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Evaluation of the Global Alliance for Chronic Diseases

Final Report

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Table of Contents

Abbreviation list 1
Executive summary 3
1 Introduction 9
1.1 This report 9
1.2 Overview of GACD 9
2 Methodology 14
2.1 Desk research 14
2.2 Bibliometric analysis 14
2.3 Primary data collection 15
2.4 Impact case studies 16
3 Implementation research in NCDs 17
3.1 Introduction to implementation science 17
3.2 The case for implementation science addressing NCDs in LMIC contexts 19
3.3 Factors affecting impact from implementation research 25
4 The GACD intervention logic 35
4.1 Description of the GACD Logic Model 35
5 The Global Funding Landscape 41
5.1 Overview of funding in implementation science and NCDs 41
5.2 Other funding partnership models 47
5.3 Role of GACD in the global funding landscape 58
6 GACD activities, outcomes and impact 62
6.1 GACD Projects 62
6.2 Scientific outputs and outcomes 65
6.3 Collaboration 70
6.4 Networking activities and outcomes 78
6.5 Capacity strengthening 81
6.6 Policy and practice outcomes 84
6.7 Impact 85
6.8 GACD activity management and evaluation 97
6.9 Value for Money 103
7 Conclusions and recommendations 104
7.1 Conclusions 104
7.2 Recommendations 106

Appendix A Methodology of the bibliometric analysis ____ 109
A.1. General data preparation ____ 109
A.2. Indicators ____ 110
Appendix B Additional bibliometric findings ____ 115
Appendix C GACD survey analysis ____ 119
C.1. Respondent background ____ 119
C.2. GACD funding and activities ____ 122
C.3. Profile of research projects ____ 126
C.4. Stakeholder involvement ____ 128
C.5. Project impacts ____ 132
C.6. GACD activities ____ 137
C.7. GACD resources ____ 141
C.8. Training opportunities ____ 142
C.9. Challenges ____ 145
Appendix D Implementation Science School-Implementation Science Workshop survey analysis 147
D.1. Overview ____ 147
D.2. GACD activities and impacts ____ 149
D.3. Opportunities outside of GACD ____ 152

Tables

Table 1 Peer review criteria ____ 12
Table 2 Potential roles for community engagement by phase of implementation research project ____ 26
Table 3 Modalities for research capacity building in LMICs ____ 32
Table 4 GACD Comparator funders ____ 42
Table 5 Overview of the GACD funding programmes ____ 62
Table 6 Overview of projects funded by funder ____ 62
Table 7 Publication output in selected chronic diseases (2014-2019) ____ 67
Table 8 Scientific outcomes through publications by GACD and comparators (2014-2019) ____ 69
Table 9 Co-publication in publications funded by GACD and comparators (2014-2019) ____ 70
Table 10 Women authorship among GACD papers and those of comparators (2014-2019) ____ 71
Table 11 Summary of co-publication network for implementation science in selected chronic diseases ____ 74
Table 12 Overview of project impact case studies ____ 87
Table 13 Publication output by selected countries ____ 115

Table 14 Publication output for diabetes 115
Table 15 Publication output for hypertension 116
Table 16 Publication output for lung diseases 116
Table 17 Scientific impact of GACD and comparators in diabetes (2014-2019) 117
Table 18 Scientific impact of GACD and comparators in hypertension (2014-2019) 117
Table 19 Scientific impact of GACD and comparators in lung diseases (2014-2019) 118
Table 20 Share of papers by sector (2014-2019) 118
Table 21 Respondents to the ISS ISW survey, by country 147

Figures

Figure 1 Research to improve health systems 18
Figure 2 Health expenditure per capita, 2018 (in US$) 19
Figure 3 Mortality due to poor-quality health care by country 20
Figure 4 Burden of disease caused by NCDs in DALY rates per 100 000, by location (2019) 21
Figure 5 Preventable deaths from different conditions in LMICs 22
Figure 6 Deaths from conditions due to poor-quality care and non-utilisation in 137 LMICs 22
Figure 7 Burden of disease in LMICs, by cause in DALYs (2017) 23
Figure 8 Conceptual model for embedded implementation research 27
Figure 9 Model of conditions enabling policy and health outcomes 28
Figure 10 Logic model for GACD 39
Figure 11 Alignment actions across the research programming cycle 48
Figure 12 Overview of the integrated EDCTP approach 56
Figure 13 Strengths of GACD funding and activities (n=67) 60
Figure 14 Weaknesses of GACD funding and activities (n=56) 61
Figure 15 GACD Project Locations 64
Figure 16 Level of involvement of different stakeholder groups (n=26) 65
Figure 17 Number of GACD publications in SCD-IS vs other SCD research over time 68
Figure 18 Co-publication network of researchers - new connections “not through projects” (top circle) and new connections “through projects” (bottom circle) 73
Figure 19 Country-to-country networks fostered by GACD (2014-2019) 75
Figure 20 Co-publication networks in SCD-IS excluding GACD-supported papers (top) and including GACD-supported papers (bottom) (2014-2019) 76
Figure 21 Co-publication networks in SCD-IS over time 2008-2013 (top) and 2014-2019 (bottom), excluding GACD-supported papers 77
Figure 22 Extent to which participation in GACD projects and activities led to outcomes for research group/institution, weighted average (n=70) 83

Figure 23 GACD research management ratings (n=26) 99
Figure 24 Respondent country (at time of GACD grant)(n=103) 119
Figure 25 Respondent role (n=103) 120
Figure 26 Respondent years of research experience at the start of the GACD grant (FTE)(n=95) 120
Figure 27 Respondent main discipline(s)/area(s) of expertise (n=102) 121
Figure 28 Involvement in the design of the project, n=72 (a) and delivery of the project, n=71 121
Figure 29 Strengths of GACD funding and activities (n=67) 123
Figure 30 Weaknesses of GACD funding and activities (n=56) 124
Figure 31 Additional activities the GACD could support that would make research more effective and increase the potential for impact (1 = most useful, 7 = least useful; n=73) 124
Figure 32 Communication about GACD funding and activities (n=74) 125
Figure 33 GACD research management ratings (n=26) 126
Figure 34 Project focus in terms of disease areas (a) and implementation science (n=26) 126
Figure 35 Areas of expertise available in project teams (n=26) 127
Figure 36 Level of involvement of different stakeholder groups (n=26) 128
Figure 37 How stakeholder engagement was initiated (n=26) 129
Figure 38 New or existing academic collaborations (n=70) 129
Figure 39 New or existing non-academic collaborations (n=70) 130
Figure 40 Phases of the project where non-academic stakeholders were involved (n=26) 130
Figure 41 Funding sources for non-academic stakeholder involvement 131
Figure 42 Current or planned collaborations with new academic partners (n=71) 131
Figure 43 Current or planned collaborations with new non-academic partners (n=71) 132
Figure 44 Extent to which GACD-funded project and participation in GACD activities led to the following impacts for research group/institution, weighted average (n=70) 132
Figure 45 Personnel from GACD project involved in activities to develop new research resources (n=26) 133
Figure 46 Stakeholders and policy makers with whom research findings were shared 134
Figure 47 Channels used to share research findings with stakeholders and policy makers (n=24) 135
Figure 48 Project contribution to changes in policy and practice (n=26) 136
Figure 49 Project contribution to reduction in NCD risk factors or NCD disease burden (n=26) 136
Figure 50 Project contribution to public health policies or healthcare delivery (n=26) 137
Figure 51 Participation in GACD activities (n=63) 137
Figure 52 Reason for not participating in GACD activities (n=63) 138
Figure 53 Value of GACD activities (n=64) 139
Figure 54 New connections with researchers outside of the project team (a, n=65) and nature of such connections (b, n=42) 139
Figure 55 Opportunities outside GACD to connect with researchers in implementation science in NCDs (n=62) 140
Figure 56 Impact of GACD activity on work outside the GACD-funded project (n=61) 141

Figure 57 Knowledge/use of GACD resources, weighted average (a, n=61) and value of GACD resources, weighted average (b, n=56) 141

Figure 58 GACD contribution to training opportunities in implementation science for academic researchers involved in GACD research grant (n=26) 142

Figure 59 Implementation Science School and Implementation Science Workshop impact on ways of working (n=24) 143

Figure 60 Training opportunities for implementing partners or other non-academic stakeholders (n=26) 143

Figure 61 Training opportunities outside the GACD to develop skills in NCD-implementation science (n=62) 144

Figure 62 Opportunities outside of GACD to obtain funding for implementation science research (n=62) 145

Figure 63 Project challenges encountered in undertaking the research project (n=53) 146

Figure 64 Covid-19 pandemic effect on the delivery of research projects (n=72) 146

Figure 65 Years of research experience (n=13) 148

Figure 66 Respondent main discipline(s) / area(s) of expertise (n=13) 148

Figure 67 Respondent participation in GACD activities (n=13) 149

Figure 68 How the respondents found out about the GACD activities (n=13) 149

Figure 69 Establishing new connections to other researchers through GACD activities (n=13) 150

Figure 70 The nature of the new connections established through GACD activities (n=9) 150

Figure 71 Impact on ways of working (n=13) 151

Figure 72 Impact on career progression (n=13) 152

Figure 73 Long-term engagement with Implementation research (n=13) 152

Figure 74 Opportunities to obtain funding for implementation science research in NCDs outside of GACD (n=13) 153

Figure 75 Opportunities to connect with researchers doing implementation science in NCDs outside of GACD (n=13) 153

Figure 76 Opportunities to develop skills in NCD-implementation science outside of GACD (n=13) 154

