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Connecting the Dots and the VicHealth Local Government Partnership: systems science in a broad municipal health approach: a qualitative study.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068190
Article Type:	Original research
Date Submitted by the Author:	12-Sep-2022
Complete List of Authors:	O'Halloran, Siobhan; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Hayward, Joshua; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Strugnell, Claudia; Deakin University - Geelong Waterfront Campus, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Felmingham, Tiana; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Poorter, Jaimie; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Kilpatrick, Stephanie; VicHealth Fraser, Penny; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Needham, Cindy; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Rhook, Ebony; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development DeMaio, Alessandro; VicHealth Allender, Steven; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development
Keywords:	PUBLIC HEALTH, QUALITATIVE RESEARCH, Community child health < PAEDIATRICS

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Connecting the Dots and the VicHealth Local Government Partnership: systems science in a broad municipal health approach: a qualitative study.

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Keywords: Systems dynamics, Systems thinking, Community based systems dynamics, Obesity prevention, Public Health, Group Model Building, Children, Communities, Capacity Building

Word count 3023

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ABSTRACT

Objective: To present an approach to build capacity for the use of systems science to support local communities in municipal public health and wellbeing planning.

Design: Qualitative study

Setting: Local government authorities

Participants: Thirteen local governments were trained in community-based system dynamics (CBSD), and specifically group model building (GMB) techniques to mobilise local community efforts. Local government facilitation teams delivered GMB workshops to community stakeholder groups from 13 communities.

Main Outcomes: Stakeholders developed causal loop diagrams (CLD) representing localised drivers of mental wellbeing, healthy eating, active living or general health and wellbeing of children and young people. After which locally tailored action plans were developed. Training in CBSD was implemented with facilitation teams in 13 local government areas, followed by the local delivery of GMB workshops.

Results: Overall, 110 local government staff participated in training in CBSD to develop causal loop diagrams, with stakeholders, children, young people, community members and other stakeholders participated in the GMB workshops across all 13 sites. All 13 council sites developed CLDs where participants identified themes that included healthy eating and positive mental health.

Conclusions: Local facilitation of the CBSD process has developed community informed and locally relevant CLDs that have been used to lead local action to improve the wellbeing

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of children and young people. Training employees in CBSD is one approach to increase systems thinking capacity within local government.

STRENGTHS AND LIMITATIONS OF THIS STUDY

This paper represents one of the first efforts to build systems thinking capacity within local government staff.

This paper shows that there is an opportunity for a trained labour force to become systems thinkers and for stakeholder informed actions to enhance the health and wellbeing of youth.

The framework presented in this paper may provide the means to gain insight into causal loop diagrams, not just for common drivers of public health concerns, but for all complex problems.

There is a knowledge gap about the sustainability of health and wellbeing whole-of-community systems-based prevention and community-led change.

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INTRODUCTION

Obesity is a worldwide health priority [1]. Obesity prevalence has continued to increase over recent decades and is conservatively estimated to cost $2 trillion per year or 2.8% of global GDP [2]. In Australia 25% of children (aged 5-17 years of age) are overweight or obese [3] and are at greater risk of lower self-rated health-related quality of life (HRQol), depression [4–6], and experience comorbidities such as type 2 diabetes and hypertension [7]. Obesity prevention among children is critical as obesity strongly tracks into adulthood, highlighting the need for early intervention [8].

A key challenge for chronic disease prevention is to address the complex relationships between the societal causes of preventable disease [9]. Historically, prevention efforts have centred on small groups of actors in single sectors targeting individualistic behavioural outcomes with limited success [9]. Implementation at scale has been further challenged by the need for adaption across settings, without which intervention effects are reduced by inflexibility to heterogeneity in community resources, readiness and environments, amongst other potential reasons [10–11].

Whole-of-community approaches to prevention are likely to succeed and be sustained where systems-based methods support understanding the community, environmental, social and economic drivers of disease, and by focusing on capacity-building within communities to address this challenge [11–12]. Methods from system science, like GMB and causal loop diagramming, provide means to understand the complex drivers of preventable disease by describing non-linear relationships of cause and effect, feedback loops and adaption [13]. Several examples of whole-of-community systems-based prevention trials exist in the literature at a multi-community scale [14–16]. Scaling and embedding these methods at the local government level, to support regulatory intervention and build capacity to support

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government health planning remains an important next step [17]. Local government is a particularly desirable setting for systems-based approaches due to council's regulatory remit over a range of environmental and policy levers, and the potential for regulatory interventions to create sustainable, equitable changes, and to ameliorate the impacts of harmful system drivers (e.g., the built environment, marketing) [12,17].

Development of frameworks to embed these methods within local government are emerging internationally, examples include Public Health England's (PHE) local government whole systems approach to address obesity [18]. Several councils and boroughs across England have utilised the programme to operationalise local-led approaches to obesity by engaging with their local stakeholders to implement systems change across the community [18]. In 2019, PHE launched the *Whole Systems Approach to Obesity: a guide to support local approaches to promoting a healthy weight programme for local governments across England* which includes systems mapping of obesity drivers with community stakeholders as a central tool [18].

In 2020, VicHealth initiated the 'VicHealth Local Government Partnership - Young people leading healthier communities' (VLGP). The partnership aims to create community environments where children and young people aged 0-25 years could become physically active, socially connected, and mentally healthy [19]. VLGP currently includes 13 metropolitan, regional and rural Victorian Local Governments, using systems thinking methods to direct, and guide municipal chronic disease prevention in young people [19].

This paper describes the design of a framework to embed systems thinking as a guiding principle for the delivery of municipal prevention of chronic disease in children and young people. The specific approach to systems dynamics is outlined, alongside the processes used to initially build councils' capacity, and ongoing support mechanisms to guide continued use

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of the systems thinking methods. Some results reflecting early outcomes from the local communities are provided.

PARTICIPANTS AND METHOD

Study Design and data collection

Study context

The state of Victoria, south-eastern Australia, has a population of ~6.7 million people and is comprised of 79 Local Government Areas (LGA) [20]. Individual LGAs vary broadly across various measures including geographical size, population density, rurality and cultural and linguistic diversity [20]. Overall, 28% of Victorians were born overseas and 26% speak a language other than English [20].

VLGP overview and modules

The VLGP represents a partnership approach to building capacity for evidence-based prevention at the local government level. Councils were invited to apply to join the VLGP through a competitive process, initially open to the 39 Victorian councils with an Index of Relative Social Disadvantage (IRSD) of 1-5 and with health and wellbeing needs, between the lower and higher IRSD LGAs [21]. Sixteen councils were selected to take part in the partnership, with three in a modified partnership arrangement, which allowed one of the VLGP foundation modules to be omitted from their programme.

The VLGP provides support to the 13 partner councils to develop and deliver evidence-based action to improve children and young people's health and wellbeing through the mechanism of councils' Municipal Public Health and Wellbeing Plans (MPHWP) [19]. In Victoria, the State Government mandates that councils develop 4-year MPHWP, that guide strategic

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direction and priorities for municipal health promotion relative to a locally tailored set of priorities, taken from identified state-level drivers of poor health and health inequity [22].

The key outcomes of VLGP are to foster improvements in the capacity of councils to deliver evidence-based action in the implementation of their MPHWP, the promotion of the voices of children and young people into local government policy decisions and action, and improved rates of healthy eating, physical activity and social connectedness amongst young people aged 0-25 by the end of 2025 [19].

Eight evidenced-informed health promotion modules were developed to serve as a series of practical, 'how-to guides' for policy, program development/delivery and practice change. These guides were devised to support councils to implement action at the local level to create healthier communities for children and young people [19]. The eight modules were designed to consolidate the practice knowledge, experience and research developed from the close collaboration between VicHealth, local governments and expert partners. Each module included several impact streams, each of which included a number of evidence-informed implementation actions or key policy, program and practice changes relative to the theme of the module. The modules were divided into three categories; Foundation, Core and Stretch (Table 1) [19].

Table 1 The Victorian Local Government Partnership (VLGP) modules and impact streams [19]

	Modules and impact streams
Foundation Modules Compulsory modules that provided the basic building blocks to develop staff capabilities and skills in systems-thinking and engagement with children and young people in planning, policies and programs	**Connecting the Dots - creating solutions for lasting change** Big picture thinking for better solutions **Leading the Way - engaging young voices for change** Including children and young people in policy creation Including children and young people in planning

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Core Modules Evidence based activities, designed to address childhood obesity	**Building Active Communities** Increasing active travel to and from school Increasing walking and bike riding in council strategies Creating opportunities for all Victorians to be active Including gender equity in council spot and recreation policy Empowering and enabling women to get active through local promotion of 'This Girl Can-Victoria' **Creating connected and supportive communities** Co-designing with young people for better community wellbeing Building proud and inclusive communities Addressing social determinants of mental wellbeing **Building Better Food Systems for Healthier Communities** Creating thriving local food systems Embedding healthy food and drink options in council owned and operated places Using healthy rewards and sponsorships in community activities Enabling healthy partnerships
Stretch modules Optional modules that built on essential health policy priorities to promote healthy environments for children and young people	**Increasing alcohol harm prevention at a local level** Adopting alcohol harm prevention actions to protect children and young people **Strengthening tobacco control at a local level** Adoption tobacco control actions to protect children and young people **Promoting everyday creativity at a local level** Increasing equity in creative strategies Embracing opportunities for children to inform creative programs Improving opportunities for young people to lead creative programs

153

154 **Connecting the Dots** [19]

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The Connecting the Dots (CtD) foundation module contained one impact stream with two required implementation actions which consisted of structured training workshops and the delivery of systems thinking approaches (Table 2).

Table 2 VicHealth Local Government Partnership (VLGP) Connecting the Dots foundation module [19]

Connecting the Dots – Creating solutions for lasting change		
Impact stream	**Implementation action**	**Formal training & support**
Big picture thinking for better solutions	Understanding systems thinking approaches	Block 1 – Fundamentals in systems thinking & facilitation
	Actioning new systems thinking approaches	Block 2 – Workshop preparation & delivery support

Understanding systems thinking approaches: Fundamentals in Systems Thinking & Facilitation

This stream consisted of a series of training sessions (Block 1) designed to quickly upskill (~10hrs pivoted to online learning in some cases due to COVID-19, work from home and travel restrictions) council core facilitation teams on; 1) the basics of systems thinking including the fundamental skills around concepts and language; 2) community based systems dynamics (CBSD) and GMB workshop facilitation process via participation in facilitated demonstrations and guided facilitation practice [19].

Initial plans for local delivery of the workshop process, including context/framing, facilitation team membership, key participant groups, and engagement/workshop timelines were also covered. The use of the Systems Thinking in Community Knowledge Exchange (STICKE) systems mapping software program (STICKE Version 3 © Deakin University)

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was used throughout the training as it allows council and community members to build causal loop diagrams (CLDs) using a supported online process [23].

