

BMJ Open Applying systems thinking to identify enablers and challenges to scale-up interventions for hypertension and diabetes in low-income and middle-income countries: protocol for a longitudinal mixed-methods study

Anusha Ramani-Chander ¹, Rohina Joshi ^{2,3}, Josefien van Olmen,⁴ Edwin Wouters ⁵, Peter Delobelle ^{6,7}, Rajesh Vedanthan ⁸, J Jaime Miranda ^{9,10}, Brian Oldenburg,¹¹ Stephen Sherwood,¹² Lal B Rawal,¹³ Robert James Mash ¹⁴, Vilma Edith Irazola,¹⁵ Monika Martens,^{16,17} Maria Lazo-Porras,⁹ Hueiming Liu ¹⁰, Gina Agarwal,¹⁸ Gade Waqa,¹⁹ Milena Soriano Marcolino ²⁰, Maria Eugenia Esandi,²¹ Antonio Luiz Pinho Ribeiro ^{22,23}, Ari Probandari ²⁴, Francisco González-Salazar,²⁵ Abha Shrestha ^{26,27}, Sujarwoto Sujarwoto ²⁸, Naomi Levitt,²⁹ Myriam Paredes,³⁰ Tomohiko Sugishita,³¹ Malek Batal,^{32,33} Yuan Li,^{34,35} Hassan Haghparast-Bidgoli ³⁶, Violet Naanyu,³⁷ Feng J He,³⁸ Puhong Zhang,^{35,39} Sayoki Godfrey Mfinanga ^{40,41}, Jan-Walter De Neve ⁴², Meena Daivadanam,^{43,44} Kamran Siddiqi ⁴⁵, Pascal Geldsetzer,^{46,47} Kerstin Klipstein-Grobusch ^{48,49}, Mark D Huffman,^{10,50} Jacqui Webster,¹⁰ Dike Ojji,⁵¹ Andrea Beratarrechea,⁵² Maoyi Tian,^{10,53} Maarten Postma,⁵⁴ Mayowa O Owolabi ⁵⁵, Josephine Birungi,^{56,57} Laura Antonietti,⁵⁸ Zulma Ortiz,²¹ Anushka Patel,¹⁰ David Peiris ¹⁰, Darcelle Schouw,¹⁴ Jaap Koot,⁵⁴ Keiko Nakamura,⁵⁹ Gindo Tampubolon,⁶⁰ Amanda G Thrift ¹, on behalf of the Global Alliance for Chronic Diseases Upscaling Working Group Collaborators.

To cite: Ramani-Chander A, Joshi R, van Olmen J, *et al*. Applying systems thinking to identify enablers and challenges to scale-up interventions for hypertension and diabetes in low-income and middle-income countries: protocol for a longitudinal mixed-methods study. *BMJ Open* 2022;12:e053122. doi:10.1136/bmjopen-2021-053122

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-053122>).

Received 06 May 2021
Accepted 04 February 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Professor Amanda G Thrift;
amanda.thrift@monash.edu

ABSTRACT

Introduction There is an urgent need to reduce the burden of non-communicable diseases (NCDs), particularly in low-and middle-income countries, where the greatest burden lies. Yet, there is little research concerning the specific issues involved in scaling up NCD interventions targeting low-resource settings. We propose to examine this gap in up to 27 collaborative projects, which were funded by the Global Alliance for Chronic Diseases (GACD) 2019 Scale Up Call, reflecting a total funding investment of approximately US\$50 million. These projects represent diverse countries, contexts and adopt varied approaches and study designs to scale-up complex, evidence-based interventions to improve hypertension and diabetes outcomes. A systematic inquiry of these projects will provide necessary scientific insights into the enablers and challenges in the scale up of complex NCD interventions. **Methods and analysis** We will apply systems thinking (a holistic approach to analyse the inter-relationship between constituent parts of scaleup interventions and the context in which the interventions are implemented) and adopt a longitudinal mixed-methods study design to explore

Strengths and limitations of this study

- The Global Alliance for Chronic Disease 2019 Scale-up Call provides a unique opportunity to systematically study up to 27 funded scale-up projects in non-communicable diseases being rolled out in low and middle-income countries and other low-resource settings.
- The study team is independent of the scale-up project teams and this will help minimise any conflict of interest that may potentially exist.
- Feedback about the common challenge due to COVID-19 pandemic may overshadow any other challenges that may have existed in scale-up implementation.

the planning and early implementation phases of scale up projects. Data will be gathered at three time periods, namely, at planning (T_p), initiation of implementation (T_0) and 1-year postinitiation (T_1). We will extract project-related data from secondary documents at T_p and conduct

multistakeholder qualitative interviews to gather data at T_0 and T_1 . We will undertake descriptive statistical analysis of T_p data and analyse T_0 and T_1 data using inductive thematic coding. The data extraction tool and interview guides were developed based on a literature review of scale-up frameworks.

Ethics and dissemination The current protocol was approved by the Monash University Human Research Ethics Committee (HREC number 23482). Informed consent will be obtained from all participants. The study findings will be disseminated through peer-reviewed publications and more broadly through the GACD network.

INTRODUCTION

Non-communicable disease (NCD)-related mortality and morbidity are increasing worldwide. In 2016, an estimated 41 million people died from NCDs globally, accounting for about 71% of global deaths. NCDs are also the leading cause of premature death worldwide, and by far, the greatest proportion of these premature deaths (85%) occurs in low and middle-income countries (LMICs).^{1 2} The recent Global Burden of Disease report highlights the increasing burden due to disability from NCDs.³ In 2019, diabetes is now included as a leading cause of global disability-adjusted life years (DALYs), while 6 of the top 10 leading causes of DALYs are now due to NCDs.³ This is a dramatic increase from 1990 when only 3 of the top 10 causes of DALYs were attributable to NCDs. This trend is likely to continue given that the population is ageing, and NCDs occur more commonly with advancing age.

The United Nation's Sustainable Development Goals (SDGs), drawn up in 2015, highlighted this growing global burden due to NCDs and specifically set a target to reduce by one-third premature deaths from NCDs by 2030.^{4 5} In 2011, global leaders met at the first UN High-Level Meeting and acknowledged the global threat due to NCDs.^{6 7} In the third UN High-Level Meeting on NCDs in 2018, this need was reiterated, but it was also recognised that several LMICs faced system-level challenges to achieve their NCD goals such as poor system capacity, weak primary healthcare, limited health infrastructure and investments, resource constraints not limited to financial and also health workforce related, and medical supply-related issues.^{2 8-10} Despite this heightened recognition, public health experts and policymakers continue to grapple with these constraints and challenges, which necessitate country-specific strategies to accelerate the reach of evidence-based interventions (EBIs) targeting prevention, treatment and management of NCDs, particularly in low-resource settings.⁹⁻¹¹

Identification of the issues, challenges and enablers in the implementation of EBIs for prevention and treatment of NCDs, particularly in LMICs, is crucial for enhancing scale-up efforts, and supporting countries to achieve their SDG targets for controlling NCDs.¹²⁻¹⁴

RESEARCH GAP

World Health Organization (WHO) defines a health system as—'consists of organisations, people and actions

whose primary intent is to promote, restore or maintain health'.¹⁵ These large systems involve subsystems of interactive elements also referred to as 'building blocks', which include service delivery, infrastructure, workforce, information, medical supplies and finance.^{15 16} The interactions and relationships between these system elements and actors—the people who represent each of these elements as stakeholders—form a continuously evolving and dynamic system. These health system components alongside contextual factors such as socioeconomic, political and institutional contexts form a complex environment for scale up. This complex web of interactions can impact all stages of planning, implementation, integration, scale up and sustainability of NCD interventions but have not been adequately researched.^{13 16-21} While there is some literature available on small-scale trials of successful implementation of interventions for NCD prevention, information about the challenges in the large-scale implementation of such interventions and the interacting with the health system dynamics is scarce, especially across different contexts.^{14 22 23}

A system wide understanding of the issues involved in NCD scale-up efforts and the context in which the programmes are being implemented is timely and necessary in order to make a significant improvement in prevention and treatment efforts globally. We define systems thinking as 'a holistic approach to analyse the interrelationship between constituent parts of scale-up interventions and the context in which the interventions are implemented'.^{16-18 21 24} Systems thinking will allow us to explore interconnectedness (context and connections), perspectives and boundaries (scope and scale) of interventions.¹⁸ It will increase our knowledge of the components, actors and stakeholders involved, the role of contextual factors, processes, challenges, enablers and pathways, and on how dynamics and relationships between the different elements evolve as a response to the scale up of interventions.^{16 17} Such information will assist researchers, programme implementers, policymakers and other stakeholders to plan, design, guide, implement and evaluate the scale up of NCD interventions more efficiently and effectively.^{12 17}

Study context: GACD 2019 scale-up call

The Global Alliance for Chronic Diseases (GACD) is an alliance of health research funders, which co-ordinates and supports implementation research activities that address the prevention and treatment of the major NCDs, such as hypertension, diabetes, cardiovascular disease, lung disease, mental health and cancer. The GACD aims to tackle this increasing burden of NCDs by investing in projects that involve collaborations and partnerships across countries and using these projects to build scientific knowledge in the area of implementation science and research.

In 2019, the GACD released its fifth joint call inviting proposals from projects that were 'Scaling-up projects in prevention and control of Hypertension and Diabetes'.

This is the first time that global funding has been made available for scale up of NCD-related interventions, especially in LMICs. This call has resulted in funding of 27 projects globally representing a total funding investment of approximately US\$50 million.^{25 26} Most projects are being implemented in LMICs spread across South America, Africa and Asia with research partnerships and collaborations in high-income countries (HICs) such as Australia, USA, UK, Canada, Belgium, The Netherlands, Slovenia and Germany. Others are targeted at disadvantaged populations in HICs. This presents a unique opportunity to follow the journey of up to 27 different projects being scaled up in different regions, using various interventions and adopting diverse approaches, but all targeted at preventing or treating hypertension and diabetes.

It should be acknowledged that there is no single agreed on definition for ‘scaling up’ or ‘scale-up’, terms that have been widely used in the fields of infectious disease prevention and control, HIV/AIDS and maternal and child health for many years. The WHO and ExpandNet define scale-up as ‘deliberate efforts to increase the impact of successfully tested health innovations so as to benefit more people and to foster policy and programme development on a lasting basis’.²⁷ Depending on the pathway adopted, scale-up projects may be described as being horizontal when the project expands the reach of the programme to cover more people; vertical mostly refers to institutionalisation and integration into policy or health system changes; and diversification refers to adding more interventions to the same population.^{23 27–31} Projects could also adopt a combination of these pathways. Scale out is another term that is encountered in implementation science literature and mostly refers to the adaptation efforts and strategies that are involved while implementing EBIs to new populations or a new delivery system, but under conditions that are mostly similar to where the intervention was originally tested.³²

AIM

The overall aim of this study is to understand the enablers of, and challenges to, scaling up NCD-related interventions in LMICs and vulnerable groups in HICs. We will apply systems thinking to examine up to 27 projects to achieve the following objectives:

1. To identify which NCD interventions and activities are currently part of scale-up research projects.
2. To understand how NCD-related scale-up projects are planned and implemented with a focus on capturing similarities and differences, in the enablers and challenges, that exist both within and between-countries and contexts.
3. To identify the processes and nuances of stakeholder engagement in the planning and development of multicountry and multisectoral collaborative scale-up projects. Specific questions include:
 - How are the stakeholders identified, and roles defined?