Abbreviation list

Abbreviation	Explanation
AHA	American Heart Association
ARC	Average of relative citations
BCURE	Building Capacity to Use Research Evidence
CAGR	Compound Annual Growth Rates
CBT	Cognitive-Behavioural Therapy
CDI	Citation Distribution Index
CEPI	Coalition for Epidemic Preparedness Innovations
CFIR	Consolidated Framework for Implementation Research
CIO	Charitable Incorporated Organisation
CoP	Community of Practice
CRAs	Collaborative Research Actions
CVDs	Cardiovascular diseases
DALYs	Disability-Adjusted Life Years
DDA	Disciplinary Diversity of Authors
DDR	Disciplinary Diversity of References
DHHS	Department of Health & Human Services (US)
DHSC	Department of Health and Social Care (UK)
DP	Diabetes Prevention
EDCTP	European and Developing Countries Clinical Trials Partnership
ENMESH	European Network for Mental Health Service Evaluation
FCDO	Foreign, Commonwealth & Development Office (UK)
FP6	Sixth Framework Programme (European Commission)
FWCS	Field Weighted CiteScore
GA	General Assembly
GACD	Global Alliance for Chronic Diseases
GloPID-R	Global Research Collaboration for Infectious Disease Preparedness
GPC	Group of Programme Coordinators
GSK	GlaxoSmithKline
HCP	Highly Cited Publications
HERN	Health Equity Research Network

HGBI	Healthy Brains Global Initiative
HICs	High-Income Countries
HPSR	Health Policy and Systems Research
HRCS	Health Research Classification System
ICR	International collaboration rate
IHS	Indian Health Service
iPIER	Improving Programme Implementation through Embedded Research
IS	Implementation Science
JGHT	Joint Global Health Trials
JICA	Japan International Cooperation Agency
LMICs	Low- and Middle-Income Countries
MHIN	Mental Health Innovation Network
MoH	Ministry of Health
MRC	Medical Research Council
NCDs	Non-Communicable Diseases
NHMRC	Australian National Health and Medical Research Council
NIH	National Institutes of Health
NIHR	National Institute of Health Research
ODA	Official Development Assistance
PAHO	Pan American Health Organisation
PIs	Principal Investigators
PLM	Programme Logic Model
PSIAs	Participating States' Initiated Activities
RTSL	Resolve to Save Lives
SCD	Selected Chronic Disease
SDG	Sustainable Development Goal
SDPI	Special Diabetes Program for Indians
SI	Specialisation Index
SIDA	Swedish International Development Agency
SRA	Strategic Research Agenda
UKPRP	UK Prevention Research Partnership
UN	United Nations
WHO	World Health Organization

Executive summary

Technopolis Ltd was commissioned to conduct an independent, external evaluation to understand the impact of activities funded by the Global Alliance for Chronic Diseases (GACD) and derive insights and recommendations for maximising the impact of GACD's future work. The evaluation considered GACD activities since 2010 and was conducted between November 2020 and June 2021. This executive summary lays out the main findings from the review and the study team's recommendations for the future.

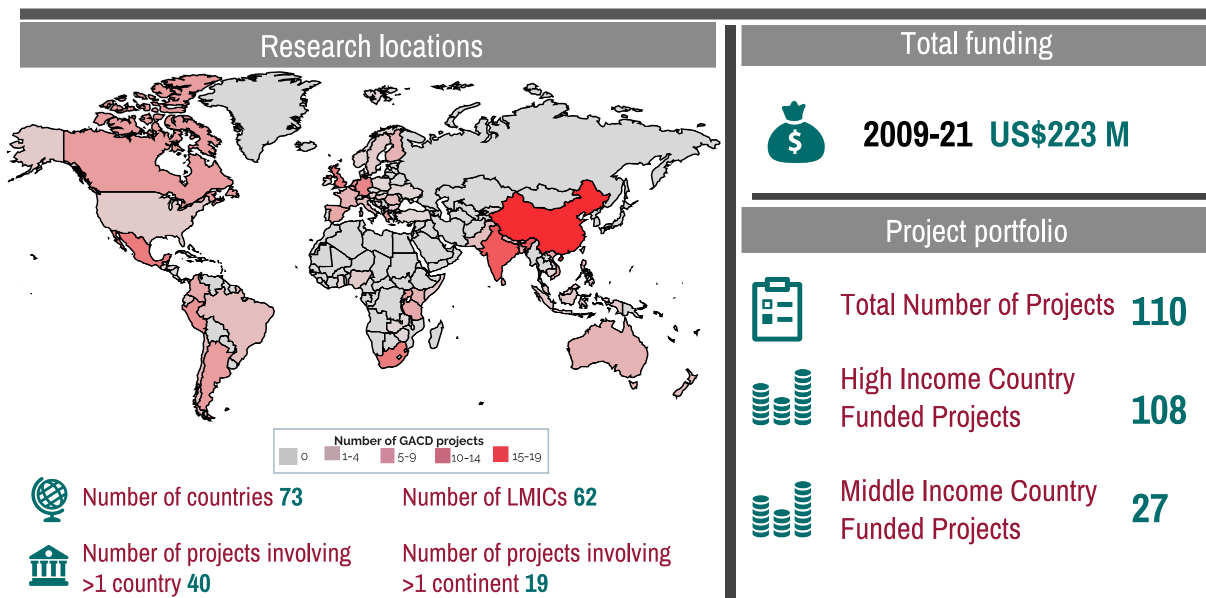
The study team employed a theory-based mixed-methods approach, including both qualitative and quantitative methods, which included development of an intervention logic, and data collection and analysis through desk research, bibliometrics, online surveys (of project team members and training participants), stakeholder interviews and impact case studies.

GACD and its activities

GACD was founded in 2007 as an alliance of major health research funders around the world with the mission "*to reduce the burden of chronic non-communicable diseases (NCDs) in low- and middle-income countries (LMICs), and in vulnerable populations in high-income countries (HICs), by building evidence to inform national and international NCD policies and contribute to the achievement of the Sustainable Development Goals*".

GACD is addressing this mission in three ways: (1) by supporting member funders to invest in high quality, impactful implementation research targeting NCDs; (2) by building implementation science capacity in the NCD field; and (3) by facilitating networks, collaborations and partnerships.

Among the first five GACD funding calls, each had a different focus: hypertension, diabetes, chronic non-communicable lung diseases, mental health and scale-up. In total, 110 projects have been funded under these calls thus far, with a total funding of US$223m. Projects are generally between 3 and 5 years in duration and are located in 73 countries across all continents (36% are multi-country and 19% are multi-continent projects).



Number of
Field weighted
Top 10% Highly Cited
HIC-LMIC International Collaboration
Disciplinary Diversity of
Share of mixed gender
Share of women

Main findings

- *GACD has an important role in the global funding landscape*

GACD is an alliance of research funders that coordinates funding of implementation science projects addressing NCDs in LMICs and vulnerable populations in HICs. The GACD model tries to accommodate the priorities and requirements of each funder and fosters consensus among members on which research areas they should fund, through joint calls. There are no direct comparators to GACD, and the alliance plays an important role in the funding landscape by providing a focal point for implementation science research in NCDs, raising awareness and knowledge of this type of research globally among stakeholders, including funders and researchers, and offering networking and capacity building opportunities.

- *GACD has established a well-functioning model for collaboration between funders*

The alliance has established a model for coordination among the many funders through joint processes (e.g. joint review panel). This has led to efficiencies and improved consistency of proposal assessment across the agencies. It has also allowed funders to learn from each other about implementation science and NCD research as well as funding processes.

Funders are overall positive about GACD as an alliance. The secretariat was recognised for bringing focus and clarity to the discussions and provides valuable support. Involving an External Advisory Group to inform call topic selection has been welcomed and has re-assured members that they are supporting relevant topics. Joint funding processes developed for GACD calls – and trust in the relationships – are now in place. This can benefit future co-funding activities between GACD members.

GACD's flexibility in accommodating the different funding requirements of individual GACD members has enabled broad participation in calls. However, the diversity of members also poses challenges, such as defining an appropriate scope for calls and monitoring research outcomes across the portfolio.

- *GACD members fund high-quality NCD-implementation science projects of relevance to needs of LMICs and vulnerable populations in HICs*

Interviewees noted that the quality and relevance of GACD proposals and projects have increased over time, partly owing to increased awareness of implementation science and increased research capacity. This has led to research findings and resources that are relevant for needs in the specified LMIC and HIC vulnerable population contexts and which have the potential to contribute to decreasing the burden of NCDs.

Bibliometric analysis of GACD-funded publications indicates that GACD managed to increase the share of LMIC authorship compared to publications by comparator funders (i.e., selected GACD members' non-GACD outputs or non-GACD members). Citation-based scientific outcomes of GACD-funded publications published between 2014-2019 are of a similar level to those of comparator funders and significantly higher than the overall world level for selected chronic diseases (hypertension, diabetes and lung diseases).

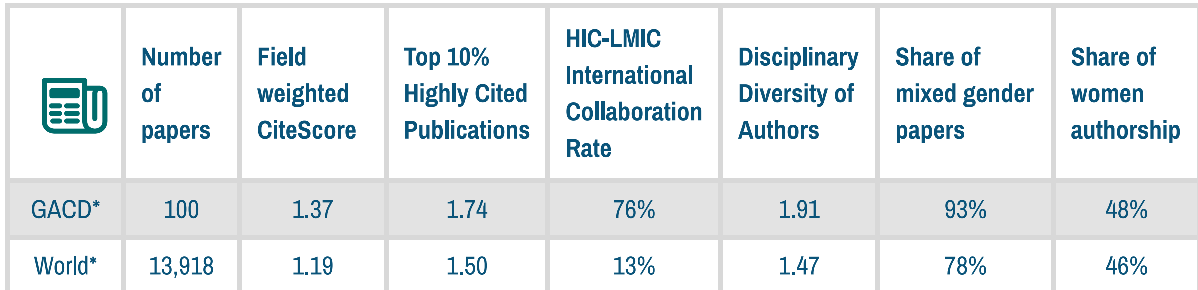
- *GACD projects and activities are fostering collaborations across countries, disciplines and sectors*

Of the 300 GACD publications included in the bibliometric analysis, 81% involve authors from at least 2 countries compared to 37%-46% for the comparators. HIC-LMIC collaborations are particularly supported: 60% of the 300 publications have both HIC and LMIC authors, against a comparator value of 15-17%. 41% of authors on GACD publications are women, which is at a similar level to that of comparator funders.