Regional advisors and a central coordination team comprising of academic and practitioner experts in systems thinking methodologies and local government representatives comprised the CtD team. The regional advisors worked closely with their nominated councils (2-3 councils each) to deliver training and provide continued implementation support and guidance. Partner councils established core facilitation teams to lead and deliver the actioning of new systems thinking approaches. Each team consisted of a VicHealth funded project officer based at the local councils and other council employees overseeing the MPHWP Additional staff involved in child/youth health and community engagement and non-council staff were also nominated for training. Approximately, 2-10 persons undertook the training sessions within each council. The Fundamentals in Systems Thinking & Facilitation impact stream was completed in full before councils began delivering participatory GMB workshops with the community.

Actioning new systems thinking approaches: workshop preparation & delivery

This impact stream included a series of online seminars (~10 hrs) designed to support council teams scheduled alongside the delivery of community based GMB workshops (Block 2). The preparation seminars covered various topics and focused closely on supporting council teams as they negotiated the tasks and preparations relative to the stages of GMB workshop delivery [19].

Council core facilitation teams delivered at least three participatory GMB workshops of ~1-3 hours to groups of community stakeholders from each of the 13 partner councils (Table 3). Stakeholders included young people, children, community leaders, and diverse community members drawn from across all sectors including local government, non-government

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organisations, small business, commercial sector, education, community organisations and healthcare providers.

Table 3 Summary of the Victorian Local Government Partnership (VLGP) Group Model Building (GMB) workshop process

Workshop	Duration	Participant capacity	Objectives
1	120 minutes	5-25 participants	Orientation of participants to VLGP project, local context for work and GMB process to be undertaken. Development of initial systems map.
2	120 minutes	5-25 participants	Refinement of systems map based on revisions since workshop 1 and further conversation and consideration of health and wellbeing determinants. Optionally: Discussion of preliminary insights on potential focal points on systems map for community-led action, and potential additional invitees and recruitment strategies for workshop 3.
3	180 minutes	5-25 participants (with option to extend up to 100 participants)	Introduction and orientation to systems map for new participants if required. Further discussion of revisions to systems map since workshop 2. Facilitated discussion and prioritisation of potential community-led actions identified in response to insights from systems map.

Together council core facilitation teams and workshop participants created a CLD of the locally relevant drivers of health and wellbeing of children or young people in their community and determined the highest-priority leverage points for action. The method used to generate the systems map in the form of CLD was the GMB technique, which is a

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structured collaborative CBSD methodology, designed to guide participants through developing hypotheses about the connections between various contributing factors in complex problems [13]. The CLD highlighted drivers of childhood health and the complex, non-linear relationships between those drivers. The structured process then resulted in a CLD which represented a view on the systems components, relationships and boundaries (Figure 1) [13]. CLDs were de-identified.

Following the completion of the participatory systems mapping and community engagement process, councils were supported by the CtD team to use the CLD developed by the group to guide the identification and prioritisation of stakeholder informed actions that can be applied in the community to support children and young people health during 2022 - 2025. These will be driven by their own CLD and informed by evidence including case studies from previous successful interventions [24]. Action will be recorded throughout the duration of the project, including tracking against the systems map in STICKE. Forthcoming publications will examine the implications of local community contexts and priorities on the precise adaptations to process undertaken by individual councils.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research**.**

RESULTS

All 13 councils had participated in the initial systems training, with 110 total staff (>18 year of age) attending the training across all councils. Individual facilitation teams based at the councils included a funded project officer and between three and 12 additional staff including council employees involved in child/youth health and community engagement, and staff from external community organisations collaborating with councils, such as sports facilities or health services.

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All councils successfully created CLDs (Figure 1), with council stakeholders including: children and young people, the local prevention workforce, service providers, policy and decision makers, and grass-roots community members from sectors including local government, non-government organisations, small business, education, community organisations and healthcare providers. The systems maps resulting from the workshop process were similar in range and scope to other prevention efforts which have used these methods across multiple community sites in Victoria [24]. Identified themes by communities included healthy eating and positive mental health.

Fig. 1 An example of a casual loop diagram from the Victorian Local Government Partnership (VLGP)

DISCUSSION

This paper describes the capacity building of local councils to use systems thinking and participatory methods within local governments to inform the implementation of MPHWP. Councils demonstrated complex systems science practice to develop CLD with community stakeholders (with an understanding of systems theory) which can then act as basic logic models for community led action and implementation.

The logic underpinning the approach used in CtD has been published previously and posits that building and sustaining capacity for work informed by CBSD methods increases leadership and organisational engagement with prevention, and collaboration across community organisations, which generates higher quality, more sustainable outcomes within communities [25]. We observed that local stakeholder informed prevention designs allowed for differences between communities and adaption to the local context rather than a predefined program of work. The effectiveness of this locally informed prevention approach and community capacity building has been reported in previous trials e.g., Whole of Systems

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Trial of Prevention Strategies for Childhood Obesity (WHO STOPS) [24], Romp and Chomp [26], It's Your Move [27], Be Active Eat Well [28].

There is an increased focus using systems thinking at local community level to improve population health. Recent examples include PHE's support for whole of systems change, given to all 408 UK local authorities and potentially impacting 55M people [18]. The UK's guidance also calls for action at local communities and emphasises the development of shared models of the complexity within community, using a range of techniques from group model building. Our systems guidance incorporated into the CtD module has arisen from several trials of systems thinking in obesity prevention results, notably trials in schools (e.g., 'It's Your Move 2 [29]) and local communities [30]. These trials began with a heavy investment of researcher support in assisting doing systems science [15] and then moved to building capacity and supporting people within local communities to deliver and evolve systems thinking in situ [30]. These types of approaches also look promising in Aboriginal and Torres Strait Islander People rural communities [31].

Our results, and these implications for practice parallel early trials of systems thinking in health. For example, Healthy Together Victoria (HTV), was a large-scale initiative that applied a 'complex whole of systems approach' to the prevention of chronic disease [32]. HTV provides many pointers to future practice and built a workforce of system thinkers from across the state in local government, community health and non-government organisations to implement a range of actions at the community and state level [32–33]. The VLGP builds on one of the key lessons from HTV: the challenge to identify the most effective ways to support communities to deliver a systems approach at a local level [32,34]. This project shows providing capacity building in systems thinking, via CtDs, can support council staff to access and apply knowledge from >20 years' experience in complex systems thinking, obesity prevention and

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CLDs observed that the strong organisational and structural factors such as regional advisors who provided continued support allowed the novice facilitation teams to build confidence while developing their practical know-how for systems thinking in the community setting.

Building local capacity likely creates positive change within communities. This is shown in outcomes of previous trials like WHO STOPS, which catalysed >300 community members to drive >400 actions ranging from council food policy, soft drink bans and active transport strategies [24]. As a result, WHO STOPS showed initial reductions in overweight and obesity in the first two years of intervention, compared to no change in the control group [24], however, these were not sustained. The longer-term outcomes (four years) demonstrated significant maintenance of health-related quality of life, reduced takeaway, nutrient-poor snack consumption (boys only), and water consumption (girls only) favouring intervention children compared to controls. Highlighting for the first time that long-term behavioural and HRQol improvements are possible using a whole of community systems approach to childhood obesity [24].

The CtD module represents one of the first efforts to build systems thinking capacity amongst local government staff, which provided the opportunity for the trained labour force to become systems thinkers and identified stakeholder informed actions for their communities to enhance the health and wellbeing of children and young people. This was demonstrated by their ability to observe the interconnected determinants of health and wellbeing through the use of CLDs. A well scripted systematic and rigorous approach to using systems science was applied during the CtD workshops and GMB sessions.

There is limited evidence about the sustainability of health and wellbeing, community-led change. As noted with the 4-year WHOSTOPS trial which positively impacted children's health, the long term (>2 years) sustainability of community-based action is still understudied

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[24]. A key knowledge gap is the quality and effectiveness of the training materials used in the delivery of systems thinking facilitation, teaching of specific skills and knowledge, the training methods and participant's use of the online platform. For example, there may have been gaps in participants' knowledge as they progressed from workshop training to systems thinking facilitation. The use of STICKE enabled participants to create CLDs online and has been considered to be useful by participants [23]. However, it is possible the functionality requires updating to accommodate upscaling. Pivoting to online following COVID-19 restrictions, appears to be efficient in facilitating GMB rather than in person delivery, although there is little evidence to support this approach, and this may differ across the metropolitan, regional, and rural LGAs.

Future research

The future of chronic disease prevention is pointing to the co-creation of systemic change supporting communities using techniques to address complexity; a move from single behaviour, individual focus to a consideration of wholistic relations of cause and effect across multiple levels of community action [11]. As the Lancet Commission on Obesity shows, this has implications for science, as the approach is less amenable to randomized controlled trials and more suited to implementation and hybrid studies, as it places the control of the effort in the hands of communities, at the agreed expense of intervention fidelity and generalisability [11].

This paper and our broader community behaviour intervention research [24, 28, 30] raises some questions for future studies: What should the user interface and user experience look like? Could gamification, where the use of game thinking in a non-game context to engage users and to solve problems, be included as part of the systems thinking toolkit? Could an accreditation system where the recognition of communities that meet the requirements of

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certain standards be applied? Does this systems approach improve health? Can this approach be transferred to tackle other complex issues beyond obesity prevention? Can prior experience with community-based action on childhood obesity provide communities with the fundamentals to apply systems science thinking to other areas of community concern such as recovery plans from major disasters like bushfire, floods, and COVID-19 and the development of strategies for climate change resilience?

CONCLUSION

This paper has provided an example of establishing the capacity of a government workforce by developing their knowledge and understanding of systems theories tools and practice. An emphasis on the process to create change, but not at the expense of local empowerment and adaptability should be considered when planning the implementation of systems science at the local government level.

Acknowledgments

We wish to acknowledge VicHealth which funded the Local Government Partnership.

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Collaborators None declared

Author Contributions SOH, SA and JH conceptualized the study. SOH conducted the literature search and led the drafting and the revision of the manuscript. SA supervised the study and provided overall guidance. JH contributed significantly to the revision of the manuscript. All authors contributed to a collaborative effort to write and revise the

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manuscript. All authors reviewed and revised drafts and approved the final version for submission.

Funding SOH, JH, JP, TF, CN, PF, SK EH, AD are supported by VicHealth N/A award/grant number. CS was a researcher within a NHMRC Centre for Research Excellence in Obesity Policy and Food Systems. SA is a lead investigator receiving funding from VicHealth and Australian National Health and Medical Research Council grants. The funding bodies were not involved in the design of the study, interpretation of the data or in writing of the manuscript. No other financial disclosures were reported.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval

This study was approved by the Deakin University Human Research Ethics Committee (HEAG-H-121_2022). This study was carried out in accordance with the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research 2018. Informed consent was obtained from participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data are available from the corresponding author upon reasonable request.