- What are the methods used to establish and sustain engagement?
 - What are the perceptions of stakeholders regarding the planning and roll-out of interventions?
 - What are the governance systems in place to manage and maintain relationships between the stakeholder groups?
 - What is the relationship of the researchers with the other stakeholders?
4. To identify how scale-up projects respond and evolve in response to implementation challenges in the field, such as the COVID-19 pandemic.

CONCEPTUAL FRAMEWORK

We will use the Consolidated Framework for Implementation Research (CFIR) to systematically collect details of the characteristics of the intervention, the implementing organisation, the context, characteristics of the individuals and details of the implementation process.³³ The CFIR framework will also be used to guide the data analysis and present the findings from the different case studies. We will further use the Exploration, Preparation, Implementation, and Sustainment (EPIS) Framework as the overarching framework to guide analysis and present overall findings across all the different projects.^{34 35} The EPIS framework is widely used in the implementation science literature and its main components are the four main implementation phases forming the acronym EPIS. It enables systematic collection of factors that bridge the inner and outer context and point to interconnections and interlinkages that characterise the dynamics at play between inner and outer contexts. This framework is well suited to apply to dynamic complex systems, such as scale-up systems, as it considers adaptation as being a necessary part of the implementation process to improve fit between outer and inner contexts and is particularly relevant in multistakeholder projects. In addition, we will consider using other techniques to present specific findings such as the ‘most significant change’ technique. This technique will be used to determine the process and causal mechanisms of changes made, and in what situations and contexts these changes occur, using short stories or vignettes.^{36 37}

METHODS

Since this study is a collaborative effort of several scale-up projects, a logic framework has been developed to help plan and guide all aspects of this study (figure 1).^{38 39}

Study design

We will use a multiple case study, longitudinal study design to review up to 27 funded scale-up projects. Longitudinal study design enables us to follow projects over a period of time and to capture data from the projects as snapshots of time. We will use mixed methods to gather data at three time points from every project in real

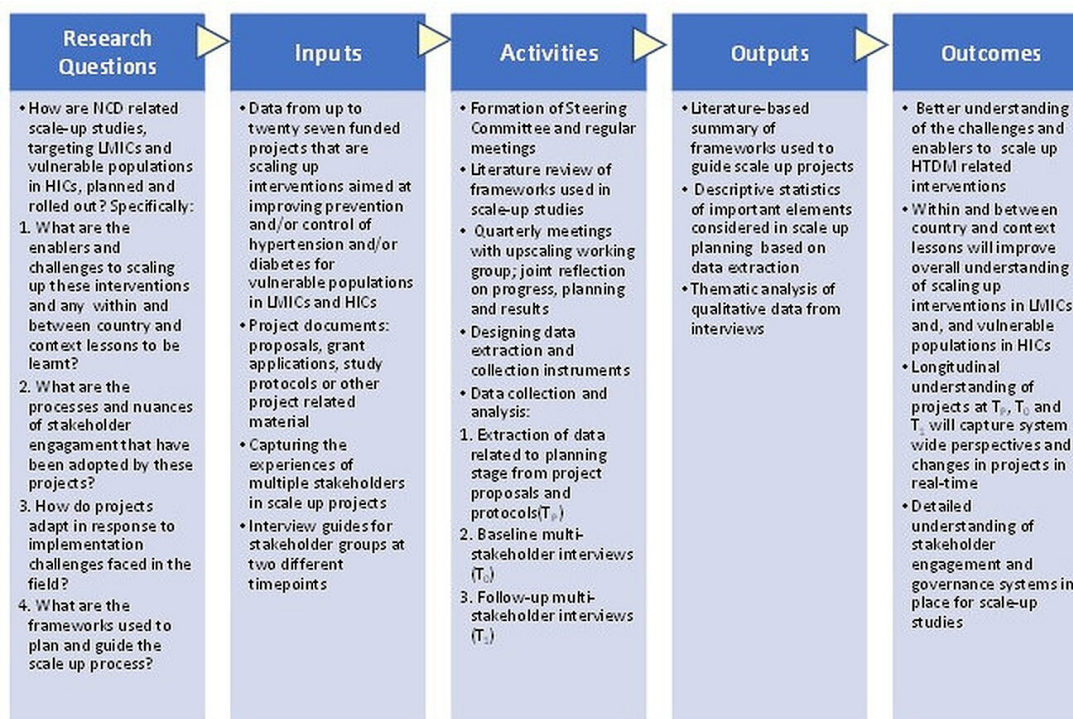


Figure 1 Logic model for the project. HICs, high-income countries; HTDM, hypertension and diabetes mellitus; LMICs, low-income and middle-income countries; NCD, non-communicable disease. Timepoints comprise the following: planning (T_p), initiation (T_0), 1-year post-implementation (T_1).

time, ie, as they are planned and being implemented in the field (figure 2). The first time point will provide a descriptive understanding of the studies, which will be followed by two time points focused on gathering system wide perspectives on the implementation process.²¹ Data collected from every project at one time point will be used to guide the data collection for subsequent time points. The mixed method data collection offers the strength of understanding issues from varied theoretical approaches and thereby developing rich insights into complex systems.^{19 40 41} The longitudinal study design will be suitable to capture and understand the enablers and challenges that stakeholders face as their projects are planned and rolled out.^{16 17 21 28} It will also provide an opportunity to determine how scale-up projects adapt and evolve in response to challenges faced across different stages of the scale-up process.

STUDY SETTING

The GACD secretariat and the Upscaling Working Group

The Upscaling Working Group was established in 2018, under the GACD research network and includes academics and researchers, with projects funded through various GACD calls since 2012, who are interested in developing and contributing to the science of scale-up. Teams from the 27 projects funded as part of the GACD Scale-up Call have also been invited to be a part of this working group (online supplemental appendix 1). We will use the quarterly scale-up group meetings to engage

with members, invite them to collaborate in this study, provide opportunities to shape the collaboration, keep the group informed about the progress of this study and jointly reflect on the findings.

Study participants

This protocol comprises up to 27 scale-up projects that have been funded and are currently being implemented. The lead researchers from the funded projects are the main stakeholders for this study and we have codesigned this protocol collaboratively with their involvement. They will be our point of contact for project-related data at all stages. We aim to capture project data from a multistakeholder perspective at project initiation (T_0) and at 1-year post-implementation (T_1). We will include a sample of the following stakeholders from across these projects:

1. Principal/lead investigator (PI), Co-PI or nominated representative(s) from the project teams.
2. Other project investigators, project team members and research partners.
3. Government representatives and policymakers.
4. Country leads, members of civil society and industry partners.
5. Staff members or frontline workers or community health workers.
6. Members of the community where scale-up is planned or end-users of interventions (T_1 only).

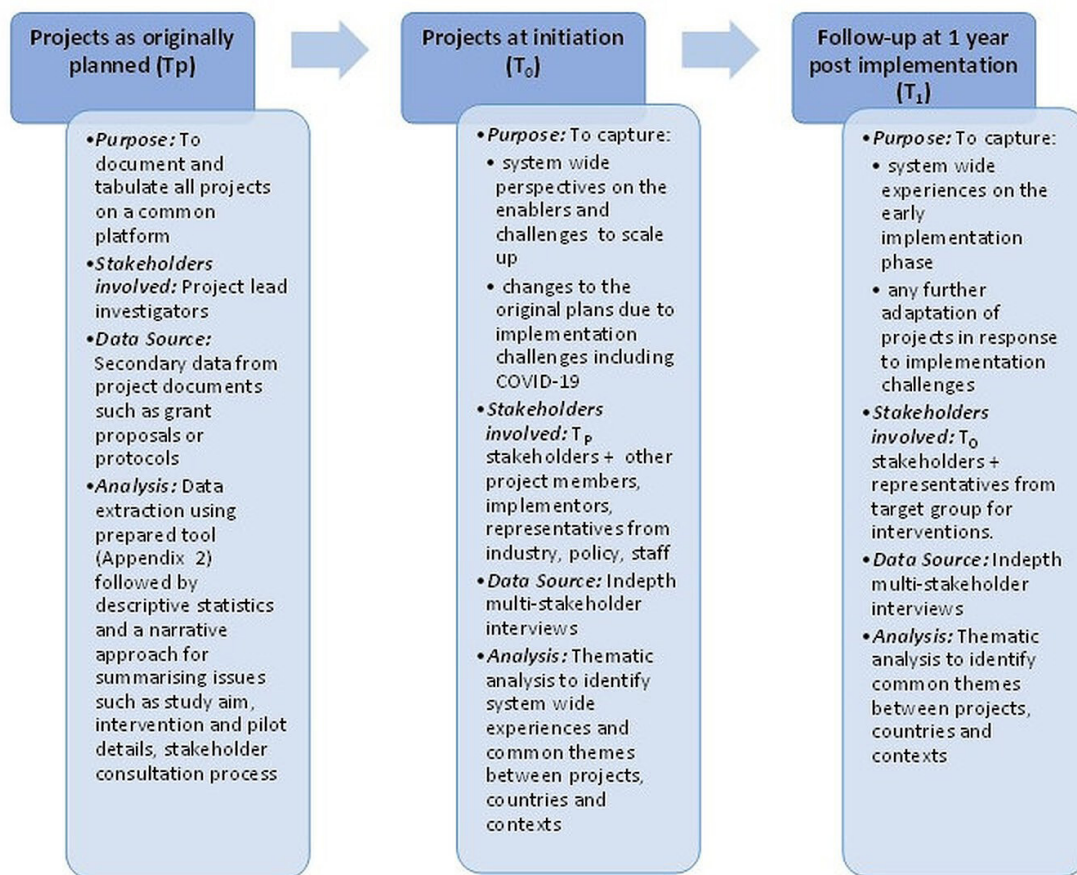


Figure 2 Design of the study.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research. The individual projects are likely to have community and patient involvement, depending on the specifics of each project, and that will form a part of the individual project protocol and is beyond the scope of this current protocol.

Data collection

Data will be captured from each project at three different time points using a data extraction tool and interview guides (figure 2). The data extraction tool will map different projects and help understand which studies involve health policy, education (prevention) and health systems (prevention and management). We undertook a literature review of scale up studies, with a focus on analysis of frameworks, to develop a roadmap for conducting scale-up studies and thereby guide development of the study tools.^{27 31 42–53}

Planning stage (T_p)

Initially, project teams will be invited to share project documents with information regarding how their scale-up project in hypertension and diabetes was originally planned. These documents could include the study protocol, funding application or any other relevant documentation that the teams are willing to share. Using our

data extraction tool (online supplemental appendix 2), we will extract the same data from each project.

Interview at project initiation (T_0)

In order to apply a systems thinking lens, semistructured in-depth qualitative interviews will be conducted with a sample of up to five stakeholders from every project. Project-related data gathered at T_p will help guide the discussions at T_0 , with multistakeholder interviews used to capture individual perspectives on the challenges and enablers to the scale-up process. We will also be able to capture insights into the nuances of stakeholder engagement and role of relationships that exist within each project. The interviews at this time point will also help capture changes in the project plan that have resulted from the COVID-19 pandemic. Four separate interview guides, targeted specifically at principal investigators, team members, partners, and frontline staff, have been developed for this purpose (online supplemental appendices 3–6). The qualitative data will be audiotaped, transcribed verbatim and, if necessary, translated into English.

