identification of Climate-Health Actions.

In order to construct a meaningful Community Health Profile and the consequent Climate-Health Actions, some indicators were highlighted to assess the families' quality of life in the Monticelli district. The indicators have been grouped together in a questionnaire; It has been distributed to families, intercepting an average age range between 30 and 55 years, with the help of primary school in the neighbourhood. The questionnaire is organized in 9 sections: demographic data, area where the family lives, security, accessibility to services, social cohesion in the neighbourhood, daily travel, characteristics of the dwelling, quality of life in the dwelling, outdoors.

Simultaneously and in close collaboration with ASUR (Regional Healthcare Company), for a complete and significant construction of the Health Profile is begun the administration of the PASSI questionnaires (Progress of Health Services for Health in Italy). Promoted and financed since 2006 by the Italian Ministry of Health, this questionnaire aims to carry out a full-scale monitoring of the population's health status. The administration of the questionnaire is in progress; it was being

administered on a sample of 250 people in the neighborhood and it gathers information on lifestyle and behavioural risk factors of the Italian adult population (18-69 years) related to the occurrence of non-communicable chronic diseases. Among the many topics investigated by PASSI are: smoking; physical activity; obesity; excessive weight, cardiovascular risk, state of physical and psychological well-being, and other aspects related to quality of life related to health.

From the results that will emerge from the administration of these two questionnaires, the Community Health Profile will be drawn up, which will allow to the research group to select indicators that will assess the possible impacts of climate change on the inhabitants' health and well-being of the neighborhood. Moreover, these additional indicators, selected by international literature and with the citizens' contribution, will be administered within focus groups and through the contribution of new information technologies. Simultaneously, it will be conducted a survey of best practices, that many European and world cities have and are promoting, which link urban plans and projects with the objective of combating climate change and health impacts. The fields of investigation to carry out this survey will cover: *Housing and buildings; Neighbourhoods; Social environments; Connectivity, density and land use mix; Accessibility, amenities and decision-making processes; Greenspace*, etc.

To simplify this activity, a reconnaissance of the district was carried out through the analysis of the planning tools in use, and then specifically considering: demographic data, urban standards, organized for green areas (type of green areas surveyed, type of green areas of public utility, etc.) (Figure 3); services (primary services, parking areas, commercial activity, etc.) (Figure 4); mobility structure (pedestrian path's survey, bicycle lane's path, bus routes, etc.) (Figure 5). Starting from the end of 2019, the next steps will concern the activities described in the previous paragraph.

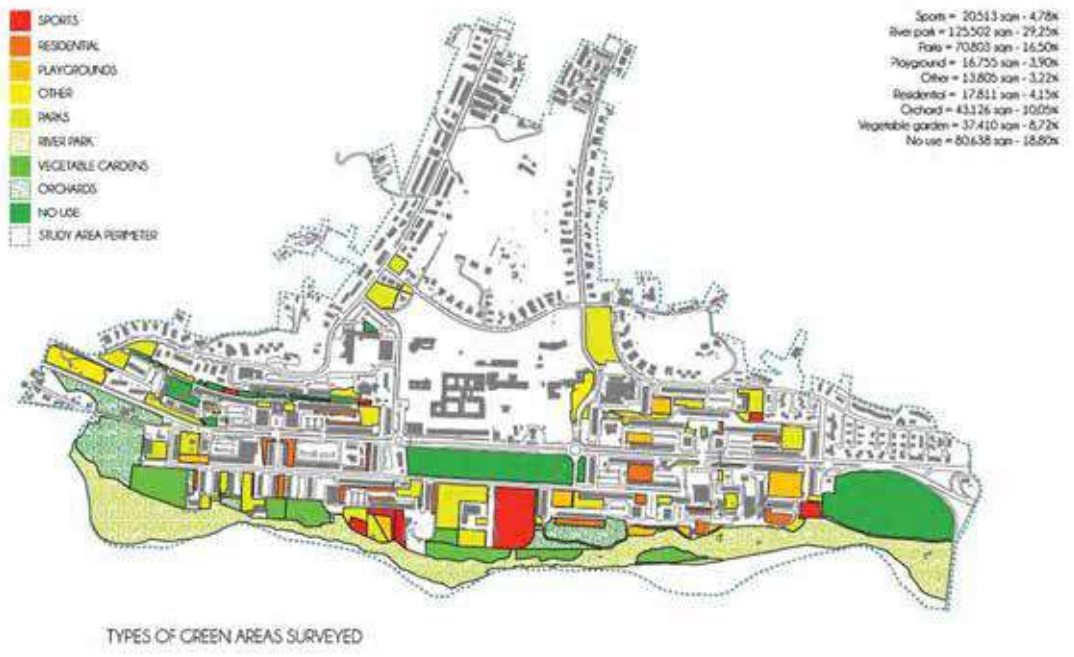

Figure 3. Types of green areas surveyed in Monticelli neighbourhood. Source: Search results