GACD also fosters collaborations across disciplines and sectors. The disciplinary diversity of authors is higher for GACD-funded papers than comparators. GACD-funded publications also have more diverse authorship in terms of non-academic categories than comparators, i.e. a higher share of authors is affiliated with government or research institutes.

GACD funds high-quality NCD-implementation research which promotes international collaboration, disciplinary diversity and mixed-gender research teams

Research grants contributed to 405 publications between 2014 and 2019



	Number of papers	Field weighted CiteScore	Top 10% Highly Cited Publications	HIC-LMIC International Collaboration Rate	Disciplinary Diversity of Authors	Share of mixed gender papers	Share of women authorship
GACD*	100	1.37	1.74	76%	1.91	93%	48%
World*	13,918	1.19	1.50	13%	1.47	78%	46%

* Publications with an implementation science and selected chronic disease (hypertension, diabetes, lung diseases) area focus

Interviews indicate that GACD is fostering truly international networks and collaboration through the Programme Groups (projects in the same disease area), cross-cutting Working Groups and Annual Scientific Meetings. GACD was highlighted as unique in this respect. For example, the Annual Scientific Meetings have forged close links between researchers and funders from different countries, working in different areas and at different career stages, which has created an engaged and enthusiastic GACD community. Programme groups and Working Groups have led to new global collaboration networks; sharing of data, knowledge and experiences; new research proposals and projects; and high-profile papers often of general value to the field.

- *GACD networking and training activities are building capacity in NCD-implementation science research*

GACD's networking and training activities have helped to build and strengthen implementation science capacity. The Implementation Science School (5-day training course) and Workshops (up to 2 days of training) are valued very highly by participants, senior experts in the field and funders. GACD is seen as a significant contributor to the expansion of implementation science and global implementation science capacity in the last decade, having attracted new entrants to the area – either early career researchers or researchers from other fields. The training has had an impact on trainees' skills, ways of working and research careers.

- *Engagement with policy makers and other research users is a key enabler of impact*

Involvement of policy makers, practitioners or other stakeholders in projects, either as collaborators or consultants, is the key mechanism for facilitating impact in GACD projects, as it encourages buy-in from the intended research users. Formal stakeholder engagement plans and pathways to impact are useful for enabling stakeholder involvement in projects and uptake of project findings. Engagement with international organisations such as WHO, European Commission and African Union in particular is a route to facilitating impact beyond the research site(s).

- *GACD projects have the potential to achieve policy impacts in the future*

With around half of GACD-funded projects still on-going, and many that completed only recently, most projects have not (yet) led to large-scale implementation or adoption to date, even though some projects have led to changes in policy and guidance. In addition, the COVID-19 pandemic required policy makers to shift their priority to address the most urgent needs at hand. Avenues for uptake of GACD research evidence are however in place: Many projects have collaborated with or consulted policy makers and other stakeholders during the time of the project, and have mechanisms in place for dissemination and communication of findings to the relevant users. Hence, most principal investigators who responded to our survey expect their projects to lead to policy/practice outcomes and subsequent impact on health, such as reduced risk factors, reduced morbidity and mortality, and greater health equity.

- *Low visibility and inconsistent monitoring of GACD*

There is a need to capture outcomes and impact (with projects finishing), synthesise findings, and communicate those to key stakeholders to facilitate scale-up, implementation and

impact. However, the portfolio and monitoring information currently available is inconsistent and often inadequate, hampering efforts to enhance GACD's visibility and hence influence outside its immediate network, and to maximise learning about key success factors to support future research.

Recommendations

1. **Explore options for additional partnerships and co-funding involving smaller clusters of GACD members**

There is potential for additional partnership and co-funding models within GACD – for example involving clusters of like-minded funders – to complement existing GACD activities. This would provide a number of opportunities, for example, simplified and agile mechanisms for co-funding, enabling support for international consortia; or funding opportunities with a different scope such as fellowships or calls on specific research questions.

These partnerships involving smaller groups of GACD members could be stand-alone initiatives outside GACD if necessary. However, linking with the wider GACD Network would result in added benefit for the alliance (e.g. learning across projects) and efficiencies.

2. **Improve collection, sharing and synthesis of portfolio and monitoring information**

GACD does not currently have a process for collecting consistent data for its funded portfolio and any outputs/outcomes, and is consequently unable to synthesise an overview. Project details and monitoring information are often held by the individual funders; however, this is not always accessible to GACD. In turn, GACD monitoring currently comprises only a light-touch annual report.

GACD should create systems and/or mechanisms to collect the relevant portfolio and output/outcome/impact information from grantees and/or funders and to synthesise this information at the portfolio level. We understand the GACD secretariat is currently working on a standardised reporting system that gathers key data while minimising burden on the researchers. The Theory of Change developed for this evaluation could serve as a monitoring framework to capture relevant indicators.

3. **Enhance stakeholder engagement**

Activities at GACD level have limited involvement of stakeholders (e.g. policy makers, healthcare providers, etc.), unlike research projects. This limits GACD's level of influence – a missed opportunity given the alliance's strong funder and researcher networks. Enhanced stakeholder networks could help inform selection of call topics and GACD research; foster new collaborations; support uptake of outputs; and facilitate the pathway to impact.

While existing networking and training activities could be opened up to stakeholders, they may not align with stakeholders' needs and time pressures. Thus, GACD may need to develop tailored events and resources for engagement and user capacity building which could be provided via the Implementation Science e-Hub. There is also an opportunity to target specific organisations regionally or internationally such as WHO, Pan American Health Organisation (PAHO), and the African Union.

4. **Increase visibility of GACD and what it has to offer**

GACD's visibility beyond the alliance members is low. This limits its potential to engage more widely with other funders, researchers and stakeholders. Even among members and grantees there is little awareness of all the resources on offer such as the Metadata Index and Data Dictionary. Therefore, there is a need to improve GACD's communication activities.

GACD should enhance its external communications and improve discoverability of relevant tools and resources by improving their visibility to potential users. The first step would be to deliver the GACD Communications Strategy 2020 – 2024, which has similar goals to our recommendation and identifies activities to progress towards those goals.

5. **Ensure sustainability of GACD networks as the community grows**

The GACD network has expanded with each call and training course. As GACD grows, there is a risk of networks becoming unsustainable or developing silos.

Creating alumni network/s not only of previous project participants but also of trainees would be a valuable initial step towards more sustainability. If Recommendation 3 is implemented, a new network of stakeholders may emerge. To gain the most benefit from these networks, GACD could look into fostering cross-communication or collaboration (as relevant) between the different networks.

1 Introduction

1.1 This report

Technopolis Ltd was commissioned to conduct an independent, external evaluation to understand the impact of activities funded by the Global Alliance for Chronic Diseases (GACD) and derive insights and recommendations for maximising the impact of GACD's future work. The evaluation considered GACD activities since 2010 and was conducted between November 2020 and June 2021.

The main objectives of the evaluation were to:

- Provide information on how GACD delivers on its core aim
- Provide information on how GACD delivers on its additional aims of strengthening capacity and capability in NCD focussed implementation research, through its research, networking and training activities
- Provide information on the value gained from these activities and whether there are ways of increasing the value
- Provide information on any tangible outcomes and impacts from the research, networking and capacity strengthening activities funded by the alliance to date
- Provide guidance to GACD on future opportunities to enhance its activities and impact

The evaluation considered a set of research questions regarding GACD's research funding, networking and capacity building activities as well as GACD's processes to investigate both the outputs/outcomes/impacts achieved, including enablers and barriers, as well as the position and role of the programme in the global funding landscape, and GACD's comparative effectiveness at achieving the intended outputs, outcomes and impacts. The evaluation also described the intervention logic for GACD.

This report lays out the main findings from the evaluation and the study team's recommendations on opportunities to enhance the impact of GACD's activities in the future.

1.2 Overview of GACD

1.2.1 History and governance

GACD was formally launched in 2009 as an alliance of major health researcher funders around the world, inspired by a consensus publication[1] calling to address the looming burden of non-communicable diseases (NCDs) in low- and middle-income countries (LMICs) and in specific vulnerable populations in high-income countries (HICs). The first GACD funding call was launched in 2011 and focussed on the topic of hypertension as a risk factor for cardiovascular diseases.

The work of GACD is supported through a small, jointly funded staff team. Initially, this took the form of a small secretariat, hosted at University College London (2012-18), and funded on an annual basis. More recently, GACD has become a Charitable Incorporated Organisation (CIO) under the name 'GACD Action', formally linked to the larger Medical Research Foundation (the 'Foundation') in the UK. This brings the benefit of a legal entity and ability to appoint staff

[1] Daar, A. S., Singer, P. A., Persad, L., Pramming, S. K., Matthews, R., Beaglehole, R., Borysiewicz, L. K., Colagiuri, S., Ganguly, N., Glass, R. I., Finegood, D. T., Nabel, E. G., Sarrafzadegan, N., Yach, D., & Bell, J. (2007). Grand challenges in chronic non-communicable diseases. Nature, 450(November), 494–496.

within a more stable framework. The funding agencies as Associate Members confirm their support annually to GACD and their annual contribution is the sole income of GACD Action. The GACD staff team is very small and benefits from association with the larger charitable organisation which provides business support, e.g. HR and financial services, and has formal responsibility for reporting to the UK Charity Commission.