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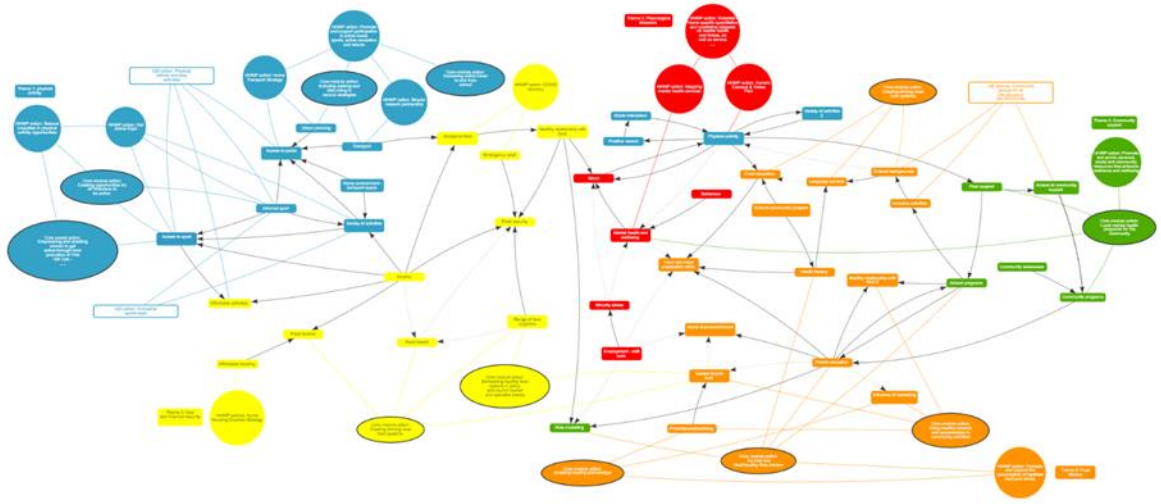

Fig. 1 An example of a casual loop diagram from the Victorian Local Government Partnership (VLGP)

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Standards for Reporting Qualitative Research: A Synthesis of Recommendations (SRQR)

Checklist item	**Page number in Manuscript**
Title and abstract	
Title	1
Abstract	2-3
Introduction	
Problem Formulation	4-5
Purpose or research question	5-6
Methods	
Qualitative approach and research paradigm	9
Researcher characteristics and reflexivity	6
Context	6-7
Sampling strategy	7
Ethical issues pertaining to human subjects	12
Data collection methods	9-12
Data collection instruments and technologies	9-12
Units of study	9-12
Data processing	12
Data analysis	12
Techniques to enhance trustworthiness	12
Results/findings	
Synthesis and interpretation	12-13
Links to empirical data	12-13
Discussion	
Integration with prior work, implications, transferability, and contribution(s) to the field	13-17
Limitations	15-16
Other	
Conflicts of interest	18
Funding	18

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BMJ Open

Building capacity for the use of systems science to support local government public health planning: a case study of the VicHealth Local Government Partnership in Victoria, Australia

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068190.R1
Article Type:	Original research
Date Submitted by the Author:	21-Nov-2022
Complete List of Authors:	O'Halloran, Siobhan; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Hayward, Joshua; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Strugnell, Claudia; Deakin University - Geelong Waterfront Campus, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Felmingham, Tiana; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Poorter, Jaimie; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Kilpatrick, Stephanie; VicHealth Fraser, Penny; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Needham, Cindy; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Rhook, Ebony; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development DeMaio, Alessandro; VicHealth Allender, Steven; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development
Primary Subject Heading:	Public health
Secondary Subject Heading:	Global health, Public health, Qualitative research, Research methods
Keywords:	PUBLIC HEALTH, QUALITATIVE RESEARCH, Community child health < PAEDIATRICS

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Building capacity for the use of systems science to support local government public health planning: a case study of the VicHealth Local Government Partnership in Victoria, Australia

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Keywords: Systems dynamics, Systems thinking, Community based systems dynamics, Obesity prevention, Public Health, Group Model Building, Children, Communities, Capacity Building

Word count 3023

ABSTRACT

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Objective: To present an approach to build capacity for the use of systems science to support local communities in municipal public health and wellbeing planning.

Design: Case study.

Setting: Local government authorities participating in the VicHealth Local Government Partnership Victoria, Australia.

Participants: Local government staff members were trained in community-based system dynamics (CBSD), and group model building (GMB) techniques to mobilise local community efforts. The trained local government facilitation teams then delivered GMB workshops to community stakeholder groups from 13 local government areas (LGA)s.

Main Outcomes: Training in CBSD was conducted with council facilitation teams in 13 LGAs, followed by the local delivery of GMB workshops 1-3 to community stakeholders. Causal loop diagrams (CLD) representing localised drivers of mental wellbeing, healthy eating, active living or general health and wellbeing of children and young people were developed by community stakeholders. Locally tailored action ideas were generated such as wellbeing classes in school, faster active transport and access to free and low-cost sporting programmes

Results: Overall, 111 local government staff participated in CBSD training. Thirteen CLDs were developed , with the stakeholders that included children, young people and community members, who had participated in the GMB workshops across all 13 council sites. Workshop 3 had the highest total number of participants (n=301), followed by workshop 1 (n=287) and workshop 2 (n=171).

Conclusions: Local facilitation of the CBSD process has developed community informed and locally relevant CLDs that will be used to lead local action to improve the wellbeing of

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children and young people. Training employees in CBSD is one approach to increase systems thinking capacity within local government.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- We trained a labour force to become systems thinkers to develop community stakeholder informed actions to improve the health and wellbeing of children and young people.

- It is unknown if there were gaps in council facilitation teams' knowledge as they progressed from workshop training to systems thinking facilitation.

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- We used a systems mapping software program that enabled participants to develop CLDs online and to observe the interconnected determinants of health and wellbeing.

- The utility of the systems mapping software used to develop CLDs was not measured

INTRODUCTION

Obesity is a worldwide health priority [1]. Obesity prevalence has continued to increase over recent decades and is conservatively estimated to cost $2 trillion per year or 2.8% of global GDP [2]. In Australia 25% of children (aged 5-17 years of age) are overweight or obese [3] and are at greater risk of lower self-rated health-related quality of life (HRQol), depression [4-6], and experience comorbidities such as type 2 diabetes and hypertension [7]. Obesity prevention among children is critical as obesity strongly tracks into adulthood, highlighting the need for early intervention [8].

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A key challenge for chronic disease prevention is to address the complex relationships between the societal causes of preventable disease [9]. Historically, prevention efforts have centred on small groups of actors in single sectors targeting individualistic behavioural outcomes with limited success [9]. Implementation at scale has been further challenged by the need for adaption across settings, without which intervention effects are reduced by inflexibility to heterogeneity in community resources, readiness and environments, amongst other potential reasons [10-11].

Whole-of-community approaches [12] to prevention are more likely to succeed and be sustained where systems-based methods support understanding the community, environmental, social and economic drivers of disease, and by focusing on capacity-building within communities to address this challenge [13-14]. Methods from system science, like GMB and causal loop diagramming, provide means to understand the complex drivers of preventable disease by describing non-linear relationships of cause and effect, feedback loops and adaption [14-15]. Several examples of whole-of-community systems-based prevention trials (e.g., communities randomised to intervention or control [12]) exist in the literature at a multi-community scale 16-18]. Scaling and embedding these methods at the local government level, to support regulatory intervention and build capacity to support government health planning remains an important next step [18]. Local government is a particularly desirable setting for systems-based approaches due to council's regulatory remit over a range of environmental and policy levers, and the potential for regulatory interventions to create sustainable, equitable changes, and to ameliorate the impacts of harmful system drivers (e.g., the built environment, marketing) [13,18].

Development of frameworks to embed these methods within local government are emerging internationally, examples include Public Health England's (PHE) local government whole

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systems approach to address obesity [19]. Several councils and boroughs across England have utilised the programme to operationalise local-led approaches to obesity by engaging with their local stakeholders to implement systems change across the community [19]. In 2019, PHE launched the *Whole Systems Approach to Obesity: a guide to support local approaches to promoting a healthy weight programme for local governments across England* which includes systems mapping of obesity drivers with community stakeholders as a central tool [19].

In 2020, VicHealth initiated the 'VicHealth Local Government Partnership - Young people leading healthier communities' (VLGP). The partnership aims to create community environments where children and young people aged 0-25 years could become physically active, socially connected, and mentally healthy [20]. VLGP currently includes 13 metropolitan, regional and rural Victorian Local Governments, using systems thinking methods to direct, and guide municipal chronic disease prevention in young people [20].

This paper describes the design of a framework to embed systems thinking as a guiding principle for the delivery of municipal prevention of chronic disease in children and young people. The specific approach to systems dynamics is outlined, alongside the processes used to initially build councils' capacity, and ongoing support mechanisms to guide continued use of the systems thinking methods. Some results reflecting early outcomes from the local communities are provided.

METHODS

Study Design and data collection

Study context

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The state of Victoria, south-eastern Australia, has a population of ~6.7 million people and is comprised of 79 Local Government Areas (LGA)[21] . Individual LGAs vary broadly across various measures including geographical size, population density, rurality and cultural and linguistic diversity [21]. Overall, 28% of Victorians were born overseas and 26% speak a language other than English [21].

VicHealth Local Government Partnership overview and modules

The VLGP represents a partnership approach to building capacity for evidence-based prevention at the local government level. Councils were invited to apply to join the VLGP through a competitive process, initially open to the 39 Victorian councils with an Index of Relative Social Disadvantage (IRSD) of 1-5 and with health and wellbeing needs, between the lower and higher IRSD LGAs [22]. The 21 submitted applications then underwent a scoring process, followed by an assessment panel discussion. Of the 21 council applications, 16 were selected to take part in the partnership, with three in a modified partnership arrangement, which allowed one of the VLGP foundation modules to be omitted from their programme.

The VLGP provides support to the 13 partner councils to develop and deliver evidence-based action to improve children and young people's health and wellbeing through the mechanism of councils' Municipal Public Health and Wellbeing Plans (MPHWP) [20]. In Victoria, the State Government mandates that councils develop 4-year MPHWP, that guide strategic direction and priorities for municipal health promotion relative to a locally tailored set of priorities, taken from identified state-level drivers of poor health and health inequity [23].

The key outcomes of VLGP are to foster improvements in the capacity of councils to deliver evidence-based action in the implementation of their MPHWP, the promotion of the voices of children and young people into local government policy decisions and action, and improved

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rates of healthy eating, physical activity and social connectedness amongst young people aged 0-25 by the end of 2025 [20].

Eight evidenced-informed health promotion modules were developed to serve as a series of practical, 'how-to guides' for policy, program development/delivery and practice change. These guides were devised to support councils to implement action at the local level to create healthier communities for children and young people [20]. The eight modules were designed to consolidate the practice knowledge, experience and research developed from the close collaboration between VicHealth, local governments and expert partners. Each module included several impact streams, each of which included a number of evidence-informed implementation actions or key policy, program and practice changes relative to the theme of the module. The modules were divided into three categories: Foundation, Core and Stretch (Table 1) [20].