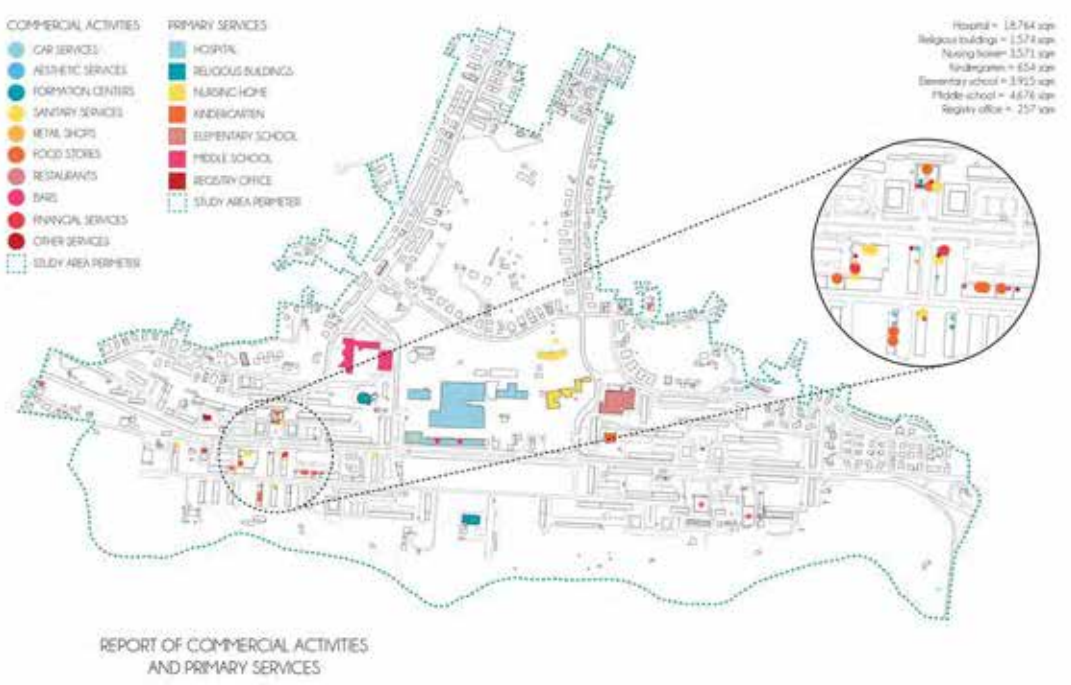

Figure 4. Report of commercial activities and primary services in Monticelli neighbourhood. Source: Search results

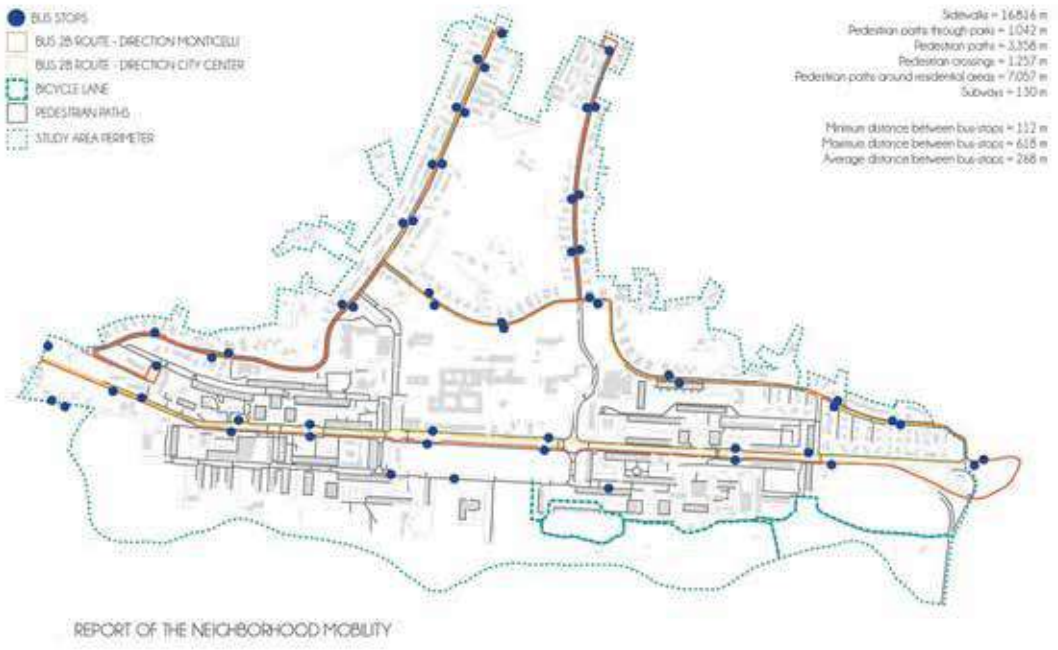

Figure 5. Report of the Monticelli neighbourhood mobility. Source: Search results

4. Conclusions

The innovation of CCUHRE regards the possibility of beginning a system of knowledge shared between the public administration, scientific community, and local community to assess projects and plans for mitigation of and adaptation to climate change and to choose the most advantageous in terms of their effects on health. This will occur through the use of IoT technologies and low-cost mobile crowdsensing. The results of CCUHRE will impact the research in the field of urban health in two ways: 1) the front-line participation of interested populations confers validity and concreteness on the research and the assessment of policies and the plans for adaptation to and mitigation of climate change, maximizing the impact of the solutions identified; 2) going beyond the concept of "urban design" guided by a top-down approach, which is strongly debated today, towards "human centred design" focusing on the knowledge of individual behavior, collaboration with the community, which makes use of contributions from various disciplines and the use of modern IoT technologies.