As a CIO, governance for GACD lies with a Board of Trustees. This is composed of five trustees, three of which are nominated by the Foundation, and two are appointed by the GACD funders. The role of the Board of Trustees is therefore overseeing the workings of GACD and ensuring they pursue their mission and comply with the appropriate legal and regulatory requirements. The GACD Strategy Board on the other hand advises on the strategic direction and on research and programmatic activities. It is composed of a senior member of staff from each Associate Member. The Strategy Board is in turn supported by an Executive Committee, composed of former, current and future 'elect' Strategy Board chairs who meet more frequently and can take executive decision making if necessary, and a Programme Subcommittee, composed of staff from Associate Members who work on the finer details of the programmes.

Strategic decisions such as the development of funding call priorities follow an iterative process steered and facilitated by the staff team. During the recent priority setting for future joint funding calls the GACD staff team convened an International Expert Advisory Group composed of experts (academic, World Health Organisation, etc.) to support the process. The expert recommendations were reported, developed and refined amongst the staff team, Programme Subcommittee and Strategy Board until agreement and a final decision on topics was taken, by the latter committee.

1.2.2 Aims and activities of GACD

GACD's approach to tackling NCDs is focussed on **implementation science** because implementation of evidence-based interventions has been identified as a bottleneck in translating research findings into societal benefit. The focus on implementation science also complements an array of more 'upstream' research programmes that are being supported outside of GACD by alliance funding agencies, such as programmes focussed on health interventions and health systems.

Implementation science is a young field within health research. GACD's approach therefore goes beyond research funding and comprises a strong networking and capacity building component. Activities to date include 110 funded projects, 8 annual scientific meetings, regular implementation science training events, as well as the GACD Research Network with currently 10 working groups. Through its working groups, GACD supports agenda-setting publications as well as tools for researchers such as a metadata index and data dictionary.

GACD also has a mandate to deliver capacity building activities alongside research projects. This is accomplished through 3 main routes:

- Implementation Science Training School, conducted over 5 or more days
- Implementation Science Workshops, conducted over 2 days
- Implementation Science e-hub, a newly developed free, comprehensive online learning space for knowledge and skill development in implementation research, particularly in relation to chronic and non-communicable diseases

GACD funding calls to date have been issued roughly every 2 years following a joint priority setting and call development process. The six joint calls issued so far are as follows:

- Call 1: Hypertension
- Call 2: Type 2 Diabetes
- Call 3: Chronic, non-communicable lung diseases
- Call 4: Mental health
- Call 5: Scale-up – Hypertension and Diabetes
- Call 6: Cancer

While early GACD funding calls have had a single-disease focus, the focus of the coming years will be more cross-cutting in recognition of the complexity underlying NCDs and the high prevalence of multi-morbidity. The 2021-2023 calls are to be rolled out at an increased frequency (annually) with the following topics anticipated:

- 2021: Prevention of NCDs in adolescents, young adults and other vulnerable stages across the life course: implementation science focussed on addressing common risk factors for NCDs through interventions that reduce health risk and/or enhance positive health and lifestyle behaviours in young people, and in other vulnerable life course stages (e.g. childhood, elderly).
- 2022: Interventions in urban environments to reduce NCD risk: implementation science focussed on individual and/or structural level interventions that can reduce NCD risk and/or maximise the health-promoting potential of cities. Transdisciplinary partnerships among health, urban planning and behavioural science experts are encouraged.
- 2023: Integrated management of multimorbidity: implementation science focussed on integrating interventions for optimising management and care for patients with multimorbidity.

1.2.3 Selection process and monitoring

GACD funding is awarded directly by Associate Members but follows aligned criteria and processes as much as possible. A GACD funding call takes the form of a jointly agreed call text and associated funding opportunities from each participating funder which may differ in their eligibility criteria. For some funders a GACD call is a dedicated funding opportunity, whereas for others it takes the form of a highlight notice in a continuous funding programme.

1.2.3.1 Call dissemination

Upon launch of a GACD call, the call text and details of the funders' specific criteria are published on the GACD website as well as on the website of each participating funder. The call is also disseminated directly to institutions via RSS feeds, and publicised on social media (mainly Twitter). GACD ensures the community is aware of upcoming funding opportunities through pre-announcements at its events.

1.2.3.2 Eligibility

Eligibility criteria for GACD calls vary between funders. Some funders will only fund researchers based in their own country, while some funders in HICs expressly welcome projects led from other countries or require collaboration between researchers in LMICs and HICs. Some funders also make it a requirement that a project should be supported by at least one other funder, or a specific other GACD member.

1.2.3.3 Application and selection

GACD operates a joint application submission system and runs a joint selection process. The aim is to increase consistency and maximise efficiency by avoiding duplication of effort and

taking advantage of economies of scale. However, not all funders are able to make use of these systems and processes due to their internal requirements. Where funders follow their own processes, the scope and selection criteria are deemed in line with those agreed by GACD.

The GACD process comprises the following steps:

- Researchers submit their application via the GACD portal
- [optional] Some funders perform an office triage checking eligibility
- [optional] GACD facilitates conversations between research teams and funders on co-funding proposals with teams based in multiple countries
- GACD members nominate a selection panel, taking into account the required thematic expertise and appropriate diversity
- Panel members review applications ahead of a joint panel meeting
- Panel members meet to discuss and score applications
- Each funder receives the recommendations for fundability, committee scores and comments on applications that are relevant to them
- Funders take a final decision on how many and which projects to fund, based on the recommendation from the joint panel as well as strategic considerations. Depending on the funds available and strength of the applications received, not all fundable applications will be funded

Review criteria are organised around the four overarching criteria of relevance and quality of the project, quality of the team, feasibility, and potential for impact. Criteria from the 2019 cancer prevention call are listed in Table 1 below.

Table 1 Peer review criteria

Review Criteria	
Relevance and quality of the project	Proposal fits within the remit of the call, strong scientific rationale, likely to lead to significant new understanding that is relevant to users, appropriate methods, innovative, taking into account relevant system barriers, ethical considerations are properly accounted for
Quality of team	Multidisciplinary team with quality track record, joint management from HIC and LMIC, plan for involving and training early career researchers, active involvement of decision makers from early-stage planning, engagement with relevant patient and community stakeholders
Feasibility of project	Challenges identified with realistic plans to overcome, understanding of contextual factors affecting implementation and plans to analyse these, taking into account inequities and equity gaps, appropriate plans for evaluation, team has strong governance and collaboration plan, project budget is justified
Potential impact	Alignment with national/international commitments, leveraging existing platforms and programs, pathway to embedding the intervention in policy and practise, both in the location(s) where research is undertaken and in new countries and contexts

Source: GACD 2019 Cancer prevention call

1.2.3.4 Monitoring

GACD Associate Members are the bodies that award and administer all individual research awards and funding. The GACD secretariat brings together individual projects under the same call as a research programme, keeps in close communication with the funded researchers through the GACD network and collects progress reports on GACD projects. This takes the form of a narrative update and happens on an annual basis also after the project has finished

(though currently there is no formal requirement for reporting to GACD after the project ended). Funded researchers thus report their progress and outputs to the GACD secretariat and where required also to their direct funder.

2 Methodology

A theory-based mixed methods approach was taken in preparing this report. This combined a desk-based review of existing data, documentation and literature with bibliometric analysis and primary data collection through surveys, interviews, and case studies.

2.1 Desk research

- *Rapid evidence review on implementation science and chronic diseases and GACD*

A rapid evidence review on implementation science and chronic diseases was conducted on published academic and grey literature. This provided contextual information including on the history of implementation research in chronic diseases and the case for investment, known barriers and enablers for conducting implementation science research in chronic diseases, and for achieving societal impact.

Additional internal documentation and data were analysed as provided by GACD Secretariat. This included the rationale for GACD, processes and activities conducted. An intervention logic model for GACD was developed based on this information. The intervention logic model explores the needs, objectives, inputs, activities, outputs, outcomes and impacts of GACD and how these are interrelated.

- *Overview of key funders in implementation science and chronic diseases*

An overview of key funders in implementation science and chronic disease was also conducted via a literature review and identification of relevant funders and programmes through targeted online searches and analysis conducted by Science Metrix. Extended information on the results of the comparator funding landscape available in Chapter 5.

- *Analysis of GACD portfolio data*

GACD monitoring data was analysed to show the total funding amounts that had been allocated to each of the five programmes (2011-2018) and the number of projects and amount funded by each funder. A geographical analysis of project locations was also carried out to explore the distribution of projects by country income group.

2.2 Bibliometric analysis

Attributable GACD publications were identified through a combination of funding acknowledgment search, publications identified in project updates provided by researchers to GACD, and publications listed on selected funders' reporting systems (UKRI Gateway to Research, EC OpenAire and NIH RePORTER). The analysis makes use of the Scopus database of publications, which provides comprehensive coverage of the scholarly literature since 1996.

A total number of 470 publications were identified as 'GACD-funded' and published between 2007[2] and 2019 were identified in Scopus. Of those, the great majority (405) were published between 2014 and 2019 and were produced through projects whose research was oriented towards hypertension, diabetes and lung diseases. This is to be expected given the first GACD projects started in 2012 and the first three GACD funding calls specifically targeted these disease areas. The focus of the following analysis is therefore on publications in the areas of

[2] The year of the first identified GACD publication in Scopus is 2007.

hypertension, diabetes and lung diseases (but not mental health) published in the years 2014-2019. This ensures a sufficient number of publications are available to allow for valid comparisons.