Table 1 The VicHealth Local Government Partnership (VLGP) modules and impact streams [20]

	Modules and impact streams
Foundation Modules Compulsory modules that provided the basic building blocks to develop staff capabilities and skills in systems-thinking and engagement with children and young people in planning, policies and programs	**Connecting the Dots - creating solutions for lasting change** Big picture thinking for better solutions **Leading the Way - engaging young voices for change** Including children and young people in policy creation Including children and young people in planning
Core Modules Evidence based activities, designed to address childhood obesity	**Building Active Communities** Increasing active travel to and from school Increasing walking and bike riding in council strategies Creating opportunities for all Victorians to be active Including gender equity in council sport and recreation policy

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	Empowering and enabling women to get active through local promotion of 'This Girl Can-Victoria' **Creating connected and supportive communities** Co-designing with young people for better community wellbeing Building proud and inclusive communities Addressing social determinants of mental wellbeing **Building Better Food Systems for Healthier Communities** Creating thriving local food systems Embedding healthy food and drink options in council owned and operated places Using healthy rewards and sponsorships in community activities Enabling healthy partnerships
Stretch modules Optional modules that built on essential health policy priorities to promote healthy environments for children and young people	**Increasing alcohol harm prevention at a local level** Adopting alcohol harm prevention actions to protect children and young people **Strengthening tobacco control at a local level** Adopting tobacco control actions to protect children and young people **Promoting everyday creativity at a local level** Increasing equity in creative strategies Embracing opportunities for children to inform creative programs Improving opportunities for young people to lead creative programs

153

154 **Connecting the Dots** [20]

155 The Connecting the Dots (CtD) foundation module contained one impact stream with two

156 required implementation actions which consisted of structured training workshops (Block1)

157 and the delivery of systems thinking approaches (Block 2) (Table 2).

158 Table 2 VicHealth Local Government Partnership (VLGP) Connecting the Dots foundation

159 module [20]

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Connecting the Dots – Creating solutions for lasting change		
Impact stream	**Implementation action**	**Formal training & support**
Big picture thinking for better solutions	Understanding systems thinking approaches	Block 1 – Fundamentals in systems thinking & facilitation
	Actioning new systems thinking approaches	Block 2 – Workshop preparation & delivery support

Understanding systems thinking approaches: Fundamentals in Systems Thinking & Facilitation

This stream consisted of a series of training sessions (Block 1) designed to quickly upskill (~10hrs pivoted to online learning in some cases due to COVID-19, work from home and travel restrictions) council core facilitation teams on; 1) the basics of systems thinking including the fundamental skills around concepts and language; 2) community-based systems dynamics (CBSD) and GMB workshop facilitation process via participation in facilitated demonstrations and guided facilitation practice [20].

Initial plans for local delivery of the workshop process, including context/framing, facilitation team membership, key participant groups, and engagement/workshop timelines were also covered. The use of the Systems Thinking in Community Knowledge Exchange (STICKE) systems mapping software program (STICKE Version 3 © Deakin University) was used throughout the training as it allows council and community members to build causal loop diagrams (CLDs) using a supported online process [24]

Regional advisors and a central coordination team comprising of academic and practitioner experts in systems thinking methodologies from Deakin University and local government representatives comprised the CtD team. The regional advisors worked closely with their

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nominated councils (2-3 councils each) to deliver training and provide continued implementation support and guidance. Partner councils established core facilitation teams to lead and deliver the actioning of new systems thinking approaches. Each team consisted of a VicHealth funded project officer based at the local councils and other council employees overseeing the MPHWP. Additional staff involved in child/youth health and community engagement and non-council staff were also nominated for training. Approximately, 2-10 persons undertook the training sessions within each council. The Fundamentals in Systems Thinking & Facilitation impact stream was completed in full before councils began delivering participatory GMB workshops with the community.

Actioning new systems thinking approaches: workshop preparation & delivery

This impact stream included a series of online seminars (~10 hrs) designed to support council teams scheduled alongside the delivery of community based GMB workshops (Block 2). The preparation seminars covered various topics and focused closely on supporting council teams as they negotiated the tasks and preparations relative to the stages of GMB workshop delivery [20].

Council core facilitation teams delivered at least three participatory GMB workshops of ~1-3 hours to groups of community stakeholders from each of the 13 partner LGAs (Table 3). Stakeholders included young people, children, community leaders, and diverse community members drawn from across all sectors including local government, non-government organisations, small business, commercial sector, education, community organisations and healthcare providers. Stakeholders were recruited by partner councils through existing networks, emails, expressions of interest, and advertisements.

Table 3 Summary of the Victorian Local Government Partnership (VLGP) Group Model Building (GMB) workshop process

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GMB Workshop	Duration	Participant capacity	Objectives
1	120 minutes	5-25 participants	Orientation of participants to VLGP project, local context for work and GMB process to be undertaken. Development of initial systems map.
2	120 minutes	5-25 participants	Refinement of systems map based on revisions since workshop 1 and further conversation and consideration of health and wellbeing determinants. Optionally: Discussion of preliminary insights on potential focal points on systems map for community-led action, and potential additional invitees and recruitment strategies for workshop 3.
3	180 minutes	5-25 participants (with option to extend up to 100 participants)	Introduction and orientation to systems map for new participants if required. Further discussion of revisions to systems map since workshop 2. Facilitated discussion and prioritisation of potential community-led actions identified in response to insights from systems map.

Together council core facilitation teams and workshop participants created a CLD of the locally relevant drivers of health and wellbeing of children or young people in their community and determined the highest-priority leverage points for action. The method used to generate the systems map in the form of a CLD was the GMB technique, which is a structured collaborative CBSD methodology, designed to guide participants through developing hypotheses about the connections between various contributing factors in complex problems [14]. A set of scripts used in the GMB workshops (graphs over time, connection circles, and action ideas) were used to guide workshop content and help stakeholders develop CLDs [25] The CLDs highlighted drivers of childhood health and the

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complex, non-linear relationships between those drivers. The structured workshop process resulted in a CLD which represented a view on the systems components, relationships and boundaries (Figure 1) [14]. (online supplemental file 1).

Following the completion of the participatory systems mapping and community engagement process, council facilitation teams were supported by the CtD team to use the CLD developed by the group to guide the identification and prioritisation of stakeholder informed actions ideas that can be applied in the community to support children and young people health during 2022 - 2025. These will be driven by their own CLD and informed by evidence including case studies from previous successful interventions [26]. Community actions will be recorded throughout the duration of the project, including tracking against the systems map in STICKE. Forthcoming publications will examine the implications of local community contexts and priorities on the precise adaptations to process undertaken by individual councils.

Patient and public involvement None.

RESULTS

All 13 partner councils had participated in the initial systems training, with 111 total staff (>18 year of age) attending the training across all councils. Individual facilitation teams based at the councils included a funded project officer and between three and 12 additional staff including council employees involved in child/youth health and community engagement, and staff from external community organisations collaborating with councils, such as sports facilities or health services. All 13 partner councils delivered GMB workshops 1-3 face-to-face and online (due to COVID-19, and travel restrictions). In some instances, workshops were combined e.g., workshop 1 combined with workshop 2 and delivered together as one session (due to time constraints and capacity of council staff). The workshop participants

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included either young people or stakeholders with the exception of workshop 3, which included young people and stakeholders together (conducted by three councils) (Table 4).

Table 4 Total number of participants who attended the Group Model Building workshops from the 13 partner local government authorities

	Workshop 1	Workshop 2	Workshop 3	Combined workshop 1 &2	Combined workshop 2 & 3
Participants (n)					
Young people	174	99	128	52	9
Stakeholders	113	72	90	7	20
Combination of both young people and stakeholders	-	-	83	-	-
Total Participants	287	171	301	59	29

All councils successfully created CLDs , with community stakeholders including: children and young people, the local prevention workforce, service providers, policy and decision makers, and grass-roots community members from sectors including local government, non-government organisations, small business, education, community organisations and healthcare providers. The diagrams resulting from the workshop process were similar in range and scope to other prevention efforts which have used these methods across multiple community sites in Victoria [26]. For example, each council's diagram included the typical elements of a CLD: variables (determined by stakeholders as influencing the health and wellbeing of children and young people in the community e.g., junk food), the connections between the variables, actions (e.g., banning sugary drinks from sporting clubs) and overarching themes. An example of a council CLD with five themes (e.g., relationships, physical activity) and nine action ideas (e.g., wellbeing classes in school, faster

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transportation, access to free and low-cost sporting programmes) identified by communities stakeholders is shown in Figure 1. ..

Fig. 1 An example of a casual loop diagram showing the variables, themes and the actions ideas generated by stakeholders from one of the VicHealth Local Government Partnership (VLGP) councils.

DISCUSSION

This paper describes the capacity building of local councils to use systems thinking and participatory methods within local governments to inform the implementation of MPHWP. The council facilitation teams demonstrated complex systems science practice to develop CLDs with community stakeholders (with an understanding of systems theory) which can then act as basic logic models for community led action and implementation.

The logic underpinning the approach used in CtD has been published previously and posits that building and sustaining capacity for work informed by CBSD methods increases leadership and organisational engagement with prevention, and collaboration across community organisations, which generates higher quality, more sustainable outcomes within communities [27]. We observed that local stakeholder informed prevention designs allowed for differences between communities and adaption to the local context rather than a predefined program of work. The effectiveness of this locally informed prevention approach and community capacity building has been reported in previous trials e.g., Whole of Systems Trial of Prevention Strategies for Childhood Obesity (WHO STOPS) [26], Romp and Chomp [28], It's Your Move [29], Be Active Eat Well [30].

There is an increased focus using systems thinking at local community level to improve population health. Recent examples include PHE's support for whole of systems change, given to all 408 UK local authorities and potentially impacting 55M people [19]. The UK's

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guidance also calls for action at local communities and emphasises the development of shared models of the complexity within community, using a range of techniques from group model building. Our systems guidance incorporated into the CtD module has arisen from several trials of systems thinking in obesity prevention results, notably trials in schools (e.g., 'It's Your Move 2 [31]) and local communities [32]. These trials began with a heavy investment of researcher support in assisting doing systems science [12] and then moved to building capacity and supporting people within local communities to deliver and evolve systems thinking in situ [32]. These types of systems thinking approaches may also support First Nation rural communities [33].

Our results, and these implications for practice parallel early trials of systems thinking in health. For example, Healthy Together Victoria (HTV), was a large-scale initiative that applied a 'complex whole of systems approach' to the prevention of chronic disease [34]. HTV provides many pointers to future practice and built a workforce of system thinkers from across the state in local government, community health and non-government organisations to implement a range of actions at the community and state level [34-5]. The VLGP builds on one of the key lessons from HTV: the challenge to identify the most effective ways to support communities to deliver a systems approach at a local level [34-36]. This project shows that providing capacity building in systems thinking, can support council staff to access and apply knowledge from Deakin University's >20 years' experience in complex systems thinking and community-based obesity prevention [26,28-30]. We observed that the strong organisational and structural factors such as researcher support and regional advisors who provided continued support allowed the novice council facilitation teams to build confidence while developing their practical know-how for systems thinking in the community setting.