One-year post-initiation (T_1)

Follow-up in-depth semistructured qualitative interviews will be conducted with multiple project stakeholders for project data at 1-year postinitiation of implementation. Data collected at T_p and T_0 will help guide the discussions at T_1 . Four separate follow-up interview guides have been

developed for this purpose (online supplemental appendices 7–10). These interviews will be used to elucidate how the projects might have been modified based on real-life implementation challenges faced during the first 12 months of implementation. In addition to the investigators, team members, partners and frontline staff interviewed at T_0 , at T_1 , we also aim to interview members of the community who are recipients of the intervention as it is envisaged that all projects will have initiated engagement and consultation with this stakeholder group by this time point. A fifth interview guide has been developed for this purpose. (online supplemental appendix 11).

We anticipate final data collection for this study will occur in July 2022.

Recruitment

A fair, transparent and collaborative approach will be used to contact the lead investigators for project data. At all stages, we will assure them of data security and confidentiality. To encourage participation, we will reiterate at every stage that the aim of this study is to develop a better shared understanding of scale-up of NCDs.

The project lead investigators will be our point of contact for identifying and introducing the participants to be interviewed for the study. All interviews will be conducted after following ethical processes to obtain informed consent from all participants. The potential participants will be emailed an information sheet, with all details of the study, and a consent form, to be signed and returned, seeking permission for participation and audio recording. Verbal consent will be obtained at the start of each interview. All interviews will be conducted by the first author (AR-C) who is a skilled qualitative researcher with several years of experience across different countries and cultural settings. Interviews will be conducted via phone or Zoom, according to the convenience of the participants. All interviews will be audio recorded and professionally transcribed for analysis purposes. We will work in close conjunction with the teams to understand and respect local sociocultural norms while conducting interviews. Given the broad range of countries that are involved in this study, language may be a challenge while conducting some interviews. In order to minimise bias and maintain quality of data, we will ensure that no translation support will be taken from within the project teams. We will, instead, identify suitable support for other members within the broader GACD umbrella or, if necessary, employ professional translators.

Data analysis

System thinking approaches will be applied for data collection and analysis.¹⁶ We will undertake descriptive statistical analysis of data from T_p and undertake inductive thematic coding analysis of the qualitative interviews conducted at T_0 and T_1 (NVivo software, QSR International, Melbourne, Australia). Thematic analysis of qualitative data will be used to identify any similarities or patterns in the data set from a wide range of perspectives.⁵⁴

Initial data extraction for analysis of T_p will be jointly undertaken by the project team (AR-C, RJ, AGT) and discussed in detail. This will provide validity of the process and results. The extracted data will be reviewed by project teams to ensure data accuracy. We will use descriptive statistics and a narrative approach to summarise the study aim, design, details of pilot studies and intervention selection, governance, type of study and other elements of the scaling-up process, such as range of stakeholders involved and details related to engagement strategy (online supplemental appendix 2), to identify patterns and themes (objective 1).

Transcripts will be open coded using thematic analysis. NVivo software (NVivo software V.12, QSR International, Melbourne, Australia) will be used to assist the investigative team with organising and analysing the qualitative data.

The draft coding scheme will be reviewed by the study team and reconciled by consensus. AR-C will organise participants' responses by the corresponding codes with support and guidance from AGT and RJ who will also review 20% of the interviews and audit the findings. This process will provide additional rigour, accuracy and face validity of results.

Following coding of each study separately, inductive thematic analysis of data obtained at T_0 and T_1 will help identify any patterns of enablers and challenges within and between countries and contexts (objective 2). This approach will help us to explore different stakeholder perspectives, to identify shared challenges and differences, if any, that exist across projects, and to identify any patterns experienced by stakeholders during the scaling-up process. Inductive thematic analysis will also help explore the process of stakeholder engagement, how these are built and strengthened with time and determine differences in the priorities between researchers, partners and other stakeholders (objective 3). The analysis will explore the nature of these relationships and how the scale-up project team govern and manage the stakeholders for flow of information and timely decision-making.

Thematic analysis of the longitudinal collection of data over all time points will be undertaken to assess how projects evolved or adapted in response to challenges arising over time (objective 4). This includes an analysis of how scale-up plans were impacted by the COVID-19 pandemic, and how governments modified their approach to the scale-up when faced with this global pandemic.

DISCUSSION

Programme implementers and policymakers face many challenges in designing and delivering innovative ideas, methods and programmes that offer effective approaches to prevention and management of NCDs particularly in LMICs. Governments and public health systems are already under-resourced, so the increasing burden from NCDs adds to the challenge of delivering programmes in the face of other conflicting health priorities.⁵⁵ For

instance, there are reports that the COVID-19 global pandemic has interrupted public health services and NCD efforts in nearly 75% of countries surveyed.⁵⁶ Other challenges faced by health systems when implementing NCD-related health programmes include lack of a national NCD policy, inadequate funding allocation, weak health systems and preparedness, poor capacity of health workers and frontline staff and poor technical infrastructure.^{57 58}

Scale-up of health system interventions is typically large collaborative efforts and include several stakeholders across different sectors of policymaking, public health, research, implementation agencies, governments, civil society and others.^{16 21} These different stakeholders form a complex system with several interactive elements, processes and actors who may at times have conflicting or differing priorities but have to align their common interests during implementation.^{15–17 21 28} Presently, there is little information and understanding of these individual components and their interactions, particularly in relation to the scale-up of complex interventions for NCDs.

Systems thinking is an approach that can help explore and identify the individual elements within complex health systems.^{16 17} By applying systems thinking to these GACD-funded projects, we will be able to identify how interactions and relationships can potentially influence the scaling-up process. This will help better design these complex interventions in the future, including practical strategies to encourage buy-in and continued engagement, to better promote sustainability.

A major advantage of our analysis is the potential to study a diversity of contexts and a diversity of NCD interventions that can individually influence scale-up efforts, such as the public health context, NCD context, political context, health and other policy context and sociocultural factors.^{44 49} This may help to identify commonalities that exist across regions, countries or contexts. It may also identify some unique and powerful country-specific and context-specific factors that influence the scale-up process. Furthermore, it may help identify the role of governance and the political economy around NCD prevention and control. Together, this may further add to better planning and implementation of scaling strategies in under-resourced settings in the future.^{59 60}

The design of our study, initiated prior to commencement of the projects, is uniquely placed to identify how teams recognise, respond, adapt and modify or potentially halt and/or discard their plans to scale-up as they encounter challenges in the field. The COVID-19 pandemic is an example of a common challenge faced in the early implementation phase of these scale-up projects, so it provides a means to identify this adaptation and evolution process.

There are a number of limitations to the study. First, many of the contributing authors of this paper are also investigators of the projects and hence a part of this working group. In order to minimise conflict of interest and bias, all data collection and analysis will

be conducted by an independent team of researchers, within the working group, who are not involved in any of the scale-up projects. The inclusion of investigators as members of this working group also presents a strength, in that researchers may have the opportunity to learn from each other, to improve the scalability of their intervention and to increase internal validity of findings through joint reflection. In addition, we are reliant on project teams to introduce us to their stakeholders/partners, and this is likely to result in some selection bias. To minimise this bias, we obtain a list of stakeholders for each project, and the study team then makes a final decision on who to invite. Third, we initially aimed to capture changes during the planning phase and early implementation phase. But, because the first round of interviews is occurring during COVID-19, we are now unlikely to be able to capture other real-world implementation challenges, which would have contributed to our understanding of scale-up science. The major threat of COVID-19, to country's health systems, also presents an opportunity to study, in the real world, how NCD interventions are affected by health system challenges. Finally, we aspire to interview the same set of stakeholders at both T_0 and T_1 , but this may not always be possible due to people's commitments, availability and staff turnover. However, fresh insights obtained through these newer participants may add to the overall quality of feedback received.

CONCLUSION

This collaborative effort will provide an opportunity to systematically evaluate how processes such as stakeholder engagement and governance evolve over time in response to challenges and facilitators in the field, and thereby contribute to scale-up efforts for NCDs in low-resource settings in the future. As a practical output, this research effort should enable us to identify a suitable framework, or a combination of different frameworks, for use by researchers, programme implementers and policymakers worldwide.

ETHICS AND DISSEMINATION

Each project funded under the scale-up call will have its own individual ethics approval, and independent of this currently described protocol. This protocol has been independently approved by the Monash University Human Research Ethics Committee (HREC number 23482).

This study is a collaborative study within the working group and has no bearing whatsoever on individual project's research, ethics or dissemination plans. This project has been codesigned with open and transparent processes of consultation with all members of the upscaling working group. Written consent for sharing of project-related data will be obtained from lead investigators, and written and verbal consent will be obtained prior to interviews. Dissemination of the results, from this study, to research, clinical and health communities will be at the annual

GACD scientific meetings, other scientific conferences and via international peer-reviewed journals.

Author affiliations

- ¹Department of Medicine, School of Clinical Sciences at Monash Health, Monash University, Clayton, Victoria, Australia
- ²The George Institute for Global Health, New Delhi, India
- ³School of Population Health, University of New South Wales, Sydney, New South Wales, Australia
- ⁴Department of Family Health and Population Medicine, University of Antwerp, Antwerpen, Belgium
- ⁵Department of Sociology, Centre for Population, Family & Health, Faculty of Social Sciences, University of Antwerp, Antwerp, Belgium
- ⁶Chronic Diseases Initiative of Africa, University of Cape Town, Cape Town, South Africa
- ⁷Department of Public Health, Vrije Universiteit, Brussel, Belgium
- ⁸Department of Population Health, NYU Grossman School of Medicine, New York City, New York, USA
- ⁹CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru
- ¹⁰The George Institute for Global Health, Faculty of Medicine, University of New South Wales, Sydney, New South Wales, Australia
- ¹¹Department of Cardiovascular Research, Translation and Implementation, Baker Heart and Diabetes Institute and La Trobe University, Melbourne, Victoria, Australia
- ¹²Fundación EkoRural and Knowledge, Technology and Innovation, Wageningen University, Wageningen, The Netherlands
- ¹³School of Health, Medical and Applied Sciences, College of Science and Sustainability, Central Queensland University, Sydney, New South Wales, Australia
- ¹⁴Division of Family Medicine and Primary Care, Stellenbosch University, Cape Town, South Africa
- ¹⁵Department of Chronic Diseases—CESCAS, Institute for Clinical Effectiveness and Health Policy (IECS), Buenos Aires, Argentina
- ¹⁶Department of Family Medicine and Population Health, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium
- ¹⁷Department of Public Health, Institute of Tropical Medicine, Antwerp, Belgium
- ¹⁸Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada
- ¹⁹C-POND, Fiji National University, College of Medicine, Nursing and Health Sciences, Suva, Fiji
- ²⁰Medical School and Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
- ²¹Epidemiological Research Institute, National Academy of Medicine, Buenos Aires, Argentina
- ²²Internal Medicine Department, School of Medicine, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
- ²³Head of Research and Innovation, Hospital das Clínicas, Universidade Federal de Minas Gerais, Minas Gerais, Brazil
- ²⁴Department of Public Health, Faculty of Medicine, Universitas Sebelas Maret, Saurakarta, Indonesia
- ²⁵Departamento de Ciencias Básicas, Division de Ciencias de la Salud, Universidad de Monterrey, Monterrey, Mexico
- ²⁶Department of Community Medicine, Kathmandu University School of Medical Sciences, Dhulikhel, Nepal
- ²⁷Dhulikhel Hospital, Dhulikhel, Nepal
- ²⁸Department of Public Administration, University of Brawijaya, Malang, Indonesia
- ²⁹Chronic Disease Initiative for Africa, Department of Medicine, University of Cape Town, Cape Town, South Africa
- ³⁰Facultad Latinoamericana de Ciencias Sociales Sede Ecuador (FLACSO), Quito, Ecuador
- ³¹Department of International Affairs and Tropical Medicine, Tokyo Women's Medical University, Tokyo, Japan
- ³²Nutrition Department, Faculty of Medicine, University of Montreal, Montreal, Québec, Canada
- ³³Centre for Public Health Research (CReSP), Montreal, Québec, Canada
- ³⁴Nutrition and Lifestyle Program, The George Institute for Global Health at Peking University Health Science Centre, Beijing, China
- ³⁵Faculty of Medicine, University of New South Wales, Sydney, New South Wales, Australia
- ³⁶Institute for Global Health, University College London, London, UK
- ³⁷Moi University and AMPATH Research, Eldoret, Kenya