For the purpose of this analysis, it is necessary to define groups of publications falling into the specific disease areas, and to identify which of those can be considered implementation science. Keyword-based searches have been conducted to identify publications in the above three selected chronic disease areas (SCD), both among the GACD-funded publications, and among all other publications in the database. In addition, the area of implementation science (IS) was also delineated using a keyword-based approach, with a focus on common terms among the publications in the journal "Implementation Science". It is important to note that this is a narrow definition to capturing implementation science research and it was aimed at differentiating the field from other closely-related research areas. Consequently, this thematic data set may underestimate the true extent of IS-relevant publications.

The implementation science set can then be intersected with the SCD-sets. This will enable a like-for-like comparison of implementation science research within the selected disease areas supported within and outside of GACD.

Two comparison groups have been constructed for this analysis, one consisting of non-GACD publications of three GACD Associate Members (European Commission, US National Institutes of Health, and UK Medical Research Council), and one consisting of three non-GACD funders (Deutsche Forschungsgemeinschaft, National Research Foundation of Korea, and Wellcome).

A detailed description of methods used in this section is given in Appendix A.

2.3 Primary data collection

- *Surveys*

Two surveys were run to complement monitoring data and obtain the views of project team members ('GACD survey' in this report) and training course participants ('ISS survey' in this report). The surveys were implemented using an online survey tool, SurveyMonkey.

GACD project team members answered questions on topics such as satisfaction with the application and granting procedures, results of projects, dissemination of results, first impact appraisal, career development, benefits of the GACD research network and resources, impact of training, and opportunities to enhance impact. Overall, 21% (103 out of 495) of GACD project team members who were invited responded to the survey, among whom 31% were principal investigators (PIs) or country leads, 34% were investigators or co-investigators and 20% were research associates or assistants. Of the 110 GACD projects, 45 were covered in the survey.

GACD training course participants not involved in GACD networks were invited to participate in the ISS survey. In total 59% (13 out of 22) of the invited individuals responded to the survey.

Full survey analysis is available in Appendices C and D.

- *Programme of interviews*

Qualitative interviews (36 in total) were conducted to gather insight into the views of the following key stakeholders on the role, effectiveness and added value of GACD: GACD staff/secretariat (3), GACD Associate member staff (9), GACD peer review committee members (3), GACD programme chairs (4), GACD Working Group chairs (8 interviews), GACD Training School faculty (3), and policy makers and independent experts (6). Interviews were semi-structured, conducted by phone or videoconference where possible. Interviews were transcribed and analysed using a thematic framework with NVivo software.

The objective of this interview programme was to gather evidence on the outcomes and impacts achieved by GACD and also to consider how GACD might in future strengthen and accelerate the work that it does to inform practical and policy decisions on tackling non communicable diseases. Interview guides were tailored according to the stakeholder type but covered topics such as funding landscape, scientific outcomes, capacity building, GACD impact, GACD activity, management and evaluation and value for money.

2.4 Impact case studies

Eight GACD-funded projects that had led to outcomes or impact in terms of policy, practice, and further research were selected for developing impact case studies based on monitoring information, interviewee recommendation and survey results. Two additional case studies were developed on GACD activities – Working Groups and Capacity Building. Desk research and input from project or activity participants informed the case studies. PIs were given the opportunity to verify the accuracy of the final case study. Relevant case study summaries are presented in this report, with the full case studies available in a separate document.

3 Implementation research in NCDs

The following provides an overview of the history of implementation research in chronic diseases and the case for investment, known barriers and enablers for conducting implementation science research in chronic diseases, and for achieving societal impact.

3.1 Introduction to implementation science

Implementation science is commonly defined as "the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services and care".[3,4]. It examines what works, for whom and under what circumstances, and how interventions can be adapted and scaled up in ways that are accessible and equitable.

Implementation science typically begins with an intervention that has been shown to be effective in some settings but is under-utilised in others.[5] The scope is broader than that of traditional clinical research, focussing not only at the patient level but also at the provider, organisation, and policy levels of healthcare, and targeting health policies, programmes, and practices.[6,7] To bring in the required expertise, implementation research requires trans-disciplinary research teams that include members such as health services researchers, economists, sociologists, anthropologists, organisational scientists, and operational partners including administrators, front-line clinicians, and patients. While clinical research typically focuses on the health effects of an intervention, implementation science typically focusses on the rates and quality of their use rather than their effects.[8] The distinction is illustrated in the following example, the use of cognitive-behavioural therapy (CBT) to effectively treat bipolar disorder:

- A clinical study investigates the impact of CBT on the patient's health status, as an outcome of the intervention
- Implementation science on the other hand measures the proportion of clinicians providing CBT, or the proportion of patients who attend a minimum level of CBT sessions, within the context of where the study is implemented

Implementation science and implementation research (which we use interchangeably in this review), as well as the related fields of health systems research and operational research, have been defined in multiple ways, often resulting in considerable overlap between definitions.[9,10]

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[3] Eccles MP, Mittman BS. Welcome to implementation science. Implement Sci. 2006;1(1)

[4] GACD. What is implementation science? Available via https://www.gacd.org/research/implementation-science

[5] Bauer MS, Damschroder L, Hagedorn H et al (2015) An introduction to implementation science for the non-specialist. BMC Psychol. 3(1)

[6] Bauer MS, Damschroder L, Hagedorn H et al (2015) An introduction to implementation science for the non-specialist. BMC Psychol. 3(1)

[7] Theobald S, Brandes N, Gyapong M et al (2018) Implementation research: new imperatives and opportunities in global health. Lancet 392(10160):2214–28.

[8] Bauer MS, Damschroder L, Hagedorn H et al (2015) An introduction to implementation science for the non-specialist. BMC Psychol. 3(1)

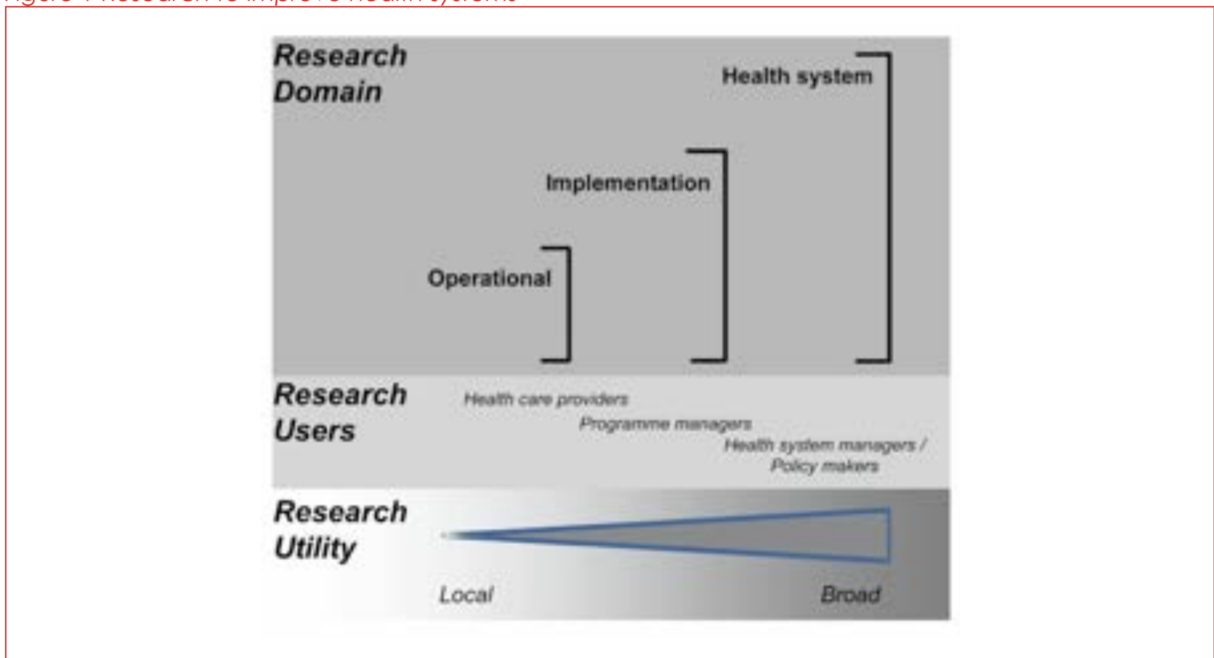
[9] Remme JHF, Adam T, Becerra-Posada F et al (2010) Defining research to improve health systems. PLoS Med. 7(11)

[10] Odeny TA, Padian N, Doherty MC et al. (2015) Definitions of implementation science in HIV/AIDS. Lancet HIV 2(5):e178–80.