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Building local capacity likely creates positive change within communities. This is shown in outcomes of previous trials like WHO STOPS, which catalysed >300 community members to drive >400 actions ranging from council food policy, soft drink bans and active transport strategies [26]. As a result, WHO STOPS showed initial reductions in overweight and obesity in the first two years of intervention, compared to no change in the control group [26], however, these were not sustained. The longer-term outcomes (four years) demonstrated significant maintenance of health-related quality of life, reduced takeaway, nutrient-poor snack consumption (boys only), and water consumption (girls only) favouring intervention children compared to controls. Highlighting for the first time that long-term behavioural and HRQol improvements are possible using a whole of community systems approach to childhood obesity [26].

The CtD module represents one of the first efforts to build systems thinking capacity amongst local government staff, which provided the opportunity for the trained labour force to become systems thinkers and identified stakeholder informed actions for their communities to enhance the health and wellbeing of children and young people. This was demonstrated by their ability to observe the interconnected determinants of health and wellbeing through the use of CLDs. A well scripted systematic and rigorous approach to using systems science was applied during the CtD workshops and GMB sessions. A well-structured training manual written by our CtD team and based on a similar format to our previous community-based interventions allowed for the training to be standardised across the 13 partner councils.

There is limited evidence about the sustainability of health and wellbeing, community-led change. As noted with the 4-year WHOSTOPS trial which positively impacted children's health, the long term (>2 years) sustainability of community-based action is still understudied [26]. A key limitation is the assessment of the quality and effectiveness of the training

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materials used in the delivery of systems thinking facilitation, teaching of specific skills and knowledge, the training methods and participant's use of the online platform. For example, it is unknown if there were gaps in participants' knowledge as they progressed from workshop training to systems thinking facilitation. The use of STICKE enabled participants to create CLDs online and has been considered to be useful by participants [24]. However, we did not measure the utility of the STICKE software. It is possible that the functionality of the STICKE software requires updating to accommodate upscaling to larger interventions across numerous geographical areas. Pivoting to online learning (following COVID-19 restrictions), for the staff training ensured good participation and appears to be efficient in facilitating GMB rather than in person delivery, although this may differ across the metropolitan, regional, and rural LGAs. However, we did not gather evidence to support this approach,

Future research

The future of chronic disease prevention is pointing to the co-creation of systemic change supporting communities using techniques to address complexity; a move from single behaviour, individual focus to a consideration of wholistic relations of cause and effect across multiple levels of community action [11]. As the Lancet Commission on Obesity shows, this has implications for science, as the approach is less amenable to randomized controlled trials and more suited to implementation and hybrid studies, as it places the control of the effort in the hands of communities, at the agreed expense of intervention fidelity and generalisability [11].

This paper and our broader community behaviour intervention research [26,30-32] raises some questions for future studies: What should the user interface and user experience look like? For example, could gamification, where the use of game thinking in a non-game context to engage users and to solve problems, be included as part of the systems thinking toolkit?

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Could an accreditation system where the recognition of communities that meet the requirements of certain standards be applied? Does this systems approach improve health? Can this approach be transferred to tackle other complex issues beyond obesity prevention? Can prior experience with community-based action on childhood obesity provide communities with the fundamentals to apply systems science thinking to other areas of community concern such as recovery plans from major disasters like bushfire, floods, and COVID-19 and the development of strategies for climate change resilience?

CONCLUSION

This paper has provided an example of establishing the capacity of a government workforce by developing their knowledge and understanding of systems theories tools and practice. An emphasis on the process to create change, but not at the expense of local empowerment and adaptability should be considered when planning the implementation of systems science at the local government level.

Acknowledgments

We wish to acknowledge Victorian Health Promotions Foundation (VicHealth) which funded the VicHealth Local Government Partnership.

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Collaborators None declared

Author Contributions SOH, SA and JH conceptualized the study. SOH conducted the literature search, led the drafting and the revision of the manuscript and prepared the

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manuscript for publication. SA supervised the study and provided overall guidance. JH contributed significantly to the revision of the manuscript with inputs from SA, TF, CN, SK, ER, JP, PF, ADM, CS All authors contributed to subsequent revisions and approved the manuscript prior to submission.

Funding SOH, JH, JP, TF, CN, PF, SK, ER, ADM are supported by VicHealth N/A award/grant number. CS was a researcher within a NHMRC Centre for Research Excellence in Obesity Policy and Food Systems (GNT1114118). SA is a lead investigator receiving funding from VicHealth and Australian National Health and Medical Research Council grant (GNT1133090). The funding bodies were not involved in the design of the study, interpretation of the data or in writing of the manuscript. No other financial disclosures were reported.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval

This study was approved by the Deakin University Human Research Ethics Committee (HEAG-H-121_2022). This study was carried out in accordance with the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research 2018. Informed consent was obtained from participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement. The data are available from the corresponding author upon reasonable request.

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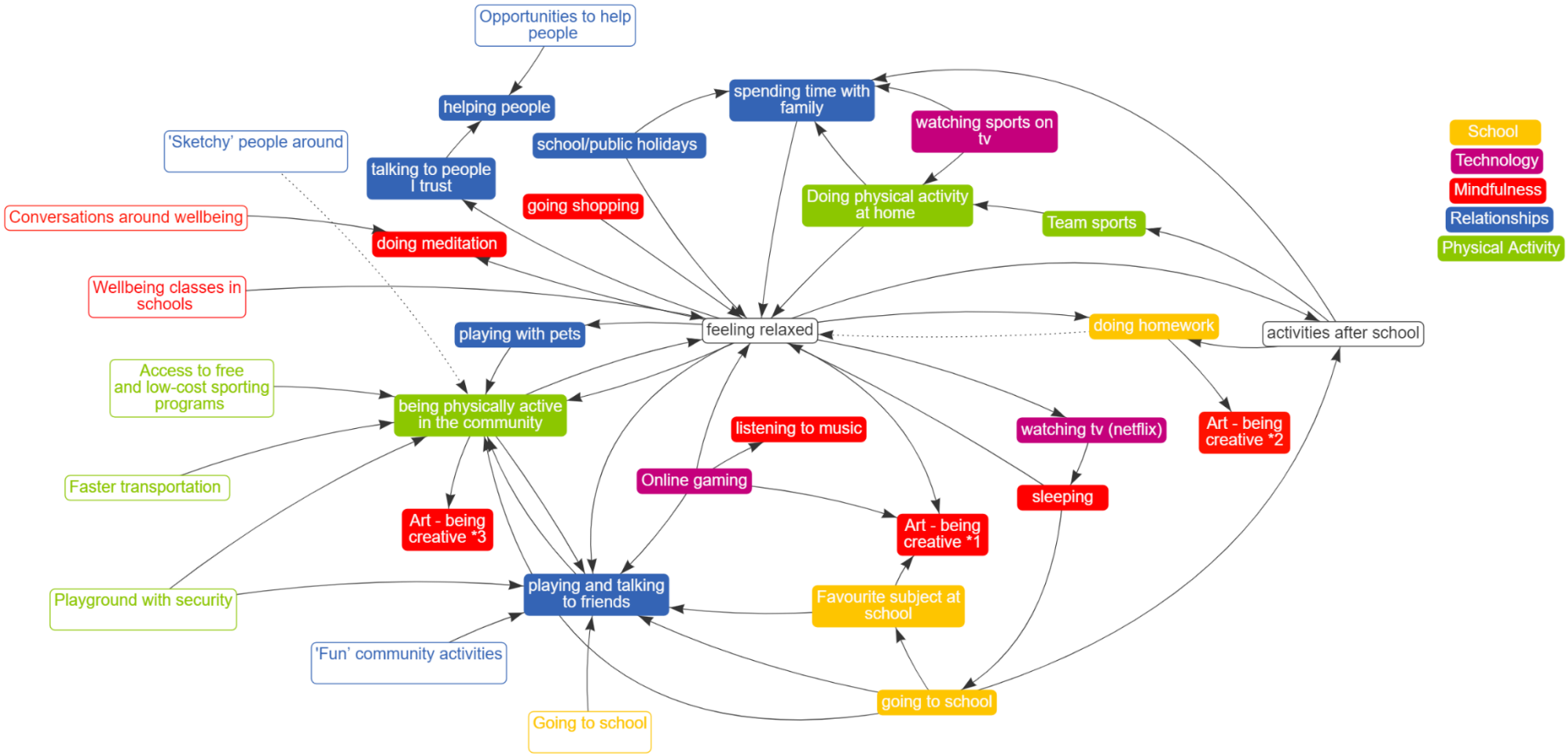
Opportunities to help people
helping people
spending time with family
watching sports on tv
'Sketchy' people around
school/public holidays
talking to people I trust
Doing physical activity at home
going shopping
Conversations around wellbeing
Team sports
doing meditation
Wellbeing classes in schools
feeling relaxed
doing homework
activities after school
playing with pets
Access to free and low-cost sporting programs
being physically active in the community
listening to music
watching tv (netflix)
Art - being creative *2
Faster transportation
Online gaming
sleeping
Art - being creative *3
Art - being creative *1
Playground with security
playing and talking to friends
Favourite subject at school
'Fun' community activities
going to school
Going to school
School
Technology
Mindfulness
Relationships
Physical Activity

The VicHealth Local Government Partnership (VLGP) Connecting the Dots framework.

The Connecting the Dots framework provides the basic building blocks to develop staff capabilities and skills in systems-thinking and engagement with children and young people in planning, policies and programs. It consists of structured training workshops (Block 1) and the delivery of systems thinking approaches (Block 2).

Connecting the Dots foundation module training workshops for council facilitation teams – Block 1

Block 1: Understanding systems thinking approaches: Fundamentals in Systems Thinking & Facilitation

Training sessions on; 1) Basics of systems thinking including the fundamental skills around concepts and language; 2) community-based systems dynamics and GMB workshop facilitation process via participation in facilitated demonstrations and guided facilitation practice.

↓

Connecting the Dots foundation module delivering of systems thinking approaches – Block 2

Block 2: Actioning new systems thinking approaches: workshop preparation & delivery

The preparation seminars covered various topics and focussed closely on supporting council teams as they negotiated the tasks and preparations relative to the stages of the 3 GMB workshop delivery facilitation practice with community stakeholders (outlined

GMB workshop 1: Orientation of participants to VLGP project, local context for work and GMB process to be undertaken. Development of initial systems map.