- ³⁸Wolfson Institute of Population Health, Barts and The London School of Medicine & Dentistry, Queen Mary University of London, Charterhouse Square, London, UK
- ³⁹The George Institute for Global Health at Peking University Health Science Center, Beijing, China
- ⁴⁰Muhimbili Centre, National Institute for Medical Research, Dar es Salaam, Tanzania
- ⁴¹Liverpool School of Tropical Medicine, Liverpool, UK
- ⁴²Heidelberg Institute of Global Health, Faculty of Medicine and University Hospital, Heidelberg University, Heidelberg, Germany
- ⁴³Department of Women's and Children's Health, Uppsala University, Uppsala, Sweden
- ⁴⁴Department of Global Public Health, Karolinska Institutet, Solna, Sweden
- ⁴⁵Department of Health Sciences, University of York, York, UK
- ⁴⁶Division of Primary Care and Population Health, Department of Medicine, Stanford University, Stanford, California, USA
- ⁴⁷Chan Zuckerberg Biohub, San Francisco, California, USA
- ⁴⁸Julius Global Health, University Medical Center Utrecht, Utrecht University, Utrecht, The Netherlands
- ⁴⁹Division of Epidemiology and Biostatistics, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa
- ⁵⁰Cardiovascular Division and Global Health Center, Washington University in St. Louis, St. Louis, Missouri, USA
- ⁵¹Department of Internal Medicine, Faculty of Clinical Sciences, University of Abuja and University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria
- ⁵²Department of Research in Chronic Diseases, Institute for Clinical Effectiveness and Health Policy, Buenos Aires, Argentina
- ⁵³School of Public Health, Harbin Medical University, Harbin, China
- ⁵⁴Unit of Global Health, Department of Health Sciences, University of Groningen, University Medical Center, Groningen, The Netherlands
- ⁵⁵Department of Medicine, University of Ibadan, Ibadan, Nigeria
- ⁵⁶Medical Research Council/Uganda Virus Research Institute & London School of Hygiene and Tropical Medicine (MRC/UVRI& LSHTM), Entebbe, Uganda
- ⁵⁷The AIDS Support Organisation (TASO), Entebbe, Uganda
- ⁵⁸Health Sciences Institute, Universidad Nacional Arturo Jauretche, Florencio Varela, Buenos Aires, Argentina
- ⁵⁹Department of Global Health Entrepreneurship, Division of Public Health, Tokyo Medical and Dental University, Tokyo, Japan
- ⁶⁰Global Development Institute, University of Manchester, Manchester, UK

Twitter Anusha Ramani-Chander @AnushRC, Peter Delobelle @PDelobelle, Rajesh Vedanthan @rvedanthan, Milena Soriano Marcolino @milenamarc, Antonio Luiz Pinho Ribeiro @tomribeiroecg, Sujarwoto Sujarwoto @sujarwoto20, Hassan Haghparast-Bidgoli @HHaghparast, Maoyi Tian @MaoyiT and Zulma Ortiz @zulmaortizok

Acknowledgements We would like to acknowledge the following people for their support from the early stages of the formation of this working group, in shaping of this protocol and/or sharing their scale up project-related data: Morven Roberts, Gary Parker, Marina Piazza, Bruce Neal, Amit Mistry, Shabbar Jaffar, Carlos Daniel Tajer, Edward Fottrell, James Batchelor, S. Read, and Anna Palagyi. We would like to thank Xuejun Yin and Patricia Busta for their assistance with translation. We would like to acknowledge the GACD Secretariat for their immense and ongoing support to all aspects of this Upscaling Working Group.

Collaborators Global Alliance from Chronic Diseases Upscaling Working Group Collaborators: Writing Group: Anusha Ramani-Chander, Rohina Joshi, Josefien van Olmen, Edwin Wouters, Peter Delobelle, Rajesh Vedanthan, J Jaime Miranda, Brian Oldenburg, Stephen Sherwood, Amanda G Thrift. Contributors: Lal Rawal, Bob Mash, Vilma Irazola, Monika Martens, Maria Lazo-Porras, Hueiming Liu, Gina Agarwal, Gade Waqa, Milena Soriano Marcolino, María Eugenia Esandi, Antonio Luiz Pinho Ribeiro, Ari Probandari, Francisco González-Salazar, Abha Shrestha, Sujarwoto Sujarwoto, Naomi N Levitt, Myriam Paredes, Tomohiko Sugishita, Malek Batal, Yuan Li, Hassan Haghparast-Bidgoli, Violet Naanyu, Feng J He, Puhong Zhang, Sayoki G Mfinanga, Jan-Walter De Neve, Meena Daivadanam, Kamran Siddiqi, Pascal Geldsetzer, Kerstin Klipstein-Grobusch, Mark D Huffman, Jacqui Webster, Dike Ojji, Andrea Beratarrechea, Maoyi Tian, Maarten J Postma, Mayowa Owolabi, Josephine Birungi, Laura Antonietti, Zulma Ortiz, Anushka Patel, David Peiris, Darcelle Schouw, Jaap Koot, Keiko Nakamura, Gindo Tampubolon.

Contributors AR-C, RJ and AGT drafted the first version of the protocol manuscript and have been responsible for collating and reviewing all feedback and making necessary revisions for the finalisation of this manuscript. RJ and AGT conceived,

designed and supervised the overall study. JvO, EW, PD, RV, JJM, BO and SS have provided significant input into the writing of this manuscript. All other group collaborating authors provided intellectual content into the fine tuning of the study design. They also continue to provide important feedback from their projects, each of which has provided a critical perspective while drafting this manuscript and the interview guides. They have also given their approval of the final version submitted for publication.

Funding RJ is supported by the Australian National Heart Foundation (102059) and a UNSW Scientia Fellowship.

Competing interests JvO reports Horizon2020 grants (643 692 and 825432) outside the submitted work. AGT declares funding from the National Health & Medical Research Council (NHMRC, Australia: GNT1042600, GNT1122455, GNT1171966, GNT1143155, GNT1182017), Stroke Foundation Australia (SG1807), and Heart Foundation Australia (VG102282) outside the submitted work. ML-P declares support from Fogarty International Centre, National Institutes of Health [R21TW009982], under the Global Alliance for Chronic Diseases (GACD) Diabetes Program/Programme. MEE reports grant funding from the Argentinian Ministry of Health (MoH) under the GACD program. AS declares funding from the Japan Agency for Medical Research & Development, as part of the GACD, outside the submitted work. FJH is partially funded by the National Institute for Health Research (NIHR) and the Medical Research Council (MRC), and is a member of the Action on Salt, and World Action on Salt, Sugar and Health (WASSH). AB declares grants from the MoH Argentina, National Institutes of Health, and World Diabetes Foundation, outside the submitted work. AP declares grant and fellowship support from the NHMRC outside the submitted work, Member of the Board of Directors, The George Institute India, and past Member of the Board of Directors, Heart Health Research Center, Beijing, PRC. RJ declares grant, outside the submitted work, from WHO Geneva, WHO South-East Asia Region (SEARO), Elrha Research for Health in Humanitarian Crises (R2HC), (Wellcome Trust, UK AID and NHS), DBT/ Wellcome Trust India Alliance and Gates Foundation. In the past 3 years, MDH has received research funding from American Heart Association, Verily, and AstraZeneca for research unrelated to this manuscript and has patents pending for heart failure polypills. The George Institute for Global Health has a patent, license, and has received investment funding with intent to commercialize fixed-dose combination therapy through its social enterprise business, George Medicines. None of the others authors has any conflict of interest to declare.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Anusha Ramani-Chander <http://orcid.org/0000-0003-2461-7139>
 Rohina Joshi <http://orcid.org/0000-0002-3374-401X>
 Edwin Wouters <http://orcid.org/0000-0003-2268-3829>
 Peter Delobelle <http://orcid.org/0000-0002-9016-7458>
 Rajesh Vedanthan <http://orcid.org/0000-0001-7138-2382>
 J Jaime Miranda <http://orcid.org/0000-0002-4738-5468>
 Robert James Mash <http://orcid.org/0000-0001-7373-0774>
 Hueiming Liu <http://orcid.org/0000-0001-9077-8673>
 Milena Soriano Marcolino <http://orcid.org/0000-0003-4278-3771>
 Antonio Luiz Pinho Ribeiro <http://orcid.org/0000-0002-2740-0042>
 Ari Probandari <http://orcid.org/0000-0003-3171-5271>
 Abha Shrestha <http://orcid.org/0000-0002-7992-7137>
 Sujarwoto Sujarwoto <http://orcid.org/0000-0003-4197-4592>
 Hassan Haghparast-Bidgoli <http://orcid.org/0000-0001-6365-2944>
 Sayoki Godfrey Mfinanga <http://orcid.org/0000-0001-9067-2684>

Jan-Walter De Neve <http://orcid.org/0000-0003-0090-8249>
 Kamran Siddiqi <http://orcid.org/0000-0003-1529-7778>
 Kerstin Klipstein-Grobusch <http://orcid.org/0000-0002-5462-9889>
 Mayowa O Owolabi <http://orcid.org/0000-0003-1146-3070>
 David Peiris <http://orcid.org/0000-0002-6898-3870>
 Amanda G Thrift <http://orcid.org/0000-0001-8533-4170>