Citizens become providers and assessors of data regarding health and well-being, simulators and evaluators of scenarios for mitigation and adaptation, joining in the design of their living environments at risk due to climate change. This will favour:

- dialogue among the public administration, citizens, and researchers;
- citizens' participation and awareness regarding city governance/decision-making;
- an understanding of the need/opportunity to adopt an integrated, transdisciplinary approach, the only one capable of responding to the complexity of the effects of climate on health in urban areas;
- the fundamental role of the "urban project" in ensuring "equitable" access to health.

In imagining recourse to a methodology centred on people's knowledge of their living environment and the contribution that they can make in evaluating the quality of the mitigation and adaptation projects it is essential to earn their trust. It is therefore necessary to dialogue and establish collaborative relationships between citizens and the public administration by sharing information and ensuring:

a) quality control of the data collected (which should be made known to the interested parties (ref. website of reference) and made available on an appropriate level of aggregation);

b) assessments of mitigation and adaptation scenarios should occur through direct interaction between experts, technicians in the public administration, and citizens.

References

Barata, M., E. Ligeti, G. De Simone, T. Dickinson, D. Jack, J. Penney, M. Rahman, R. Zimmerman (2011), “Climate change and human health in cities”. In C. Rosenzweig, W. D. Solecki, S. A. Hammer, S. Mehrotra, Eds., *Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network*, Cambridge University Press, Cambridge, UK.

Confalonieri, U., *et al.* (2007), “Human Health”. In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E., Eds., *Climate Change 2007: Impacts, Adaptation and*

Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, 391-431.

D'Onofrio R., Trusiani E. (2018), *Urban Planning for Healthy European Cities,* Springer, Switzerland.

Hughes BB, Kuhn R, Peterson CM, Rothman DS, Solórzano JR, Mathers CD, Dickson JR.(2011) "Projections of global health outcomes from 2005 to 2060 using the International Futures integrated forecasting model". *Bull World Health Organ.* 2011 Jul 1;89(7):478-86. doi: 10.2471/BLT.10.083766.

IPCC (2013), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. by Stocker, T.F., D. Qin, G.-K. *et al.*, Cambridge University Press. New York.

Ispra (2014), *Gli indicatori del clima in Italia*
http://www.isprambiente.gov.it/files/pubblicazioni/statoambiente/SA_57_15_Indicatori_clima_2014.pdf

Yick, J., Mukherjee, B. and Ghosal, D. (2008), "Wireless Sensor Network Survey". In: *Computer Networks*, 52, 2292-2330. http://dx.doi.org/10.1016/j.comnet.2008.04.002

McMichael AJ (2002), "Population, environment, disease, and survival: past patterns, uncertain futures"**.** *Lancet,* 2002 Mar 30;359(9312):1145-8. DOI:10.1016/S0140-6736(02)08164-3.

Patz JA, Graczyk TK, Geller N, Vittor AY. (2000), "Effects of envi-ronmental change on emerging parasitic diseases", *Int JParasitol* 30:1395–1405.

Smith, K.R., A. Woodward, D. Campbell-Lendrum, D.D. Chadee, Y. Honda, Q. Liu, J.M. Olwoch, B. Revich, andR. Sauerborn (2014), "Human health: impacts, adaptation, and co-benefits". In: *Climate Change 2014: Impacts,Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to theFifth Assessment Report of the Intergovernmental Panel on Climate Change.* https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf

UN-HABITAT (2011), *UN-HABITAT annual report 2010*, https://unhabitat.org/un-habitat-annual-report-2010/

Vlahov D, *et al.* (2011), "Roundtable on Urban Living Environment Research (RULER)" *Journal of Urban Health*. 2011;88(5):793–857. doi: 10.1007/s11524-011-9613-2.

World Health Organization (WHO) (1948), *Constitution of the World Health Organization: Basic. Document*, Geneva.

World Health Organization (WHO) (2015), *Climate and health country profiles - 2015a global overview.*
https://www.who.int/globalchange/resources/country-profiles/climatechange_global_overview.pdf

World Health Organization (WHO) (2016), *Health as the pulse of the new urban agenda: United Nations conference on housing and sustainable urban development, Quito*. In https://www.who.int/phe/publications/urban-health/en/

Watts N., Adger W.N., Agnolucci P., Blackstock J., Byass P., Cai W., Cox P.M. (2015), “Health and climate change: policy responses to protect public health”, *Lancet,* 386 (10006) (2015), pp. 1861-1914

Kontokosta C. (2016), **“**The Quantified Community and Neighborhood Labs: A Framework for Computational Urban Science and Civic Technology Innovation”**,** *Journal of Urban Technology. Volum*e 23, 2016 - Issue 4.