GMB workshop 2: Refinement of systems map based on revisions since workshop 1 and further conversation and consideration of health and wellbeing determinants**.** Discussion of preliminary insights on potential focal points on systems map for community-led action, and potential additional invitees and recruitment strategies for workshop 3.

GMB workshop 3: Introduction and orientation to systems map for new participants if required. Further discussion of revisions to systems maps since workshop 2. Facilitated discussion and prioritisation of potential community-led actions identified in response to insights from systems map.

↓

During GMB workshops 1-3 council facilitation teams and community stakeholders will together create a CLD of the locally relevant drivers of health and wellbeing of children or young people in their community and determined the highest-priority leverage points for action.

Standards for Reporting Qualitative Research: A Synthesis of Recommendations (SRQR)

Checklist item	**Page number in Manuscript**
Title and abstract	
Title	1
Abstract	2-3
Introduction	
Problem Formulation	4-5
Purpose or research question	5-6
Methods	
Qualitative approach and research paradigm	9
Researcher characteristics and reflexivity	6
Context	6-7
Sampling strategy	7
Ethical issues pertaining to human subjects	12
Data collection methods	9-12
Data collection instruments and technologies	9-12
Units of study	9-12
Data processing	12
Data analysis	12
Techniques to enhance trustworthiness	12
Results/findings	
Synthesis and interpretation	12-13
Links to empirical data	12-13
Discussion	
Integration with prior work, implications, transferability, and contribution(s) to the field	13-17
Limitations	15-16
Other	
Conflicts of interest	18
Funding	18

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Building capacity for the use of systems science to support local government public health planning: a case study of the VicHealth Local Government Partnership in Victoria, Australia

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068190.R2
Article Type:	Original research
Date Submitted by the Author:	12-Dec-2022
Complete List of Authors:	O'Halloran, Siobhan; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Hayward, Joshua; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Strugnell, Claudia; Deakin University - Geelong Waterfront Campus, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Felmingham, Tiana; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Poorter, Jaimie; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Kilpatrick, Stephanie; VicHealth Fraser, Penny; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Needham, Cindy; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development Rhook, Ebony; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development DeMaio, Alessandro; VicHealth Allender, Steven; Deakin University, Global Centre for Preventative Health and Nutrition, Institute for Health Transformation, School of Health and Social Development
Primary Subject Heading:	Public health
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Building capacity for the use of systems science to support local government public health planning: a case study of the VicHealth Local Government Partnership in Victoria, Australia

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Keywords: Systems dynamics, Systems thinking, Community based systems dynamics, Obesity prevention, Public Health, Group Model Building, Children, Communities, Capacity Building

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ABSTRACT

Objective: To present an approach to build capacity for the use of systems science to support local communities in municipal public health and wellbeing planning.

Design: Case study.

Setting: Local government authorities participating in the VicHealth Local Government Partnership in Victoria, Australia.

Participants: Local government staff members were trained in community-based system dynamics (CBSD), and group model building (GMB) techniques to mobilise local community efforts. The trained local government facilitation teams then delivered GMB workshops to community stakeholder groups from 13 local government areas (LGA)s.

Main Outcomes: Training in CBSD was conducted with council facilitation teams in 13 LGAs, followed by the local delivery of GMB workshops 1-3 to community stakeholders. Causal loop diagrams (CLD) representing localised drivers of mental wellbeing, healthy eating, active living or general health and wellbeing of children and young people were developed by community stakeholders. Locally tailored action ideas were generated such as wellbeing classes in school, faster active transport and access to free and low-cost sporting programmes

Results: Overall, 111 local government staff participated in CBSD training. Thirteen CLDs were developed, with the stakeholders that included children, young people and community members, who had participated in the GMB workshops across all 13 council sites. Workshop 3 had the highest total number of participants (n=301), followed by workshop 1 (n=287) and workshop 2 (n=171).

Conclusions: Local facilitation of the CBSD process has developed community informed and locally relevant CLDs that will be used to lead local action to improve the wellbeing of children and young people. Training employees in CBSD is one approach to increase systems thinking capacity within local government.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

- We trained a labour force to become systems thinkers to develop community stakeholder informed actions to improve the health and wellbeing of children and young people.
- We used a systems mapping software program that enabled participants to develop Causal Loop Diagrams (CLDs) online and to observe the interconnected determinants of health and wellbeing.
- It is unknown if there were gaps in council facilitation teams' knowledge as they progressed from workshop training to systems thinking facilitation.
- The utility of the systems mapping software used to develop CLDs was not measured.

INTRODUCTION

Obesity is a worldwide health priority [1]. Obesity prevalence has continued to increase over recent decades and is conservatively estimated to cost $2 trillion per year or 2.8% of global GDP [2]. In Australia 25% of children (aged 5-17 years of age) are overweight or obese [3] and are at greater risk of lower self-rated health-related quality of life (HRQol), depression [4-6], and experience comorbidities such as type 2 diabetes and hypertension [7]. Obesity prevention among children is critical as obesity strongly tracks into adulthood, highlighting the need for early intervention [8].

A key challenge for chronic disease prevention is to address the complex relationships between the societal causes of preventable disease [9]. Historically, prevention efforts have centred on small groups of actors in single sectors targeting individualistic behavioural outcomes with limited success [9]. Implementation at scale has been further challenged by the need for adaption across settings, without which intervention effects are reduced by inflexibility to heterogeneity in community resources, readiness and environments, amongst other potential reasons [10-11].

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Whole-of-community approaches [12] to prevention are more likely to succeed and be sustained where systems-based methods support understanding the community, environmental, social and economic drivers of disease, and by focusing on capacity-building within communities to address this challenge [13-14]–. Methods from system science, like Group Model Building (GMB) and causal loop diagramming, provide means to understand the complex drivers of preventable disease by describing non-linear relationships of cause and effect, feedback loops and adaption [14-15]. Several examples of whole-of-community systems-based prevention trials (e.g., communities randomised to intervention or control [12]) exist in the literature at a multi-community scale 16-18]. Scaling and embedding these methods at the local government level, to support regulatory intervention and build capacity to support government health planning remains an important next step [18]. Local government is a particularly desirable setting for systems-based approaches due to council's regulatory remit over a range of environmental and policy levers, and the potential for regulatory interventions to create sustainable, equitable changes, and to ameliorate the impacts of harmful system drivers (e.g., the built environment, marketing) [13,18].

Development of frameworks to embed these methods within local government are emerging internationally, examples include Public Health England's (PHE) local government whole systems approach to address obesity [19]. Several councils and boroughs across England have utilised the programme to operationalise local-led approaches to obesity by engaging with their local stakeholders to implement systems change across the community [19]. In 2019, PHE launched the *Whole Systems Approach to Obesity: a guide to support local approaches to promoting a healthy weight programme for local governments across England* which includes systems mapping of obesity drivers with community stakeholders as a central tool [19].

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In 2020, VicHealth initiated the 'VicHealth Local Government Partnership - Young people leading healthier communities' (VLGP). The partnership aims to create community environments where children and young people aged 0-25 years could become physically active, socially connected, and mentally healthy [20]. VLGP currently includes 13 metropolitan, regional and rural Victorian Local Governments, using systems thinking methods to direct, and guide municipal chronic disease prevention in young people [20].

This paper describes the design of a framework to embed systems thinking as a guiding principle for the delivery of municipal prevention of chronic disease in children and young people. The specific approach to systems dynamics is outlined, alongside the processes used to initially build councils' capacity, and ongoing support mechanisms to guide continued use of the systems thinking methods. Some results reflecting early outcomes from the local communities are provided.

METHODS

Study design and data collection

Study context

The state of Victoria, south-eastern Australia, has a population of ~6.7 million people and is comprised of 79 Local Government Areas (LGA)[21]. Individual LGAs vary broadly across various measures including geographical size, population density, rurality and cultural and linguistic diversity [21]. Overall, 28% of Victorians were born overseas and 26% speak a language other than English [21].

VicHealth Local Government Partnership overview and modules

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The VLGP represents a partnership approach to building capacity for evidence-based prevention at the local government level. Councils were invited to apply to join the VLGP through a competitive process, initially open to the 39 Victorian councils with an Index of Relative Social Disadvantage (IRSD) of 1-5 and with health and wellbeing needs, between the lower and higher IRSD LGAs [22]. The 21 submitted applications then underwent a scoring process, followed by an assessment panel discussion. Of the 21 council applications, 16 were selected to take part in the partnership, with three in a modified partnership arrangement, which allowed one of the VLGP foundation modules to be omitted from their programme.

The VLGP provides support to the 13 partner councils to develop and deliver evidence-based action to improve children and young people's health and wellbeing through the mechanism of councils' Municipal Public Health and Wellbeing Plans (MPHWP) [20]. In Victoria, the State Government mandates that councils develop 4-year MPHWP, that guide strategic direction and priorities for municipal health promotion relative to a locally tailored set of priorities, taken from identified state-level drivers of poor health and health inequity [23].

The key outcomes of VLGP are to foster improvements in the capacity of councils to deliver evidence-based action in the implementation of their MPHWP, the promotion of the voices of children and young people into local government policy decisions and action, and improved rates of healthy eating, physical activity and social connectedness amongst young people aged 0-25 by the end of 2025 [20].

Eight evidenced-informed health promotion modules were developed to serve as a series of practical, 'how-to guides' for policy, program development/delivery and practice change. These guides were devised to support councils to implement action at the local level to create healthier communities for children and young people [20]. The eight modules were designed

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to consolidate the practice knowledge, experience and research developed from the close collaboration between VicHealth, local governments and expert partners. Each module included several impact streams, each of which included a number of evidence-informed implementation actions or key policy, program and practice changes relative to the theme of the module. The modules were divided into three categories: Foundation, Core and Stretch (Table 1) [20].

Table 1. The VicHealth Local Government Partnership (VLGP) modules and impact streams [20]

	Modules and impact streams
Foundation modules Compulsory modules that provided the basic building blocks to develop staff capabilities and skills in systems-thinking and engagement with children and young people in planning, policies and programs	**Connecting the Dots - creating solutions for lasting change** Big picture thinking for better solutions **Leading the Way - engaging young voices for change** Including children and young people in policy creation; Including children and young people in planning
Core modules Evidence based activities, designed to address childhood obesity	**Building active communities** Increasing active travel to and from school; Increasing walking and bike riding in council strategies; Creating opportunities for all Victorians to be active; Including gender equity in council sport and recreation policy; Empowering and enabling women to get active through local promotion of 'This Girl Can-Victoria' **Creating connected and supportive communities** Co-designing with young people for better community wellbeing; Building proud and inclusive communities; Addressing social determinants of mental wellbeing **Building better food systems for healthier communities** Creating thriving local food systems; Embedding healthy food and drink options in council owned and operated places; Using healthy rewards and sponsorships in community activities Enabling healthy partnerships

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Stretch modules Optional modules that built on essential health policy priorities to promote healthy environments for children and young people	**Increasing alcohol harm prevention at a local level** Adopting alcohol harm prevention actions to protect children and young people **Strengthening tobacco control at a local level** Adopting tobacco control actions to protect children and young people **Promoting everyday creativity at a local level** Increasing equity in creative strategies; Embracing opportunities for children to inform creative programs; Improving opportunities for young people to lead creative programs

Connecting the Dots [20]

The Connecting the Dots (CtD) foundation module contained one impact stream with two required implementation actions which consisted of structured training workshops (Block1) and the delivery of systems thinking approaches (Block 2) (Table 2).