These research fields can be understood as a set of nested disciplines, spanning from specific local solutions to broader system-wide research questions (Figure 1):

- **Operational research** aims to develop solutions to current operational problems of specific health programmes or specific service delivery components of the health system, such as a health district or a hospital. Problems addressed are those encountered during the execution of routine processes which require practical solutions to allow more operations to proceed more effectively
- **Implementation research** aims to develop strategies to improve access to, and the use of, interventions that address health challenges, by populations in need. It starts with an intervention or intervention package shown to be efficacious in prior research, but for which major questions remain in terms of scale-up and effective integration within the health system
- **Health systems research** addresses questions that are not disease-specific but affect some or all of the building blocks of a health system. It is thus concerned with systems problems that have repercussions on the performance of the health system as a whole

Figure 1 Research to improve health systems



Source: Reproduced from[11]

Implementation research draws on a wide range of qualitative and quantitative research methods.[12] Some methods have been developed specifically to deal with implementation research questions, or are particularly suitable to implementation research, such as pragmatic trials (in which the effectiveness of an intervention in a normal practice setting with the full range of study participants is assessed), effectiveness-implementation hybrid designs (which assess the effectiveness of both an intervention and an implementation strategy), quality

[11] Remme JHF, Adam T, Becerra-Posada F et al (2010) Defining research to improve health systems. PLoS Med. 7(11)

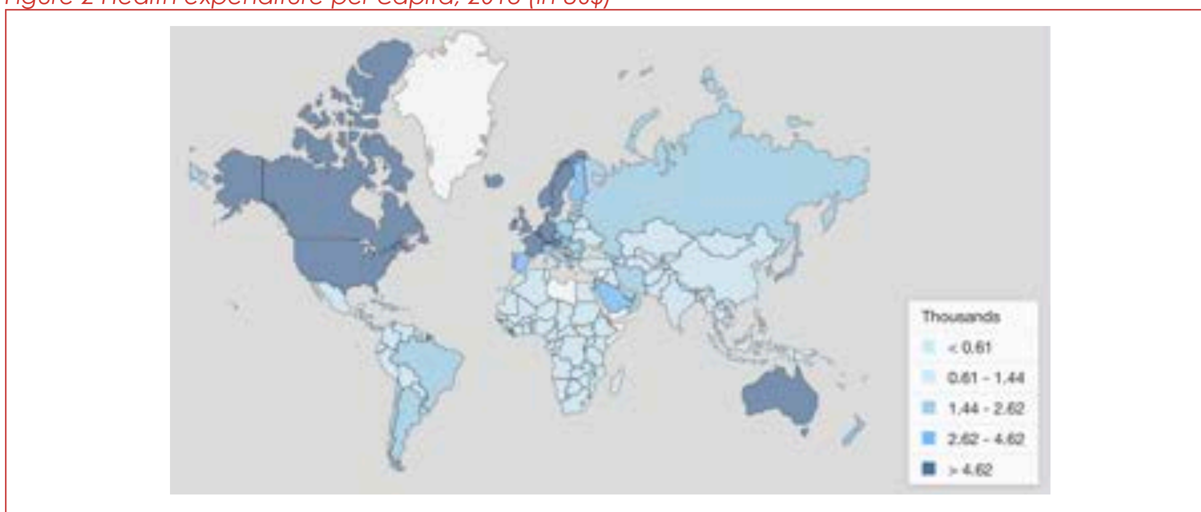
[12] Peters DH, Adam T, Alonge O et al (2013) Implementation research: What it is and how to do it. BMJ 347

improvement studies (which use a cyclical process to continually adapt formulating and implementing a plan, and analysing and interpreting the results), and participatory action (which emphasise participation and action "carried out with and by local people rather than on them").

3.2 The case for implementation science addressing NCDs in LMIC contexts

Evidence to support implementation of interventions aimed at improving health is particularly important in resource-poor countries and communities: Resource poverty requires novel solutions that ensure research results are translated into routine practice.[13] On the one hand, resource-poor countries spend only a fraction of the amount on health per citizen that resource-rich countries spend: In 2018, the average per capita expenditure in LMICs was US$608, compared to nearly US$6000 in high income countries (Figure 2).[14]

Figure 2 Health expenditure per capita, 2018 (in US$)



Source: Reproduced from[15]

At the same time, resource-poor countries experience a far higher level of excess deaths, i.e. deaths that could be reduced through existing effective healthcare interventions if delivered successfully to all those who need them.[16] In 2016, an estimated 15.6 million excess deaths occurred in LMICs.[17] Of excess deaths, around 7 million could have been prevented through public health interventions, and 8.6 million through access to high-quality care. The latter includes around 3.6 million people who did not access the health system (non-utilisation), and 5.0 million who did but received poor-quality care (Figure 3). Hence, the number of people

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[13] Yapa HM, Bärnighausen T (2018) Implementation science in resource-poor countries and communities. Implement Sci. 13(1)

[14] WHO (2018) Fact sheet: Non-communicable diseases

[15] https://data.WorldBank.org

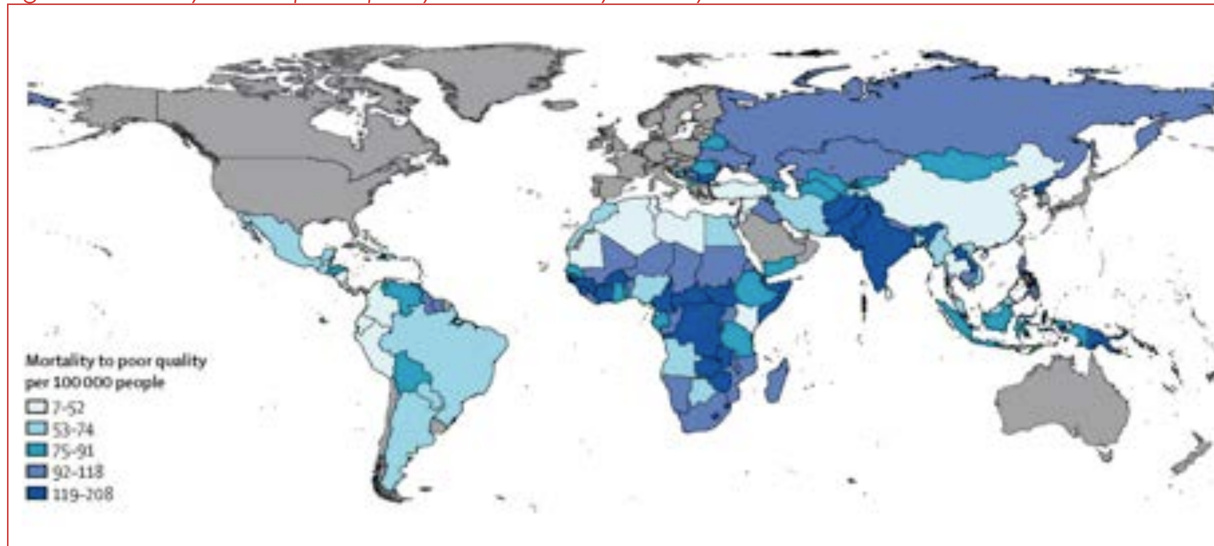
[16] Yapa HM, Bärnighausen T (2018) Implementation science in resource-poor countries and communities. Implement Sci. 13(1)

[17] Kruk ME, Gage AD, Joseph NT et al (2018) Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet 392(10160):2203–12

who received some sort of care but died due to its poor quality is higher than that of people who were unable, or not seeking, access to health services.

Implementation science can provide the evidence necessary to improve effective delivery of health care interventions and support evidence-based policymaking to enhance public health.

Figure 3 Mortality due to poor-quality health care by country



Source: Reproduced from[18]

3.2.1 The chronic disease burden in LMICs

Chronic diseases, or NCDs, are health problems that require ongoing management over a period of years or decades. Numerous physiological changes occur with increasing age, and the risk of chronic disease rises with an increased risk of experiencing more than one chronic condition at the same time (multi-morbidity). Susceptibility to developing an NCD depends on a range of risk factors such as individual lifestyle choices, including obesity, inactivity, smoking and inappropriate use of alcohol.

Globally, NCDs lead to 41 million deaths per year (around 71% of all deaths), with 78% of these (32 million) occurring in LMICs.[19] Particularly younger individuals in LMICs are affected: the probability of a 30-year old dying from an NCD before reaching 70 years old is 21.9% in developing countries – 1.5 times greater than the risk facing individuals in HICs.[20] Premature NCD death rates are highest in lower middle-income countries (503 deaths per 100,000, compared to 290 per 100,000 in HICs).

Of NCDs, cardiovascular diseases (CVD) lead to the largest number of deaths, around 18 million annually. This is followed by cancers (9.0 million), respiratory diseases (3.9 million), and

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[18] Kruk ME, Gage AD, Joseph NT et al (2018) Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet 392(10160):2203–12

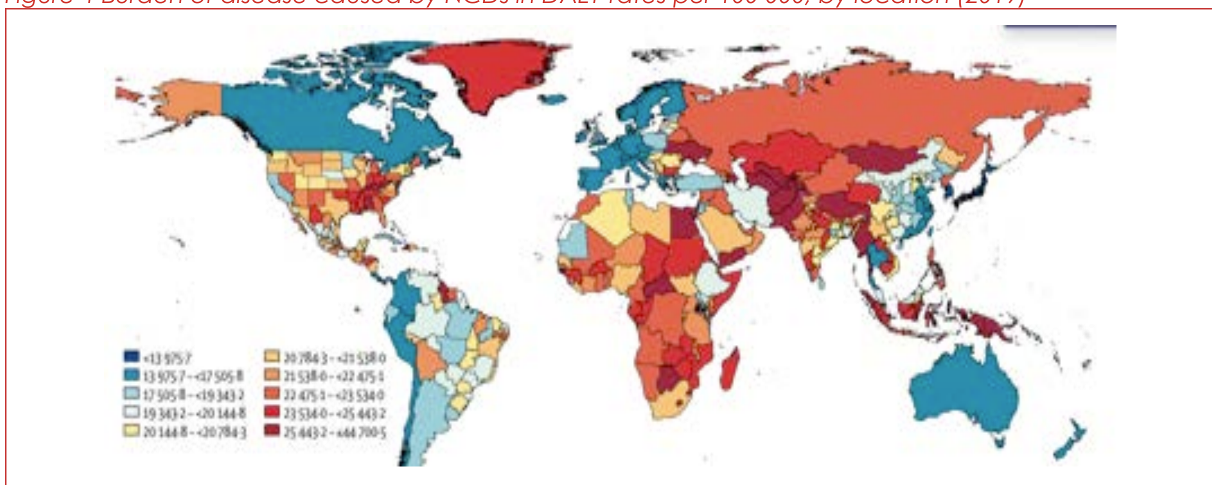
[19] WHO. Global Health Expenditure Database. 2018.