REFERENCES

- Jan S, Laba T-L, Essue BM, *et al*. Action to address the household economic burden of non-communicable diseases. *Lancet* 2018;391:2047–58.
- World Health Organization. World health statistics: monitoring health for the SDGs, 2020. Available: <https://www.who.int/publications/i/item/9789240005105> [Accessed Mar 2021].
- GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the global burden of disease study 2019. *Lancet* 2020;396:1204–22.
- World Health Organization. Global action plan for the prevention and control of non-communicable diseases 2013–2020. Available: <https://www.who.int/publications/i/item/9789241506236> [Accessed Feb 2020].
- World Health Organization. Time to deliver: report of the WHO independent high-level Commission on noncommunicable diseases, 2018. Available: <https://apps.who.int/iris/handle/10665/272710> [Accessed Jun 2020].
- United Nations. Political Declaration of the high-level meeting of the general assembly on the prevention and control of non-communicable diseases, 2012. Available: https://www.who.int/nmh/events/un_ncd_summit2011/political_declaration_en.pdf [Accessed Oct 2020].
- Beaglehole R, Bonita R, Horton R, *et al*. Priority actions for the non-communicable disease crisis. *Lancet* 2011;377:1438–47.
- NCD Countdown 2030 collaborators. Ncd countdown 2030: pathways to achieving sustainable development goal target 3.4. *Lancet* 2020;396:918–34.
- NCD Countdown 2030 collaborators. Ncd countdown 2030: worldwide trends in non-communicable disease mortality and progress towards sustainable development goal target 3.4. *Lancet* 2018;392:1072–88.
- Yamey G. What are the barriers to scaling up health interventions in low and middle income countries? A qualitative study of academic leaders in implementation science. *Global Health* 2012;8:11.
- Gillespie S, Menon P, Kennedy AL. Scaling up impact on nutrition: what will it take? *Adv Nutr* 2015;6:440–51.
- Kruk ME, Yamey G, Angell SY, *et al*. Transforming global health by improving the science of scale-up. *PLoS Biol* 2016;14:e1002360.
- Theobald S, Brandes N, Gyapong M, *et al*. Implementation research: new imperatives and opportunities in global health. *Lancet* 2018;392:2214–28.
- Fan H, Song F. An assessment of randomized controlled trials (RCTs) for non-communicable diseases (NCDs): more and higher quality research is required in less developed countries. *Sci Rep* 2015;5:13221.
- World Health Organization. Everybody's Business: Strengthening Health Systems to Improve Health Outcomes: WHO's Framework for Action, 2007. Available: https://www.who.int/healthsystems/strategy/everybodys_business.pdf [Accessed Oct 2020].
- de Savigny D, Taghreed A. Systems thinking for health systems strengthening, 2009. Available: <https://www.who.int/alliance-hpsr/resources/9789241563895/en/> [Accessed Mar 2021].
- Paina L, Peters DH. Understanding pathways for scaling up health services through the lens of complex adaptive systems. *Health Policy Plan* 2012;27:365–73.
- Atun R. Health systems, systems thinking and innovation. *Health Policy Plan* 2012;27 Suppl 4:iv4–8.
- Rutter H, Savona N, Glonti K, *et al*. The need for a complex systems model of evidence for public health. *Lancet* 2017;390:2602–4.
- Pérez-Escamilla R, Hall Moran V. Scaling up breastfeeding programmes in a complex adaptive world. *Matern Child Nutr* 2016;12:375–80.
- McGill E, Marks D, Er V, *et al*. Qualitative process evaluation from a complex systems perspective: a systematic review and framework for public health evaluators. *PLoS Med* 2020;17:e1003368.
- Stephani V, Opoku D, Quentin W. A systematic review of randomized controlled trials of mHealth interventions against non-communicable diseases in developing countries. *BMC Public Health* 2016;16:572.

- 23 Mangham LJ, Hanson K. Scaling up in international health: what are the key issues? *Health Policy Plan* 2010;25:85–96.
- 24 van Olmen J, Marchal B, Ricarte B, *et al.* The Need for a Dynamic Approach to Health System-Centered Innovations Comment on "What Health System Challenges Should Responsible Innovation in Health Address? Insights From an International Scoping Review". *Int J Health Policy Manag* 2019;8:444–6.
- 25 Global Alliance for Chronic Diseases. GACD 5th upscaling call-hypertension and diabetes, 2018. Available: <https://www.gacd.org/funding/calls-for-proposals/gacd-scale-up-call> [Accessed Feb 2020].
- 26 Global Alliance for Chronic Diseases. List of projects that received research funding in the scale up call, 2019. Available: <https://www.gacd.org/research-projects?diseases=scale-up&programme-countries=> [Accessed Feb 2020].
- 27 World Health Organization. 9 steps for developing a scaling-up strategy, 2010. Available: https://www.who.int/immunization/hpv/deliver/nine_steps_for_developing_a_scalingup_strategy_who_2010.pdf [Accessed Feb 2020].
- 28 Effken JA. Different lenses, improved outcomes: a new approach to the analysis and design of healthcare information systems. *Int J Med Inform* 2002;65:59–74.
- 29 Simmons R, Fajans P, Ghiron L. Scaling up health service delivery: from pilot innovation to policies and programmes, 2007. Available: https://www.who.int/reproductivehealth/publications/strategic_approach/9789241563512/en/ [Accessed Jun 2020].
- 30 World Health Organization. Practical guidance for scaling up health service innovations, 2009. Available: https://www.who.int/reproductivehealth/publications/strategic_approach/9789241598521/en/ [Accessed Feb 2020].
- 31 Cooley L. *Scaling up—from vision to large-scale change: a management framework for practitioners*. 3rd edn, 2016. https://www.msiworldwide.com/sites/default/files/additional-resources/2018-11/ScalingUp_3rdEdition.pdf
- 32 Aarons GA, Sklar M, Mustanski B, *et al.* "Scaling-out" evidence-based interventions to new populations or new health care delivery systems. *Implement Sci* 2017;12:111.
- 33 Keith RE, Crosson JC, O'Malley AS, *et al.* Using the consolidated framework for implementation research (CFIR) to produce actionable findings: a rapid-cycle evaluation approach to improving implementation. *Implement Sci* 2017;12:15.
- 34 Aarons GA, Hurlburt M, Horwitz SM. Advancing a conceptual model of evidence-based practice implementation in public service sectors. *Adm Policy Ment Health* 2011;38:4–23.
- 35 Moullin JC, Dickson KS, Stadnick NA, *et al.* Systematic review of the exploration, preparation, implementation, Sustainment (EPIS) framework. *Implement Sci* 2019;14:1.
- 36 Dart J, Davies R. A dialogical, story-based evaluation tool: the most significant change technique. *Am J Eval* 2003;24:137–55.
- 37 Davies R, Dart J. The 'Most Significant Change' (MSC) Technique: A Guide to Its Use, 2005. Available: <https://mande.co.uk/special-issues/most-significant-change-msc/> [Accessed Dec 2021].
- 38 W.K. Kellogg Foundation. Logic model development guide, 2004. Available: <https://www.wkkf.org/resource-directory/resources/2004/01/logic-model-development-guide> [Accessed Feb 2020].
- 39 Damelio R. *The basics of process mapping*. 2nd edn. Portland: Productivity Press, 2011: 31–8.
- 40 Caruana EJ, Roman M, Hernández-Sánchez J, *et al.* Longitudinal studies. *J Thorac Dis* 2015;7:E537–40.
- 41 Peters DH. The application of systems thinking in health: why use systems thinking? *Health Res Policy Syst* 2014;12:51.
- 42 Barker PM, Reid A, Schall MW. A framework for scaling up health interventions: lessons from large-scale improvement initiatives in Africa. *Implement Sci* 2016;11:12.
- 43 Bradley EH, Curry LA, Taylor LA, *et al.* A model for scale up of family health innovations in low-income and middle-income settings: a mixed methods study. *BMJ Open* 2012;2:e000987.
- 44 Bryce J, Requejo JH, Moulton LH, *et al.* A common evaluation framework for the African health Initiative. *BMC Health Serv Res* 2013;13 Suppl 2:S10.
- 45 Chambers DA, Glasgow RE, Stange KC. The dynamic sustainability framework: addressing the paradox of sustainment amid ongoing change. *Implement Sci* 2013;8:117.
- 46 Damschroder LJ, Aron DC, Keith RE, *et al.* Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci* 2009;4:50.
- 47 Escoffery C, Lebow-Skelley E, Udelson H, *et al.* A scoping study of frameworks for adapting public health evidence-based interventions. *Transl Behav Med* 2019;9:1–10.
- 48 Greenhalgh T, Wherton J, Papoutsi C, *et al.* Beyond adoption: a new framework for theorizing and evaluating Nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *J Med Internet Res* 2017;19:e367.
- 49 Cooley L, Linn JF. Taking innovations to scale: methods, applications and lessons, 2014. Available: https://www.usaid.gov/sites/default/files/documents/1865/v5web_R4D_MSI-BrookingsSynthPaper0914-3.pdf [Accessed Feb 2020].
- 50 NCD Alliance. Universal health coverage and non-communicable diseases: a mutually reinforcing agenda, 2014. Available: https://ncdalliance.org/sites/default/files/rfiles/UHC%20and%20NCDs%202014_A4_final_web.pdf [Accessed Sept 2020].
- 51 Wong F, Stevens D, O'Connor-Duffany K, *et al.* Community health environment scan survey (chess): a novel tool that captures the impact of the built environment on lifestyle factors. *Glob Health Action* 2011;4:5276.
- 52 Yamey G. Scaling up global health interventions: a proposed framework for success. *PLoS Med* 2011;8:e1001049.
- 53 Zamboni K, Schellenberg J, Hanson C, *et al.* Assessing scalability of an intervention: why, how and who? *Health Policy Plan* 2019;34:544–52.
- 54 Nowell LS, Norris JM, White DE. Thematic analysis: Striving to meet the Trustworthiness criteria. *Int J Qual Methods* 2017;16.
- 55 Fouad H, Latif NA, Ingram RA, *et al.* Scaling up prevention and control of noncommunicable diseases in the WHO Eastern Mediterranean Region. *East Mediterr Health J* 2018;24:52–62.
- 56 The Lancet NCD Countdown 2030. COVID-19: a new lens for non-communicable diseases. *Lancet* 2020;396:649.
- 57 Islam SMS, Purnat TD, Phuong NTA, *et al.* Non-Communicable diseases (NCDs) in developing countries: a symposium report. *Global Health* 2014;10:81.
- 58 Nishtar S, Niinistö S, Sirisena M, *et al.* Time to deliver: report of the WHO independent high-level Commission on NCDs. *Lancet* 2018;392:245–52.
- 59 Narayan KMV, Ali MK, del Rio C, *et al.* Global noncommunicable diseases--lessons from the HIV-AIDS experience. *N Engl J Med* 2011;365:876–8.
- 60 Binagwaho A, Nutt CT, Mutabazi V, *et al.* Shared learning in an interconnected world: innovations to advance global health equity. *Global Health* 2013;9:37.

Appendix 1: List of scale-up projects funded in the GACD scale-up call in 2019

Name	Location of scale-up (country)	Programme contact
1. DIABFRIL - LATAM	Argentina, Chile, Columbia, Mexico, Peru	Leocadio Rodriguez Manas
2. SUNI-SEA - Scaling-up NCD Interventions in South East Asia	Indonesia, Myanmar, Vietnam	Maarten Postma
3. SCUBY	Belgium, Cambodia, Slovenia	Josefien van Olmen
4. WHO PEN at Scale	Eswatini	Jan-Walter De Neve
5. INTE-AFRICA	Tanzania, Uganda	Shabbar Jaffar
6. Evaluating the role of pharmacists and m-Health strategies in the management of hypertension in General Pueyrredon	Argentina	Maria Eugenia Esandi
7. Implementation of a model of management of myocardial infarction patients.	Belgium	Carlos Daniel Tajer
8. Healthy Schools	Argentina	Jonatan Konfino
9. Use of mHealth and social media to strengthen a primary prevention program for type2 diabetes in public primary care clinics	Argentina	Andrea Beratarrechea
10. Evaluating and bringing to scale alternative food networks to address diabetes mellitus and hypertension	Ecuador	Malek Batal
11. Scaling up the Community Health Assessment Program in the Philippines (CHAP-P)	Philippines	Gina Agarwal
12. Community mHealth Integrated Care (ComHIC) to manage hypertension/diabetes in Tanzania's overburdened health system	Tanzania	Keiko Nakamura
13. Community-based lifestyle intervention for diabetes management in rural Nepal	Nepal	Tomohiko Sugishita
14. School-based education programme to reduce salt: Scaling up in China (EduSalts)	China	Feng He
15. Scaling up the Primary Health Integrated Care Project for Chronic Conditions in Kenya an implementation research project	Kenya	Pablo Perel

Appendix 1: List of scale-up projects funded in the GACD scale-up call in 2019 [20]