Table 2. VicHealth Local Government Partnership (VLGP) Connecting the Dots foundation module [20]

Connecting the Dots – creating solutions for lasting change		
Impact stream	**Implementation action**	**Formal training & support**
Big picture thinking for better solutions	Understanding systems thinking approaches	Block 1 – Fundamentals in systems thinking & facilitation
	Actioning new systems thinking approaches	Block 2 – Workshop preparation & delivery support

Understanding systems thinking approaches: fundamentals in systems thinking & facilitation

This stream consisted of a series of training sessions (Block 1) designed to quickly upskill (~10hrs pivoted to online learning in some cases due to COVID-19, work from home and

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travel restrictions) council core facilitation teams on; 1) the basics of systems thinking including the fundamental skills around concepts and language; 2) community-based systems dynamics (CBSD) and GMB workshop facilitation process via participation in facilitated demonstrations and guided facilitation practice [20].

Initial plans for local delivery of the workshop process, including context/framing, facilitation team membership, key participant groups, and engagement/workshop timelines were also covered. The use of the Systems Thinking in Community Knowledge Exchange (STICKE) systems mapping software program (STICKE Version 3 © Deakin University) was used throughout the training as it allows council and community members to build causal loop diagrams (CLDs) using a supported online process [24]

Regional advisors and a central coordination team comprising academic and practitioner experts in systems thinking methodologies from Deakin University and local government representatives comprised the CtD team. The regional advisors worked closely with their nominated councils (2-3 councils each) to deliver training and provide continued implementation support and guidance. Partner councils established core facilitation teams to lead and deliver the actioning of new systems thinking approaches. Each team consisted of a VicHealth funded project officer based at the local councils and other council employees overseeing the MPHWP. Additional staff involved in child/youth health and community engagement and non-council staff were also nominated for training. Approximately, 2-10 persons undertook the training sessions within each council. The Fundamentals in Systems Thinking & Facilitation impact stream was completed in full before councils began delivering participatory GMB workshops with the community.

Actioning new systems thinking approaches: workshop preparation & delivery

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This impact stream included a series of online seminars (~10 hrs) designed to support council teams scheduled alongside the delivery of community based GMB workshops (Block 2). The preparation seminars covered various topics and focused closely on supporting council teams as they negotiated the tasks and preparations relative to the stages of GMB workshop delivery [20].

Council core facilitation teams delivered at least three participatory GMB workshops of ~1-3 hours to groups of community stakeholders from each of the 13 partner LGAs (Table 3). Stakeholders included young people, children, community leaders, and diverse community members drawn from across all sectors including local government, non-government organisations, small business, commercial sector, education, community organisations and healthcare providers. Stakeholders were recruited by partner councils through existing networks, emails, expressions of interest, and advertisements.

Table 3. Summary of the Victorian Local Government Partnership (VLGP) Group Model Building (GMB) workshop process

GMB workshop	Duration (minutes)	Participant capacity	Objectives
1	120	5-25 participants	Orientation of participants to VLGP project, local context for work and GMB process to be undertaken. Development of initial systems map.

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2	120	5-25 participants	Refinement of systems map based on revisions since workshop 1 and further conversation and consideration of health and wellbeing determinants. Optionally: Discussion of preliminary insights on potential focal points on systems map for community-led action, and potential additional invitees and recruitment strategies for workshop 3.
3	180	5-25 participants (with option to extend up to 100 participants)	Introduction and orientation to systems map for new participants if required. Further discussion of if required. Further discussion of workshop 2. Facilitated discussion and prioritisation of potential community-led actions identified in response to insights from systems map.

Together, council core facilitation teams and workshop participants created a CLD of the locally relevant drivers of health and wellbeing of children or young people in their community and determined the highest-priority leverage points for action. The method used to generate the systems map in the form of a CLD was the GMB technique, which is a structured collaborative CBSD methodology, designed to guide participants through developing hypotheses about the connections between various contributing factors in complex problems [14]. A set of scripts used in the GMB workshops (graphs over time, connection circles, and action ideas) were used to guide workshop content and help stakeholders develop CLDs [25] The CLDs highlighted drivers of childhood health and the complex, non-linear relationships between those drivers. The structured workshop process resulted in a CLD which represented a view on the systems components, relationships and

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boundaries (Figure 1) [14]. (see online supplemental file 1for a summary of Connecting the Dots framework).

Following the completion of the participatory systems mapping and community engagement process, council facilitation teams were supported by the CtD team to use the CLD developed by the group to guide the identification and prioritisation of stakeholder informed actions ideas that can be applied in the community to support children and young people health during 2022 - 2025. These will be driven by their own CLD and informed by evidence including case studies from previous successful interventions [26]. Community actions will be recorded throughout the duration of the project, including tracking against the systems map in STICKE. Forthcoming publications will examine the implications of local community contexts and priorities on the precise adaptations to process undertaken by individual councils.

Patient and public involvement

None.

RESULTS

All 13 partner councils had participated in the initial systems training, with 111 total staff (>18 year of age) attending the training across all councils. Individual facilitation teams based at the councils included a funded project officer and between three and 12 additional staff including council employees involved in child/youth health and community engagement, and staff from external community organisations collaborating with councils, such as sports facilities or health services. All 13 partner councils delivered GMB workshops 1-3 face-to-face and online (due to COVID-19, and travel restrictions). In some instances, workshops were combined e.g., workshop 1 combined with workshop 2 and delivered together as one

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session (due to time constraints and capacity of council staff). The workshop participants included either young people or stakeholders with the exception of workshop 3, which included young people and stakeholders together (conducted by three councils) (Table 4).

Table 4. Total number of participants who attended the Group Model Building workshops from the 13 partner local government authorities

	Workshop 1	Workshop 2	Workshop 3	Combined workshop 1 & 2	Combined workshop 2 & 3
Participants (n)					
Young people	174	99	128	52	9
Stakeholders	113	72	90	7	20
Combination of both young people and stakeholders	–	–	83	–	–
Total participants	287	171	301	59	29

All councils successfully created CLDs , with community stakeholders including: children and young people, the local prevention workforce, service providers, policy and decision makers, and grass-roots community members from sectors including local government, non-government organisations, small business, education, community organisations and healthcare providers. The diagrams resulting from the workshop process were similar in range and scope to other prevention efforts which have used these methods across multiple community sites in Victoria [26]. For example, each council's diagram included the typical elements of a CLD: variables (determined by stakeholders as influencing the health and wellbeing of children and young people in the community e.g., junk food), the connections between the variables, actions (e.g., banning sugary drinks from sporting clubs) and overarching themes. An example of a council CLD with five themes (e.g., relationships, physical activity) and nine action ideas (e.g., wellbeing classes in school, faster

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transportation, access to free and low-cost sporting programmes) identified by stakeholders is shown in Figure 1.

DISCUSSION

This paper describes the capacity building of local councils to use systems thinking and participatory methods within local governments to inform the implementation of MPHWP. The council facilitation teams demonstrated complex systems science practice to develop CLDs with community stakeholders (with an understanding of systems theory) which can then act as basic logic models for community led action and implementation.

The logic underpinning the approach used in CtD has been published previously and posits that building and sustaining capacity for work informed by CBSD methods increases leadership and organisational engagement with prevention, and collaboration across community organisations, which generates higher quality, more sustainable outcomes within communities [27]. We observed that local stakeholder informed prevention designs allowed for differences between communities and adaption to the local context rather than a predefined program of work. The effectiveness of this locally informed prevention approach and community capacity building has been reported in previous trials e.g., Whole of Systems Trial of Prevention Strategies for Childhood Obesity (WHO STOPS) [26], Romp and Chomp [28], It's Your Move [29], Be Active Eat Well [30].

There is an increased focus using systems thinking at local community level to improve population health. Recent examples include PHE's support for whole of systems change, given to all 408 UK local authorities and potentially impacting 55M people [19]. The UK's guidance also calls for action at local communities and emphasises the development of shared models of the complexity within community, using a range of techniques from GMB. . Our systems guidance incorporated into the CtD module has arisen from several trials of systems

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thinking in obesity prevention results, notably trials in schools (e.g., 'It's Your Move 2 [31]) and local communities [32]. These trials began with a heavy investment of researcher support in assisting doing systems science [12] and then moved to building capacity and supporting people within local communities to deliver and evolve systems thinking in situ [32]. These types of systems thinking approaches may also support First Nation rural communities [33].

Our results, and these implications for practice, parallel early trials of systems thinking in health. For example, Healthy Together Victoria (HTV), was a large-scale initiative that applied a 'complex whole of systems approach' to the prevention of chronic disease [34]. HTV provides many pointers to future practice and built a workforce of system thinkers from across the state in local government, community health and non-government organisations to implement a range of actions at the community and state level [34-5]. The VLGP builds on one of the key lessons from HTV: the challenge to identify the most effective ways to support communities to deliver a systems approach at a local level [34-36]. This project shows that providing capacity building in systems thinking, can support council staff to access and apply knowledge from Deakin University's >20 years' experience in complex systems thinking and community-based obesity prevention [26,28-30]. We observed that the strong organisational and structural factors such as researcher support and regional advisors who provided continued support allowed the novice council facilitation teams to build confidence while developing their practical know-how for systems thinking in the community setting.

Building local capacity likely creates positive change within communities. This is shown in outcomes of previous trials like WHO STOPS, which catalysed >300 community members to drive >400 actions ranging from council food policy, soft drink bans and active transport strategies [26]. As a result, WHO STOPS showed initial reductions in overweight and obesity in the first two years of intervention, compared to no change in the control group [26],

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however, these were not sustained. The longer-term outcomes (four years) demonstrated significant maintenance of health-related quality of life, reduced takeaway, nutrient-poor snack consumption (boys only), and water consumption (girls only) favouring intervention children compared to controls. Highlighting for the first time that long-term behavioural and HRQol improvements are possible using a whole of community systems approach to childhood obesity [26].

The CtD module represents one of the first efforts to build systems thinking capacity amongst local government staff, which provided the opportunity for the trained labour force to become systems thinkers and identified stakeholder informed actions for their communities to enhance the health and wellbeing of children and young people. This was demonstrated by their ability to observe the interconnected determinants of health and wellbeing through the use of CLDs. A well scripted systematic and rigorous approach to using systems science was applied during the CtD workshops and GMB sessions. A well-structured training manual written by our CtD team and based on a similar format to our previous community-based interventions allowed for the training to be standardised across the 13 partner councils.