[20] Allen LN, Pullar J, Wickramasinghe KK et al (2018) Evaluation of research on interventions aligned to WHO "Best Buys" for NCDs in low-income and lower-middle-income countries: A systematic review from 1990 to 2015. BMJ Glob Heal. 3(1)

diabetes (1.6 million).[21] Over the past year, the continued global rise in chronic illness and related risk factors, including obesity, high blood sugar, and outdoor air pollution created a perfect storm for fuelling COVID-19 deaths: 1.7 billion people (22% of the global population) have at least one underlying condition that puts them at increased risk of severe COVID-19 if infected.[22]

Those affected by NCD often have to cope with disabilities over many years, representing a large disease burden. In 2019, the number of years lost due to ill-health, disability or early death as a result of NCDs – expressed in DALYs (disability-adjusted life years) – was 1.62 billion, 64% of total DALYs.[23] Similar to premature death rates, LMICs are more strongly affected in terms of DALY rates due to NCDs (while there is also significant variation in some HICs, e.g. the USA) (Figure 4).[24] And the burden of NCDs is increasing, rising by nearly 20% over the past 10 years (NCDs accounted for 43% of total DALYs in 1990).

Figure 4 Burden of disease caused by NCDs in DALY rates per 100 000, by location (2019)



Source: Reproduced from[25]

Many deaths can be averted through public health measures or avoided through quality health care and access to existing interventions. By far the largest number of these excess deaths were due to CVD, making up 34% (5.3 million) of all excess deaths (Figure 5).[26] Of these, around half could have been prevented by population level interventions and half by access to quality health services. Other NCDs with a high number of avertable and avoidable deaths include chronic respiratory conditions (920,000), mental health (540,000) and cancer (490,000).

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[21] WHO. Global Health Expenditure Database. 2018.

[22] Clark A, Jit M, Warren-Gash C et al (2020) Global, regional, and national estimates of the population at increased risk of severe COVID-19 due to underlying health conditions in 2020: a modelling study. Lancet Glob Heal. 8(8):e1003–17

[23] Abbafati C, Machado DB, Cislaghi B et al (2020) 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 396(10258):1204–22

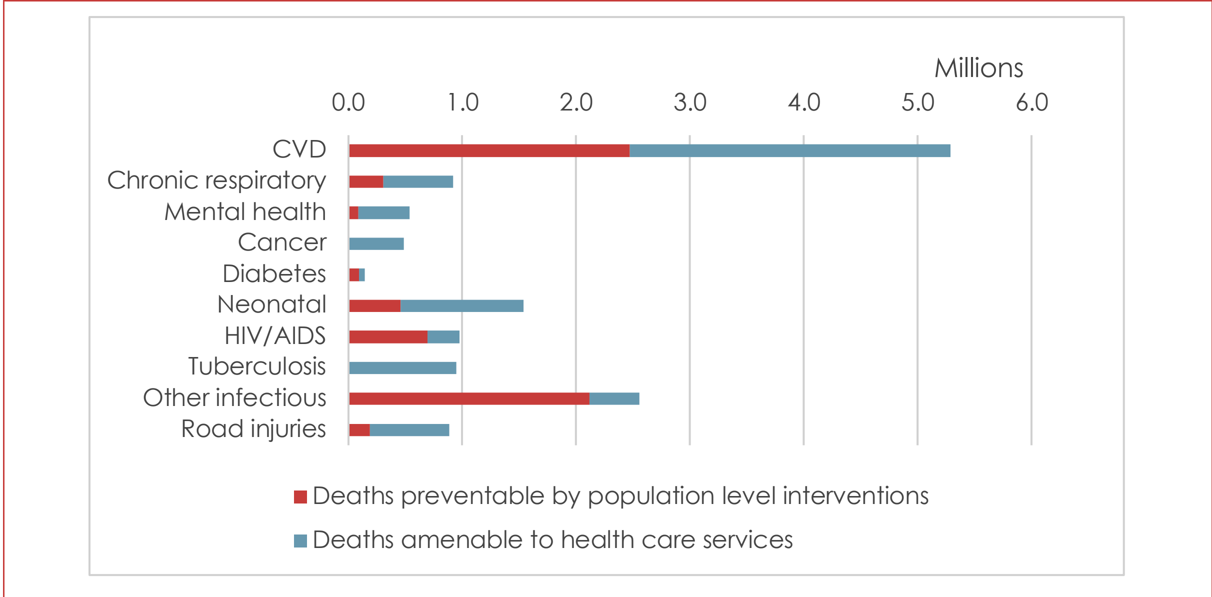
[24] GBD 2019 Diseases and Injuries Collaborators (2020) GBD cause and risk summaries: Non-communicable diseases—Level 1 cause. Lancet

[25] GBD 2019 Diseases and Injuries Collaborators (2020) GBD cause and risk summaries: Non-communicable diseases—Level 1 cause. Lancet

[26] Kruk ME, Gage AD, Joseph NT et al (2018) Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet 392(10160):2203–12

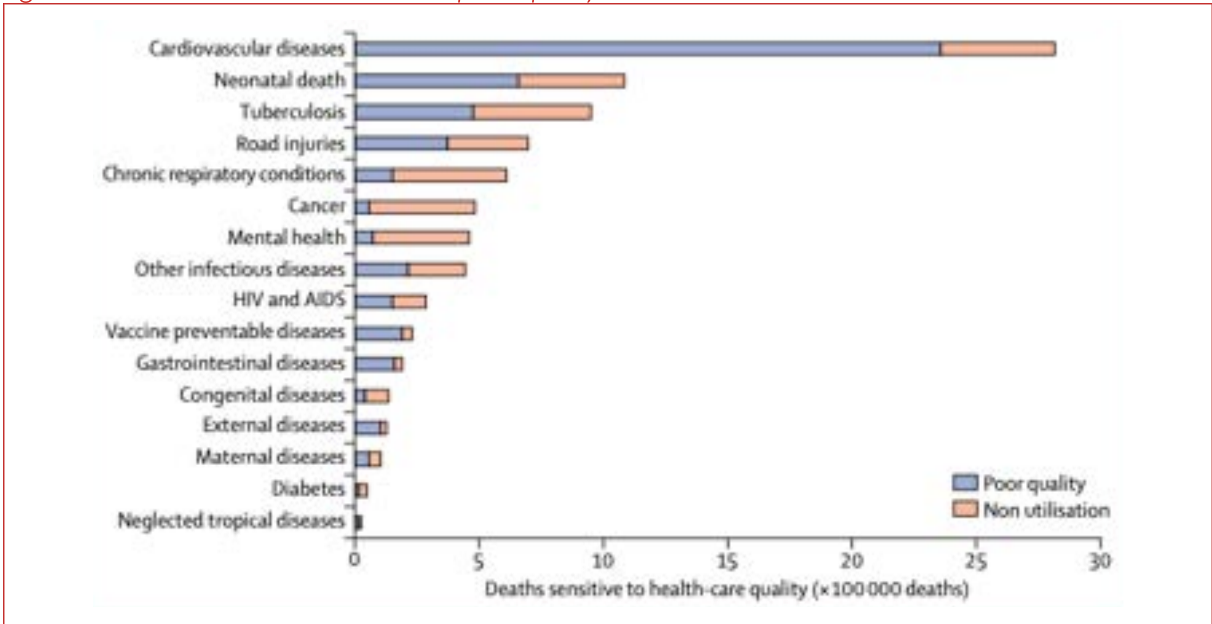
While these latter diseases caused preventable deaths mainly due to individuals not accessing health care services ("non-utilisation"), the majority of preventable deaths from CVD were due to provision of poor-quality care (Figure 6).

Figure 5 Preventable deaths from different conditions in LMICs



Source: Data from[27]

Figure 6 Deaths from conditions due to poor-quality care and non-utilisation in 137 LMICs

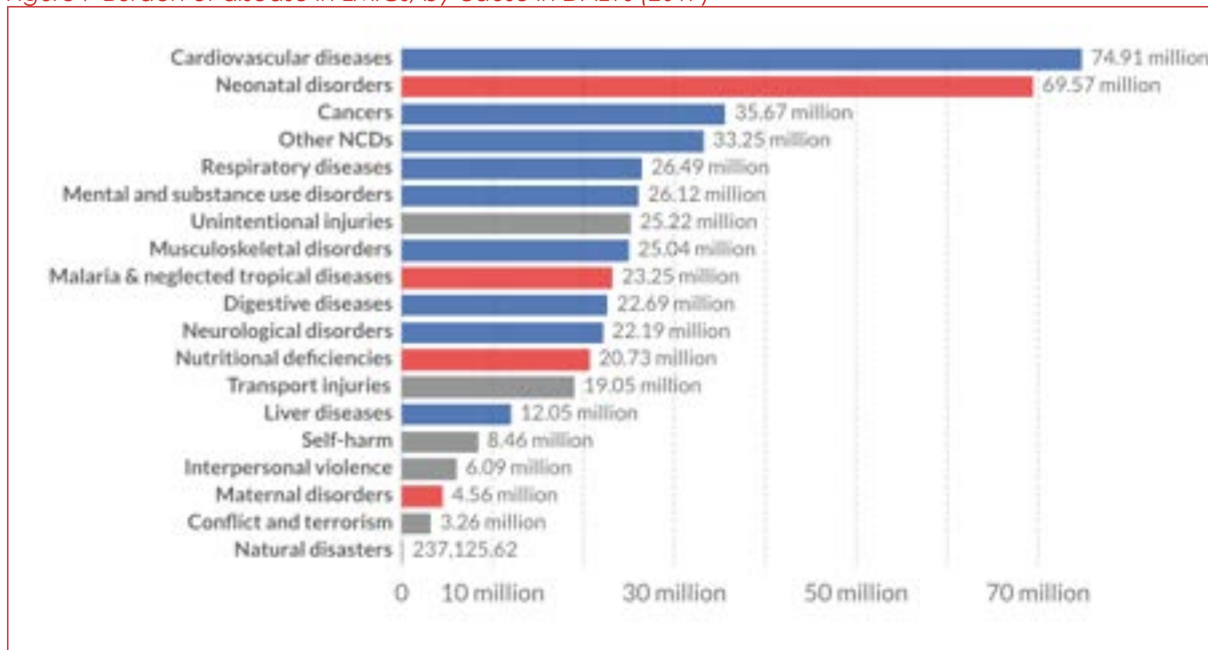


[27] Kruk ME, Gage AD, Joseph NT et al (2018) Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet 392(10160):2203–12

Source: Reproduced from[28]. Estimates were based on a comparison of mortality for conditions amenable to health care between countries with well performing health systems and LMICs.