Name	Location of scale-up (country)	Programme contact
16. The Bangladesh D:CLARE Project [Diabetes: Community-Led Awareness, Response and Evaluation]	Bangladesh	Ed Fottrel
17. CHArMING - Control of Hypertension and diAbetes in MINas Gerais	Brazil	James Batchelor
18. Scaling up food policy interventions to reduce non-communicable diseases in the Pacific Islands	Fiji, Samoa	Jacqui Webster
19. An evaluation of the Resolve to Save Lives salt reduction program in China	China	Bruce Neal
20. Strengthening China's essential public health package for hypertension and diabetes care in rural village clinics through meaningful use of health information systems	China	David Peiris
21. Scale-up of a primary care intervention for cardiovascular risk management in Malang, Indonesia	Indonesia	Anushka Patel
22. Scaling up interventions to improve the control of hypertension and diabetes in partnership with the governments of Kerala and Tamil Nadu	India	Brian Oldenburg
23. Evaluating the implementation of Group Empowerment and Training (GREAT) for diabetes in South Africa.	South Africa	Robert Mash
24. Assessing COPC scale-up in selected learning sites of the Cape Town Metro: community-based NCD prevention interventions (ACCELERATE)	South Africa	S Read
25. Evaluating the implementation and scale-up of Nigeria National Salt reduction program	Nigeria	Dike Bevis Ojji
26. Implementing and scaling up a team-based care strategy for hypertension control in Colombia and Jamaica.	Jamaica and Colombia	Marshall Tulloch-Reid
27. Addressing hypertension and diabetes through community engaged systems in Puno, Peru (Andes study)	Peru	German Malaga

Appendix 2: Details of elements extracted using the Data Extraction Tool (Tp)

1. Location of scale-up project, types of project documents shared by teams, key team members.
2. Identification of the need or gap that exists in the population currently.
3. An understanding of the scale-up project:
 - a. Project aim or goal.
 - b. Type of scale-up project - Policy related /Service improvement / anything else
 - c. Smallest Administrative Unit where the scale-up is planned.
 - d. Has any framework been used to support whole project?
 - e. What is the objective of the project? (actions taken to achieve the aims).
 - f. Details about Study Design, Phases/ Key steps/ Components of the project.
4. Details about the intervention being scaled-up.
5. Details about what is novel or innovative about the intervention.
6. Primary outcomes and outcome measures.
7. Secondary outcomes and outcome measures.
8. Expected project outputs.
9. Understanding of the stakeholders and project team involved in the scale-up:
 - a. Who are the beneficiaries / frontline staff/ other beneficiaries?
 - b. Is there a Partnering organisation / Industry partner / NGO involved?
 - c. Other professional bodies or stakeholders involved.
 - d. Who are the government stakeholders?
 - e. Any specific details of engagement strategy with stakeholders.
10. Details about the pilot stage:
 - a. whether a pilot was conducted prior or if it is being conducted as a part of scale-up.
 - b. Details about pilot timing, external funding, whether it was / will be evaluated.
11. Specific information about the scale-up:
 - a. Goal
 - b. details of specific framework, if used, to guide scale-up
 - c. whether it is horizontal or vertical scale-up.
 - d. whether there is phase to test the scale-up.
12. Understanding of the national context for scale-up and whether there is a national policy in place for managing NCDs and any other response by the government national or local to NCD management.
13. Is cost-effectiveness and process evaluation analysis being conducted?

Appendix 3: Timepoint 0 (T₀)- Baseline Interview guide for Principal Investigators (or representative identified by them)

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect baseline information about your scale up study

1. *Can you tell me a little bit about yourself and your motivations that led to this scale-up project*
2. *Please tell me a little about the scale-up project?*
 - a. Can you explain briefly what is being scaled-up?
 - b. What was the opportunity to scale up? Why?
 - c. Is there anything new or novel about what is being scaled-up?
 - i. If it is new, what is new about it (e.g. a technical innovation/process (new delivery approach), organizational innovation (new partnerships), or a combination)?
 - d. What was the architecture for this scaling opportunity?
 - e. Who were the actors and players?
 - f. As a PI do you think the scale-up is a fairly simple model or is it complex? Why?
 - g. Is the scale-up a horizontal or vertical scale-up?
 - h. Is the scale up model selected based on what actually will happen if government/health system will take over? If not, how might it change?
 - i. Are there any risks, fears or weaknesses?
3. *Please tell me a little bit about the partnering organisation?*
 - *What is its role?*
 - *In your opinion what are the main strengths that the organisation brings?*
 - *What are the challenges that you think the organisation will face during the scale-up process?*
4. *Could you tell me a little bit about the Chief Investigator/s?*
 - a. *What expertise do they bring?*
 - b. *How well do you know them? Have you worked with them previously?*
 - c. *Does it make a difference if you know them well or not? Why?*
 - d. *How do you, the Chief Investigators & other key partnering organisation members plan to keep in touch during the process?*
5. *Who you think are the relevant stakeholders and end-beneficiaries in your project?*
 - a. *Have you started consulting with them?*
 - i. *If so, how?*
 - ii. *If not, at what stage will you be consulting with them?*
 - b. *What is their role? What are the challenges in ensuring their buy-in?*
6. *Could you tell me a little bit about the governance structure of the project team and collaborators?*
 - a. *How is the project structured to enable input from all stakeholders?*

- b. *How do you meet (e.g. Zoom, face-to-face) and how often?*
 - c. *How are decisions made and who makes the final decision regarding project processes?*
7. *What do you think about the health system in the countries where the project is being implemented? **Alternative questions for those who have projects that do not involve the health system:** What do you think about the health system and other relevant system in the countries where the project is being implemented?"*
 - a. *Is it generally open to change and receptive and encouraging to new ideas?*
 - b. *What are the critical challenges that the health system poses with regard to implementation/adoption/scale up of the project? How do you know this?*
 - c. *How does the project design take into account the health system challenges? If your project is across several LMIC countries how does the design reflect the changing local system?*
 - d. *We noted in the proposal that you have included process and economic evaluations. Could you comment how you think the findings from these evaluations may address the health system challenges and inform the end-users?*
8. *Are there any industry stakeholders for this project (specific probe if not mentioned in 7 above, or for expansion)?*
 - a. *Who are they?*
 - b. *What is their role? What are the challenges in ensuring their buy-in?*
 - c. *At what stage will you be consulting with them?*
9. *Please tell me a little about the local government and key government stakeholders (specific probe for expansion).*
 - a. *What is their role and how important is their role?*
 - b. *What do you think are the challenges in partnering with them?*
 - c. *How do you plan to ensure their buy-in and what stage of the project is this important?*
 - d. *Do you see any ongoing issues with regard to this?*
10. *Are there any other health service providers who are involved in the delivery of the program, in the technical advisory board, designing the intervention, or otherwise involved in this project (specific probe if not mentioned in 7 above, or for expansion)?*
 - a. *What is their role?*
 - b. *How do you plan encourage them to participate and contribute?*
 - c. *What are the challenges in keeping them motivated and interested?*
11. *Tell me a little about the end-beneficiaries of this program*
 - a. *What are their health needs currently with regard to hypertension and diabetes?*
 - b. *How are these needs being met currently?*
 - c. *At what stage of the program implementation are they being consulted and in what manner?*
 - d. *Why do you think they will adopt and continue with the model/innovation?*
 - e. *Has the same group of beneficiaries successfully taken up any program previously? Is there a history of acceptance?*
 - f. *What do you perceive to be the main challenges in their uptake of the program?*
 - g. *How do you plan to deal with these challenges?*
12. *Tell me a little bit about the front-line staff who will be delivering the program?*
 - a. *How important do you think their role is?*
 - b. *At what stage of the program is their role most important?*
 - c. *Do they have other conflicting projects or programs that they work in?*
 - d. *What are their challenges and motivators to promote this programme?*
 - e. *What is the incentive for them to promote this program?*

- f. What sort of resources are being invested in their training? Is there written documentation of all policies that they need to follow?
- g. Has any training material been prepared for their work?

13. *Has a pilot been conducted? If yes:*

- a. When was the pilot conducted? Where was it conducted?
- b. Was it in the same location as the scale up? (same local environment or different?)
- c. Was the pilot evaluated? If so, what documentation and methods were used to gather data?
- d. How did you or the team assess that the pilot program could be scaled up? How do you know that the program is effective (that it works)? How do you know that the program is an efficient way of delivering to the community?
- e. What were some of the challenges that the team faced during pilot stage? How did you deal with them?
- f. What were the main learnings from the pilot? Do you think that the pilot provided any tweaking to the original program strategy?
- g. What were the learnings about stakeholders- motivators, buy-in, challenges/ barriers?
- h. What were the challenges that arose from the health system perspective?
- i. Has the intervention changed because of the results of the pilot?
- j. How are you measuring fidelity?
- k. Did you undertake a cost-effectiveness of the pilot intervention? If yes, how did you use that information for scale up? If not done at pilot, then why not?

If no pilot was conducted:

- a. *Could you please explain why a pilot or feasibility study was not conducted?*
- b. How does the team plan to scope the study, identify local challenges and barriers, and determine what works well and what does not work well?

14. *Please tell me a little bit about the scale-up plan and strategy*

- a. Is there a specific plan or strategy that is going to be used to guide the process? Has it been documented?
- b. Which members of the team, partners and other stakeholders are aware of this strategy?
- c. Which members of the team, partners and other stakeholders have been consulted while drawing this up?
- d. Have you used any framework to guide the scale up design and strategy? Why did you apply that particular framework? Did you consider any others?
- e. Do you see any potential issues for long term sustainability of the program?
- f. What do you think will happen if a new unplanned challenge emerges during implementation? What qualities do you think your team or organisation has to cope with this? How will the team know and respond?
- g. Are you measuring cost-effectiveness of scale up? If so could you briefly explain how? If not, why not?

Appendix 4: Timepoint 0 (T₀)- Baseline Interview guide for Chief Investigators and Project Team Members

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect baseline information about the scale up project

1. *Can you tell me a little bit about yourself and your motivations that led to this scale-up project*
2. *Please tell me a little about the scale-up project?*
 - j. Can you explain briefly what is being scaled-up?
 - k. What was the opportunity to scale up? Why?
 - l. Is there anything new or novel about what is being scaled-up?
 - i. If it is new, what is new about it (e.g. a technical innovation/process (new delivery approach), organizational innovation (new partnerships), or a combination)?
 - m. What was the architecture for this scaling opportunity?
 - n. Who were the actors and players?
 - o. As a CI do you think the scale-up is a fairly simple model or is it complex? Why?
 - p. Is the scale-up a horizontal or vertical scale-up?
 - q. Are there any risks, fears or weaknesses?
3. *Could you tell me a little bit about the Principal Investigator/s?*
 - e. *What expertise do they bring?*
 - f. *How well do you know them? Have you worked with them previously?*
 - g. *Does it make a difference if you know them well or not? Why?*
 - h. *How do you plan to keep in touch during the process?*
4. *Who you think are the relevant stakeholders and end-beneficiaries in your project?*
 - a. *Have you started consulting with them?*
 - i. *If so, how?*
 - ii. *If not, at what stage will you be consulting with them?*
 - b. *What is their role? What are the challenges in ensuring their buy-in?*
5. *Could you tell me a little bit about the governance structure of the project team and collaborators?*
 - d. *How is the project structured to enable input from all stakeholders?*
 - e. *How do you meet (e.g. Zoom, face-to-face) and how often?*
 - f. *How are decisions made and who makes the final decision regarding project processes?*