There is limited evidence about the sustainability of health and wellbeing, community-led change. As noted with the 4-year WHOSTOPS trial which positively impacted children's health, the long term (>2 years) sustainability of community-based action is still understudied [26]. A key limitation is the assessment of the quality and effectiveness of the training materials used in the delivery of systems thinking facilitation, teaching of specific skills and knowledge, the training methods and participant's use of the online platform. For example, it is unknown if there were gaps in participants' knowledge as they progressed from workshop training to systems thinking facilitation. The use of STICKE enabled participants to create CLDs online and has been considered to be useful by participants [24]. However, we did not

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measure the utility of the STICKE software. It is possible that the functionality of the STICKE software requires updating to accommodate upscaling to larger interventions across numerous geographical areas. Pivoting to online learning (following COVID-19 restrictions), for the staff training ensured good participation and appears to be efficient in facilitating GMB rather than in person delivery, although this may differ across the metropolitan, regional, and rural LGAs. However, we did not gather evidence to support this approach,

Future research

The future of chronic disease prevention is pointing to the co-creation of systemic change supporting communities using techniques to address complexity; a move from single behaviour, individual focus to a consideration of wholistic relations of cause and effect across multiple levels of community action [11]. As the Lancet Commission on Obesity shows, this has implications for science, as the approach is less amenable to randomized controlled trials and more suited to implementation and hybrid studies, as it places the control of the effort in the hands of communities, at the agreed expense of intervention fidelity and generalisability [11].

This paper and our broader community behaviour intervention research [26,30-32] raises some questions for future studies: What should the user interface and user experience look like? For example, could gamification, where the use of game thinking in a non-game context to engage users and to solve problems, be included as part of the systems thinking toolkit? Could an accreditation system where the recognition of communities that meet the requirements of certain standards be applied? Does this systems approach improve health? Can this approach be transferred to tackle other complex issues beyond obesity prevention? Can prior experience with community-based action on childhood obesity provide communities with the fundamentals to apply systems science thinking to other areas of

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community concern such as recovery plans from major disasters like bushfire, floods, and COVID-19 and the development of strategies for climate change resilience?

CONCLUSION

This paper has provided an example of establishing the capacity of a government workforce by developing their knowledge and understanding of systems theories tools and practice. An emphasis on the process to create change, but not at the expense of local empowerment and adaptability should be considered when planning the implementation of systems science at the local government level.

*** ***

Acknowledgements

We wish to acknowledge Victorian Health Promotions Foundation (VicHealth), which funded the VicHealth Local Government Partnership.

Contributors

SOH, SA and JH conceptualized the study. SOH conducted the literature search, led the drafting and the revision of the manuscript and prepared the manuscript for publication. SA supervised the study and provided overall guidance. JH contributed significantly to the revision of the manuscript with inputs from SA, TF, CN, SK, ER, JP, PF, ADM, CS All authors contributed to subsequent revisions and approved the manuscript prior to submission.

Funding

SOH, JH, JP, TF, CN, PF, SK, ER, ADM are supported by VicHealth N/A award/grant number. CS was a researcher within a NHMRC Centre for Research Excellence in Obesity Policy and Food Systems (GNT1114118). SA is a lead investigator receiving funding from VicHealth and Australian National Health and Medical Research Council grant

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(GNT1133090). The funding bodies were not involved in the design of the study, interpretation of the data or in writing of the manuscript. No other financial disclosures were reported.

Competing interests

None declared.

Patient consent for publication

Not applicable.

Ethics approval

This study was approved by the Deakin University Human Research Ethics Committee (HEAG-H-121_2022). This study was carried out in accordance with the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research 2018. Informed consent was obtained from participants.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data availability statement. The data from the study are available from the corresponding author upon reasonable request.

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Figure. 1 An example of a casual loop diagram showing the variables, themes and the actions ideas generated by stakeholders from one of the VicHealth Local Government Partnership (VLGP) councils

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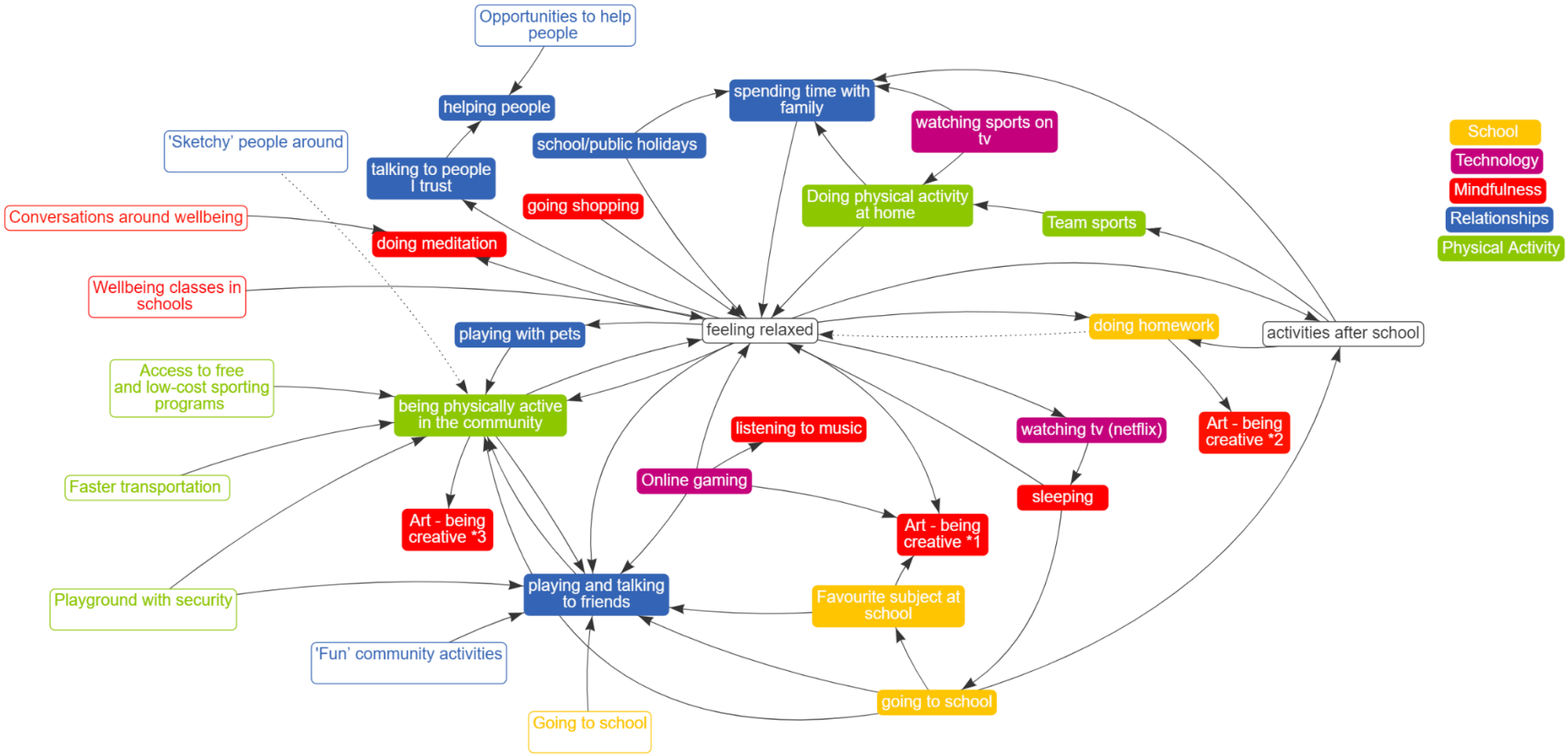
Opportunities to help people
helping people
spending time with family
watching sports on tv
'Sketchy' people around
school/public holidays
talking to people I trust
Doing physical activity at home
going shopping
Conversations around wellbeing
Team sports
doing meditation
Wellbeing classes in schools
feeling relaxed
doing homework
activities after school
playing with pets
Access to free and low-cost sporting programs
being physically active in the community
listening to music
watching tv (netflix)
Art - being creative *2
Faster transportation
Online gaming
sleeping
Art - being creative *3
Art - being creative *1
Playground with security
playing and talking to friends
Favourite subject at school
'Fun' community activities
going to school
Going to school
School
Technology
Mindfulness
Relationships
Physical Activity

The VicHealth Local Government Partnership (VLGP) Connecting the Dots framework.

The Connecting the Dots framework provides the basic building blocks to develop staff capabilities and skills in systems-thinking and engagement with children and young people in planning, policies and programs. It consists of structured training workshops (Block 1) and the delivery of systems thinking approaches (Block 2).

Connecting the Dots foundation module training workshops for council facilitation teams – Block 1

Block 1: Understanding systems thinking approaches: Fundamentals in Systems Thinking & Facilitation

Training sessions on; 1) Basics of systems thinking including the fundamental skills around concepts and language; 2) community-based systems dynamics and GMB workshop facilitation process via participation in facilitated demonstrations and guided facilitation practice.

↓

Connecting the Dots foundation module delivering of systems thinking approaches – Block 2

Block 2: Actioning new systems thinking approaches: workshop preparation & delivery

The preparation seminars covered various topics and focussed closely on supporting council teams as they negotiated the tasks and preparations relative to the stages of the 3 GMB workshop delivery facilitation practice with community stakeholders (outlined

GMB workshop 1: Orientation of participants to VLGP project, local context for work and GMB process to be undertaken. Development of initial systems map.

GMB workshop 2: Refinement of systems map based on revisions since workshop 1 and further conversation and consideration of health and wellbeing determinants**.** Discussion of preliminary insights on potential focal points on systems map for community-led action, and potential additional invitees and recruitment strategies for workshop 3.

GMB workshop 3: Introduction and orientation to systems map for new participants if required. Further discussion of revisions to systems maps since workshop 2. Facilitated discussion and prioritisation of potential community-led actions identified in response to insights from systems map.

↓

During GMB workshops 1-3 council facilitation teams and community stakeholders will together create a CLD of the locally relevant drivers of health and wellbeing of children or young people in their community and determined the highest-priority leverage points for action.

Standards for Reporting Qualitative Research: A Synthesis of Recommendations (SRQR)

Checklist item	**Page number in Manuscript**
Title and abstract	
Title	1
Abstract	2-3
Introduction	
Problem Formulation	4-5
Purpose or research question	5-6
Methods	
Qualitative approach and research paradigm	9
Researcher characteristics and reflexivity	6
Context	6-7
Sampling strategy	7
Ethical issues pertaining to human subjects	12
Data collection methods	9-12
Data collection instruments and technologies	9-12
Units of study	9-12
Data processing	12
Data analysis	12
Techniques to enhance trustworthiness	12
Results/findings	
Synthesis and interpretation	12-13
Links to empirical data	12-13
Discussion	
Integration with prior work, implications, transferability, and contribution(s) to the field	13-17
Limitations	15-16
Other	
Conflicts of interest	18
Funding	18

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