6. *What do you think about the health system in the countries where the project is being implemented? **Alternative questions for those who have projects that do not involve the health system:** What do you think about the health system and other relevant system in the countries where the project is being implemented?"*
 - a. *Is it generally open to change and receptive and encouraging to new ideas?*
 - b. *What are they critical challenges that the health system (other system) poses with regard to the project? How do you know this?*
 - c. *How does the project design take into account the health (or other) system challenges?*
7. *Are there any industry stakeholders for this project (specific probe if not mentioned in 7 above, or for expansion)?*
 - a. *Who are they?*
 - b. *What is their role? What are the challenges in ensuring their buy-in?*
 - c. *At what stage will you be consulting with them?*
8. *Please tell me a little about the local government and key government stakeholders (specific probe for expansion).*
 - a. *What is their role and how important is their role?*
 - b. *What do you think are the challenges in partnering with them?*
 - c. *How do you plan to ensure their buy-in and what stage of the project is this important?*
 - d. *Do you see any ongoing issues with regard to this?*
9. *Are there any other health service providers who are involved in the delivery of the program (specific probe if not mentioned in 7 above, or for expansion)?*
 - a. *What is their role?*
 - b. *How do you plan encourage them to participate and contribute?*
 - c. *What are the challenges in keeping them motivated and interested?*
10. *Tell me a little about the end-beneficiaries of this program*
 - a. *What are their health needs currently with regard to hypertension and diabetes?*
 - b. *How are these needs being met currently?*
 - c. *At what stage of the program implementation are they being consulted and in what manner?*
 - d. *Why do you think they will adopt and continue with the model/innovation?*
 - e. *Has the same group of beneficiaries successfully taken up any program previously? Is there a history of acceptance?*
 - f. *What do you perceive to be the main challenges in their uptake of the program?*
 - g. *How do you plan to deal with these challenges?*
11. *Tell me a little bit about the front-line staff who will be delivering the program?*
 - a. *How important do you think their role is?*
 - b. *At what stage of the program is their role most important?*
 - c. *Do they have other conflicting projects or programs that they work in?*
 - d. *What are their challenges and motivators to promote this programme?*
 - e. *What is the incentive for them to promote this program?*
 - f. *What sort of resources are being invested in their training? Is there written documentation of all policies that they need to follow?*
 - g. *Has any training material been prepared for their work?*
12. *Has a pilot been conducted? If yes:*
 - a. *When was the pilot conducted? Where was it conducted?*
 - b. *Was it in the same location as the scale up? (same local environment or different?)*
 - c. *Was the pilot evaluated? If so, what documentation and methods were used to gather data?*

- d. How did you or the team assess that the pilot program could be scaled up? How do you know that the program is effective (that it works)? How do you know that the program is an efficient way of delivering to the community?
- e. What were some of the challenges that the team faced during pilot stage? How did you deal with them?
- f. What were the main learnings from the pilot? Do you think that the pilot provided any tweaking to the original program strategy?
- g. What were the learnings about stakeholders- motivators, buy-in, challenges/ barriers?
- h. What were the challenges that arose from the health system perspective?
- i. Has the intervention changed because of the results of the pilot?
- j. How are you measuring fidelity?

If no pilot was conducted:

- c. *Could you please explain why a pilot or feasibility study was not conducted?*
- d. How does the team plan to scope the study, identify local challenges and barriers, and determine what works well and what does not work well?

13. Please tell me a little bit about the scale-up plan and strategy

- h. Is there a specific plan or strategy that is going to be used to guide the process? Has it been documented?
- i. Which members of the team, partners and other stakeholders are aware of this strategy?
- j. Which members of the team, partners and other stakeholders have been consulted while drawing this up?
- k. Do you see any potential issues for long term sustainability of the program?
- l. What do you think will happen if a new unplanned challenge emerges during implementation? What qualities do you think your team or organisation has to cope with this? How will the team know and respond?
- m. Are you measuring cost-effectiveness? If so could you briefly explain how?

Appendix 5: Timepoint 0 (T₀)- Baseline Interview guide for local government stakeholders

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect baseline information about your scale up project.

1. *Can you tell me a little bit about yourself and your motivations that made you to partner in this scale-up project*
2. *Please tell me a little about the scale-up project?*
 - r. Can you explain briefly what is being scaled-up?
 - s. What was the opportunity to scale up? Why?
 - t. Is there anything new or novel about what is being scaled-up?
 - i. If it is new, what is new about it (e.g. a technical innovation/process (new delivery approach), organizational innovation (new partnerships), or a combination)?
 - u. What was the architecture for this scaling opportunity?
 - v. Who were the actors and players?
 - w. As a government representative do you think the scale-up is a fairly simple model or is it complex? Why?
 - x. Are there any risks, fears or weaknesses?
3. *Please tell me a little bit about your government’s role in this project?*
 - *Why does this project interest your local government?*
 - *What is your governments role in this project?*
 - *In your opinion what are the main strengths that your local government brings?*
 - *What are the challenges that you think the government systems will face during the scale-up process?*
4. *Could you tell me a little bit about the local organisation in the scale-up?*
 - i. *What expertise do they bring?*
 - j. *How well do you know them? Have you worked with them previously?*
 - k. *Does it make a difference if you know them well or not? Why?*
 - l. *How do you, plan to keep with the team during the process? What challenges do you see in keeping this relationship through the process?*
5. *When were you first informed about this project? What were you told? Who introduced this project to you?*
6. *Could you tell me a little bit about the governance structure of the project team and collaborators?*
 - g. *How is the project structured to enable input from all stakeholders?*
 - h. *How do you meet (e.g. Zoom, face-to-face) and how often?*
 - i. *How are decisions made and who makes the final decision regarding project processes?*

7. *What do you think about the health system in your country?*
 - a. *Is it generally open to change and receptive and encouraging to new ideas?*
 - b. *What are the critical challenges that the health system poses with regard to the project? How do you know this?*
 - c. *How does the project take into account the health system challenges?*

8. *Tell me a little about the end-beneficiaries of this program*
 - a. *What are their health needs currently with regard to hypertension and diabetes?*
 - b. *How are these needs being met currently?*
 - c. *At what stage of the program implementation are they being consulted and in what manner?*
 - d. *Why do you think they will adopt and continue with the model/innovation?*
 - e. *Has the same group of beneficiaries successfully taken up any program previously? Is there a history of acceptance?*
 - f. *What do you perceive to be the main challenges in their uptake of the program?*
 - g. *How do you plan to deal with these challenges?*

9. *Were you involved in a pilot of this project? If yes:*
 - a. *How did you assess that the pilot program could be scaled up? How do you know that the program is effective (that it works)? How do you know that the program is an efficient way of delivering to the community?*
 - b. *What were some of the challenges that your local government faced during pilot stage? How did you deal with them?*
 - c. *What were the main learnings from the pilot? Do you think that the pilot provided any tweaking to the original program strategy?*
 - d. *What were the challenges that arose from the health system perspective?*
 - e. *Has the intervention changed because of the results of the pilot?*

10. *Please tell me a little bit about the scale-up plan and strategy*
 - n. *Is there a specific plan or strategy that is going to be used to guide the process? Has it been documented?*
 - o. *Were you consulted in this process?*
 - p. *Do you see any potential issues for long term sustainability of the program?*
 - q. *What do you think will happen if a new unplanned challenge emerges during implementation? What qualities do you think your local government has to cope with this?*

Appendix 6: Timepoint 0 (T₀) Baseline Interview front-line workers and staff

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

1. Tell me little bit about the community and end-beneficiaries of this project:
 - a. What is their general awareness level about hypertension and diabetes?
 - b. What are their health needs currently with regard to hypertension and diabetes?
 - c. How are these needs being met currently?
 - d. Were they involved during or are they being consulted and in what manner?
 - e. Why do you think they will adopt and continue with the model/innovation?
 - f. Has the same group of beneficiaries successfully taken up any program previously? Is there a history of acceptance?
 - g. What do you perceive to be the main challenges in their uptake of the program?
2. Tell me about your role and work on this project?
 - a. Who is your employer?
 - b. What are your main responsibilities?
 - c. When did you start working in this role?
 - d. Why did you take up this job?
 - e. What do you think will help you to do this role well?
 - f. What do you think is the most challenging or difficult thing about your role?
3. Do you have any other similar projects or programs that you work for presently?
 - a. Are these roles similar or different? In what way?
 - b. Do you think this be a challenge for you to balance all these roles?
4. About governance systems:
 - a. Who do you report to and how do you report to them?
 - b. What supports do you receive from the organisation?
 - c. If you have a problem with regard to this project- what will you do? Who will you contact?
5. Do you think Covid-19 might have an impact on your job in anyway?
 - a. How?
 - b. Did you have to change your working in any manner?

Appendix 7: Timepoint 1 (T₁) Follow-up Interview guide for Principal Investigators (or representative identified by them)

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect baseline information about your scale up study

-
1. *Last time you told us about the scale-up project, and now I'd like to know how this might have changed?*
 - a. Has the scale-up unit changed? If so, how?
 - b. Has the opportunity for scale up changed? If so how?
 - c. Has the novelty about what is being scaled-up changed?
 - i. If so, how?
 - d. Has the architecture for this scaling opportunity changed? How?
 - e. Have the actors and players changed? How?
 - f. Last time you stated that the scale-up was a fairly simple/complex model? Has your view changed? How?
 - g. Has there been a change to how the government/health system will take over the scale-up project? How?
 - h. Have any new risks, fears or weaknesses arisen?
 2. *Last time you told me a little bit about the partnering organisation ...*
 - a. *Has their role changed?*
 - b. *Last time you stated that their main strength were Has your view of this changed? How?*
 - c. *What have been the challenges that you think the organisation has faced during the scale-up process?*
 3. *Last time you told us a little bit about the Chief Investigator/s, and I'd like to know how your perceptions have changed?*
 - a. *The expertise that they bring.*
 - b. *How well you know them?*
 - c. *How have you kept in touch during the process?*
 4. *Last time you stated that the relevant stakeholders and end-beneficiaries in your project were*
 - a. *Have you started consulting with them?*
 - i. *If so, when did you start consulting with them? How?*
 - ii. *If not, at what stage will you be consulting with them?*
 - b. *Has their role changed since the last time we spoke? What have been the challenges in ensuring their buy-in?*
 5. *Last time you told me about the governance structure of the project team and collaborators. You stated that it was*
 - a. *Has this structure changed? If not how has it enabled input from all stakeholders? If so, how has it changed and how has it facilitated input from all stakeholders?*
 - b. *How have you met and how often? Has it been enough?*

- c. *How have the decisions been made and who makes the final decision regarding project processes?*
6. *Last time you told me that the health system in the countries where the project is being implemented were.... **Alternative questions for those who have projects that do not involve the health system:** Last time you told me that the health system and other relevant system in the countries where the project is being implemented were....*
 - a. *Has your view changed about whether it is generally open to change and receptive and encouraging to new ideas? On what do you base this view?*
 - b. *What are the critical challenges that the health system has posed with regard to the project? How do you know this?*
 - c. *How have you been able to take into account the health system challenges*
 - d. *If relevant: How has the process and economic evaluations helped to address the health system challenges and inform the end-users?*
7. *Last time you told me about the specific needs of the health beneficiaries. You stated that*
 - a. *Has your view changed about their health needs with regard to hypertension and diabetes?*
 - b. *At what stage of the program implementation have they been consulted and in what manner?*
 - c. *Do you think they have adopted the model/innovation? Will they continue with it?*
 - d. *What do you perceive have been their main challenges in their uptake of the program?*
 - e. *How have you dealt with these challenges?*
8. *Last time you told me a little bit about the front-line staff who will be delivering the program. In retrospect*
 - a. *How important do you think their role is?*
 - b. *At what stage of the program has their role been most important?*
 - c. *Have they had other conflicting projects or programs that they work in?*
 - d. *What do you think have been their challenges and motivators to promote this programme?*
 - e. *What has been their incentive to promote this program?*
 - f. *What sort of resources are were invested in their training? Has this changed over the course of the study? Was there written documentation of all policies that they need to follow and has this changed?*
 - g. *Has their training material changed? If so, how?*
9. *Last time you told as that a pilot was being conducted as part of this project (if applicable):*
 - a. *When was the pilot conducted? Where was it conducted?*
 - b. *Was it in the same location as the scale up? (same local environment or different?)*
 - c. *Was the pilot evaluated? If so, what documentation and methods were used to gather data?*
 - d. *How did you or the team assess that the pilot program could be scaled up? How do you know that the program is effective (that it works)? How do you know that the program is an efficient way of delivering to the community?*
 - e. *What were some of the challenges that the team faced during pilot stage? How did you deal with them?*
 - f. *What were the main learnings from the pilot? Do you think that the pilot provided any tweaking to the original program strategy?*
 - g. *What were the learnings about stakeholders- motivators, buy-in, challenges/ barriers?*
 - h. *What were the challenges that arose from the health system perspective?*

- i. Has the intervention changed because of the results of the pilot?
- j. How are you measuring fidelity?

10. *Please tell me a little bit about the scale-up strategy*

- a. Has there been a specific plan or strategy that has been used to guide the process? Has it been documented?
- b. Which members of the team, partners and other stakeholders are aware of this strategy?
- c. Which members of the team, partners and other stakeholders have been consulted while drawing this up?
- d. Do you see any potential issues for long term sustainability of the program?
- e. Has a new unplanned challenge emerged during implementation? How has your team or organisation coped with this? How did the team know and how did they respond?
- f. Have you been measuring cost-effectiveness? If so could you briefly explain how?

Appendix 8: Timepoint 1 (T₁) - Follow-up Interview guide for Chief Investigators and Project Team members

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect information about the scale up project

1. *Last time you told us about the scale-up project, and now I'd like to know how this might have changed?*
 - a. Has the scale-up unit changed? If so, how?
 - b. Has the opportunity for scale up changed? If so how?
 - c. Has the novelty about what is being scaled-up changed?
 - i. If so, how?
 - d. Has the architecture for this scaling opportunity changed? How?
 - e. Have the actors and players changed? How?
 - f. Last time you stated that the scale-up was a fairly simple/complex model? Has your view changed? How?
 - g. Has there been a change to how the government/health system will take over the scale-up project? How?
 - h. Have any new risks, fears or weaknesses arisen?
2. *Last time you told us a little bit about the Principal Investigator/s, and I'd like to know how your perceptions have changed?*
 - a. *The expertise that they bring.*
 - b. *How well you know them?*
 - c. *How have you kept in touch during the process?*
3. *Last time you stated that the relevant stakeholders and end-beneficiaries in your project were*
 - a. *Have you started consulting with them?*
 - i. *If so, when did you start consulting with them? How?*
 - ii. *If not, at what stage will you be consulting with them?*
 - b. *Has their role changed since the last time we spoke? What have been the challenges in ensuring their buy-in?*
4. *Last time you told me about the governance structure of the project team and collaborators. You stated that it was*
 - a. *Has this structure changed? If not how has it enabled input from all stakeholders? If so, how has it changed and how has it facilitated input from all stakeholders?*
 - b. *How have you met and how often? Has it been enough?*
 - c. *How have the decisions been made and who makes the final decision regarding project processes?*

5. *Last time you told me that the health system in the countries where the project is being implemented were*
 - a. *Has your view changed about whether it is generally open to change and receptive and encouraging to new ideas? On what do you base this view?*
 - b. *What are they critical challenges that the health system has posed with regard to the project? How do you know this?*
 - c. *How have you been able to take into account the health system challenges*
6. *Last time you told me about the specific needs of the health beneficiaries. You stated that*
 - a. *Has your view changed about their health needs with regard to hypertension and diabetes?*
 - b. *At what stage of the program implementation have they been consulted and in what manner?*
 - c. *Do you think they have adopted the model/innovation? Will they continue with it?*
 - d. *What do you perceive have been their main challenges in their uptake of the program?*
 - e. *How have you dealt with these challenges?*
7. *Last time you told me a little bit about the front-line staff who will be delivering the program. In retrospect*
 - a. *How important do you think their role is?*
 - b. *At what stage of the program has their role been most important?*
 - c. *Have they had other conflicting projects or programs that they work in?*
 - d. *What do you think have been their challenges and motivators to promote this programme?*
 - e. *What has been their incentive to promote this program?*
 - f. *What sort of resources are were invested in their training? Has this changed over the course of the study? Was there written documentation of all policies that they need to follow and has this changed?*
 - g. *Has their training material changed? If so, how?*
8. *Last time you told as that a pilot was being conducted as part of this project (if applicable):*
 - a. *When was the pilot conducted? Where was it conducted?*
 - b. *Was it in the same location as the scale up? (same local environment or different?)*
 - c. *Was the pilot evaluated? If so, what documentation and methods were used to gather data?*
 - d. *How did you or the team assess that the pilot program could be scaled up? How do you know that the program is effective (that it works)? How do you know that the program is an efficient way of delivering to the community?*
 - e. *What were some of the challenges that the team faced during pilot stage? How did you deal with them?*
 - f. *What were the main learnings from the pilot? Do you think that the pilot provided any tweaking to the original program strategy?*
 - g. *What were the learnings about stakeholders- motivators, buy-in, challenges/ barriers?*
 - h. *What were the challenges that arose from the health system perspective?*
 - i. *Has the intervention changed because of the results of the pilot?*
 - j. *How are you measuring fidelity?*
9. *Please tell me a little bit about the scale-up strategy*
 - a. *Has there been a specific plan or strategy that has been used to guide the process? Has it been documented?*
 - b. *Which members of the team, partners and other stakeholders are aware of this strategy?*

- c. Which members of the team, partners and other stakeholders have been consulted while drawing this up?
- d. Do you see any potential issues for long term sustainability of the program?
- e. Has a new unplanned challenge emerged during implementation? How has your team or organisation coped with this? How did the team know and how did they respond?
- f. Have you been measuring cost-effectiveness? If so could you briefly explain how?

Appendix 9: Timepoint 1 (T₁) Follow-up Interview guide for Government stakeholders

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect follow up information about your scale up project.

1. *Last time you told us about the scale-up project, and now I'd like to know how this might have changed?*
 - a. Has the scale-up unit changed? If so, how?
 - b. Has the opportunity for scale up changed? If so how?
 - c. Has the novelty about what is being scaled-up changed?
 - i. If so, how?
 - d. Has the architecture for this scaling opportunity changed? How?
 - e. Have the actors and players changed? How?
 - f. Last time you stated that the scale-up was a fairly simple/complex model? Has your view changed? How?
 - g. Have any new risks, fears or weaknesses arisen?
2. *Last time you told me a little bit about your government's role in this project ...*
 - a. Has there been a change in the interest of your local government to this project? How?
 - b. Has your government's role in this project changed?
 - c. Last time you told me that the main strengths that your local government brings were Has your view of this changed? How?
 - d. What have been the challenges that you think the government has faced during the scale-up process?
3. *Last time you told me a little bit about the local organisation and their role in the scale-up process? Have your perceptions changed about ...*
 - a. The expertise that they bring.
 - b. How well you know them?
 - c. How have you kept in touch during the process?
 - d. Have they actively kept in touch with you? What have been the challenges in providing the government's perspective?
4. *Last time you told me about the governance structure of the project team and collaborators. You stated that it was*
 - a. Has this structure changed? If not how has it enabled input from all stakeholders? If so, how has it changed and how has it facilitated input from all stakeholders?
 - b. How have you met and how often? Has it been enough?
 - c. How have the decisions been made and who makes the final decision regarding project processes?

5. *Last time you told me that the health system in your country was ...?*
 - a. *Has your view changed about whether it is generally open to change and receptive and encouraging to new ideas? On what do you base this view?*
 - b. *What are they critical challenges that the health system has posed with regard to the project? How do you know this?*
 - c. *How have you been able to take into account the health system challenges*
 - d. *If relevant: How has the process and economic evaluations helped to address the health system challenges and inform the end-users?*

6. *Last time you told me about the specific needs of the health beneficiaries. You stated that*
 - a. *Has your view changed about their health needs with regard to hypertension and diabetes?*
 - b. *At what stage of the program implementation have they been consulted and in what manner?*
 - c. *Do you think they have adopted the model/innovation? Will they continue with it?*
 - d. *What do you perceive have been their main challenges in their uptake of the program?*
 - e. *How have you dealt with these challenges?*

7. *Please tell me a little bit about the scale-up strategy*
 - a. *Has there been a specific plan or strategy that has been used to guide the process? Has it been documented?*
 - b. *Have you been consulted in this process?*
 - c. *Do you see any potential issues for long term sustainability of the program?*
 - d. *Has a new unplanned challenge emerged during implementation? How has your local government coped with this? How did you become aware of this and how did you respond?*

Appendix 10: Timepoint 1 (T₁) Follow-up interview guide for front-line workers and staff

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

1. *Can you share some of your experiences, working on this role, over the past year?*
 - a. What have you enjoyed about your role?
 - b. What has been the highlight for you?

2. *What has been the most challenging thing for you, in this role, in the last 1 year?*
 - a. Has there been any challenges with the community or end-beneficiaries? What?
 - b. Has there been any challenges from the organisation? What?
 - c. Has there been any challenges from government? What?
 - d. Did you only you feel it or did other staff also face a similar situation?
 - e. How did you and other staff cope with it?
 - f. Was the problem resolved? How?
 - g. Who came up with the solution?

3. *Last time you told me about the governance systems to help communicate with the organisation- do you think that has worked well in the last year? Have you had any problems with this?*

4. *Is there anything else that you would like to share with me about what worked well and didn't work well for you over the last year in this role?*

****Thank you for your participation ****

Appendix 11: Timepoint 1 (T₁) Interview guide for community members where scale up is planned or end users of the intervention

Thank you for agreeing to take part in this interview. My name is Anusha and I am undertaking this interview as a part of my PhD Research the title of which is “Applying a systems lens to identify challenges, enablers and barriers to the GACD scale up interventions”. My supervisors for the PhD research are Prof. Amanda Thrift from Monash University and A/Prof Rohina Joshi from The George Institute of Global Health, UNSW, Sydney.

The aim of the interview is to collect baseline information about your scale up project.

1. *Last time you told me about the specific needs of the health for people with hypertension and diabetes. You stated that*
 - a. Has your view changed about the health needs of the community with regard to hypertension and diabetes?
 - b. At what stage of the program implementation have you been consulted and in what manner?
 - c. What are the benefits that this program offers?
 - d. Do you think that this model/innovation has been adopted? Do you think that the community would continue with it?
 - e. What do you perceive have been their main challenges in the uptake of the program?
 - f. How have you dealt with these challenges?

2. *Tell me a little bit about the front-line staff who will be delivering the program?*
 - a. How important do you think their role is?
 - b. How often have you kept in touch with them and how?
 - c. How often would you have liked to keep in touch with them and why?

3. *Do you see any challenges to this program for you? What about your community?*

****Thank you for your participation ****