CVD also represents the largest share of DALYs in LMICs, at around 75 million or 11.7% of the total burden of disease.[29] Cancers, respiratory diseases and mental and substance use disorders accounted for more than 25 million DALYs each (>4% of total DALYs) (Figure 7).

Figure 7 Burden of disease in LMICs, by cause in DALYs (2017)



Source: Reproduced from[30]

As LMICs improve in socio-economic status, their relative burden of disease can be expected to shift further, away from infectious, maternal, neonatal, and nutritional diseases and towards non-communicable causes. [31] Recognising this issue, the United Nations (UN) convened High-level Meetings on NCDs in 2011, 2014, and 2018, which affirmed that NCDs and the promotion of mental health constitute a major challenge for the health and well-being of people and for sustainable development, and strengthened Member States' commitment to act.[32] In 2016, NCDs were included in the Sustainable Development Goals (SDG), as SDG 3.4: by 2030, reduce premature mortality from NCDs by a third and promote mental health and wellbeing.[33]

Susceptibility to developing an NCD is dependent on a variety of risk factors, both behavioural (e.g. tobacco use, physical inactivity, unhealthy diets, harmful use of alcohol) and

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[28] Kruk ME, Gage AD, Joseph NT et al (2018) Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet 392(10160):2203–12

[29] Roser M, Ritchie H. Burden of Disease. Our World in Data. 2016

[30] Roser M, Ritchie H. Burden of Disease. Our World in Data. 2016

[31] Abbafati C, Machado DB, Cislaghi B et al (2020) 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 396(10258):1204–22

[32] UN General Assembly (2018) Political declaration of the third high-level meeting of the General Assembly on the prevention and control of non-communicable diseases

[33] https://www.who.int/health-topics/sustainable-development-goals#tab=tab_1

physiological (e.g. hypertension, obesity, raised blood glucose levels).[34] Reducing these risk factors is hence an important way to control NCDs. The risks link NCDs to poverty: better economic and educational outcomes for households enhance health, while low socioeconomic status carries a higher risk of chronic ill health.[35] NCDs then affect individuals' ability to work which further reduces income status of households – leading to a vicious cycle, where treatment costs and wage loss due to disability worsen impoverishment, which in turn exacerbates the risk of NCDs and other diseases. NCDs require long-term management, especially for patients with multi-morbidities. This affects patients' finances and poses significant challenges to health systems – especially if poorly configured and already burdened with communicable diseases (including epidemics), and maternal, neonatal and nutritional health problems.[36]

Since 2010, the WHO has promoted 24 "best buys", policy options and cost-effective interventions for the prevention and control of major NCDs, which were endorsed by the World Health Assembly in 2017.[37] However, by 2015, only half of the "best buys" interventions had been evaluated in low- and low-middle income countries[38], and a 2019 survey of NCD country capacity found that best buy interventions remained "vastly underutilised globally", particularly in LMICs.[39] Most countries lacked at least one or more clinical guidelines for the four main NCDs, and essential NCD technologies and medicines remained widely unavailable in nearly all LMICs.

Thus, while robust evidence exists for many interventions, there are inequalities in coverage and outcomes. For example, the positive effect of early treatment of CVD with antihypertensive drugs has been well documented[40], and the use of two or more such drugs for people at risk of cardiovascular events is recommended as a best buy intervention in its WHO's 2010 status report on NCDs.[41] However, inequalities in outcomes persist[42], likely linked to inequalities in the coverage of these recommended interventions.[43] The use of prevention drugs for CVD was shown to be higher in HICs and in urban areas in countries of all economic classifications.[44]

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[34] WHO. Global Health Expenditure Database. 2018.

[35] Niessen LW, Mohan D, Akuoku JK et al (2018) Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. Lancet 391(10134):2036–46

[36] Eyowas FA, Schneider M, Yirdaw BA, Getahun FA (2019) Multimorbidity of chronic non-communicable diseases and its models of care in low-and middle-income countries: A scoping review protocol. BMJ Open 9(10)

[37] WHO (2017) "Best buys" and other recommended interventions for the prevention and control of noncommunicable diseases. World Heal Organ. 17(9):28

[38] Allen LN, Pullar J, Wickramasinghe KK et al (2018) Evaluation of research on interventions aligned to WHO "Best Buys" for NCDs in low-income and lower-middle-income countries: A systematic review from 1990 to 2015. BMJ Glob Heal. 3(1)

[39] WHO (2020) Assessing national capacity for the prevention and control of noncommunicable diseases: Report of the global survey 2019

[40] Breda J, Wickramasinghe K, Peters DH et al (2019) One size does not fit all: Implementation of interventions for non-communicable diseases. BMJ 367

[41] WHO (2011) Global status report on noncommunicable diseases 2010

[42] Gheorghe A, Griffiths U, Murphy A et al (2018) The economic burden of cardiovascular disease and hypertension in low- and middle-income countries: A systematic review. BMC Public Health 18(1)

[43] WHO (2020) Assessing national capacity for the prevention and control of noncommunicable diseases: Report of the global survey 2019

[44] Yusuf S, Islam S, Chow C et al (2012) Use of secondary prevention drugs for cardiovascular disease in the community in high-income, middle-income, and low-income countries (the PURE Study): a prospective epidemiological survey. Indian Heart J. 64(1):113

Thus, inequalities are more likely to be the result of a lack of appropriate implementation than a failure of the intervention. An example is the finding of a review that Kenya probably had sufficient quantities of the drugs for those who need them, but lacked the delivery systems to make them accessible to patients.[45]

3.3 Factors affecting impact from implementation research

3.3.1 Embedding implementation research in local systems to enhance use of evidence

Implementation research needs to be relevant to local needs and aligned with policy priorities. An additional key aspect in successful implementation is social validity: the support, or acceptance, for policies and practices from the end-user, e.g. policy makers, implementers, and other stakeholders. Research users also need to be primed and have the capacity to take up findings.[46]

Research that is 'embedded' in local systems, e.g. through active involvement of decision-makers and implementers in the research process and delivery of the research through local structures, ensures that the research is relevant and increases the likelihood that stakeholders are able and motivated to take up findings. Embedded research can also draw on a better understanding of the complex environment in which an intervention is to be implemented, including aspects of an implementation strategy that could lead to its failure and other local players that need to be considered.[47] The latter may include an array of potential 'barriers' (or enablers), from business interests, the media, public and private financing bodies, regulatory agencies, civil society organisations, and religious leaders.

For example, the "Improving Programme Implementation through Embedded Research (iPIER)" initiative funded research studies that produced improvement strategies, including implementation strategies, operationalisation improvements and action plans.[48] An evaluation of the initiative found that the key facilitating factors for subsequent implementation and scale-up were actionability of findings, relevance of research to the local context, and engagement of decision-makers. Programmes that aimed to increase policymakers' capacity for using research evidence were found to be more successful when government partners were engaged through flexible, collaborative approaches that promoted ownership.[49] Collaboration and/or active engagement with policymakers and the policy process was also a key enabler of research from global health trials which incorporated implementation research.[50]

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[45] Ministry of Medical services public health and sanitation (2009) Access to Essential Medicines in Kenya A Health Facility Survey. Moh. 79

[46] Dako-Gyeke P, Asampong E, Afari E et al (2020) Capacity building for implementation research: A methodology for advancing health research and practice. Heal Res Policy Syst. 18(1)

[47] Breda J, Wickramasinghe K, Peters DH et al (2019) One size does not fit all: Implementation of interventions for non-communicable diseases. BMJ 367

[48] Langlois E V., Mancuso A, Elias V, Reveiz L (2019) Embedding implementation research to enhance health policy and systems: A multi-country analysis from ten settings in Latin America and the Caribbean. Heal Res Policy Syst. 17(1)

[49] Vogel I, Punton M (2018) Final Evaluation of the Building Capacity to Use Research Evidence (BCURE) Programme

[50] Technopolis (2019) Review of the Joint Global Health Trials funding scheme

Similarly, community engagement can be an important enabler in ensuring social validity of health interventions and supporting their implementation.[51] This is all the more important for public health measures that aim to change behaviour. For example, a recent evidence review on 'What works for health systems strengthening' concluded that "there is increasing evidence that governance-specific interventions, including civil participation and engaging community members with health service structures and processes, can lead to tangible improvements in health as well as better service uptake and quality of care".[52] Community engagement can play a role across phases in implementation research projects, from identification of key problems or issues to be addressed by the research question, to focus groups or participatory research component during the data collection phase, to assisting in the analysis and interpretation of findings, such as providing local context that helps explain an observed result.[53] Table 2 provides an overview of potential roles for community engagement across project phases.

Table 2 Potential roles for community engagement by phase of implementation research project

Phases in the IR cycle	Potential roles for community engagement
1. Problem identification	Input on key problems or issues to be addressed; understanding context conceptualising key issues; identifying key stakeholders to involve; conducting stakeholder mapping and analysis
2. Design and planning	Shaping key research aims, questions to meet local objectives; input into methodology, especially contextually appropriate approaches for data collection; review of research documents and tools (e.g. protocol, consent forms, instruments)
3. Implementation	Generating awareness and ownership of research project; potential involvement in an intervention being studied, pilot testing of instruments; participating as data collectors or respondents; formal partnership and collaboration with community groups
4. Analysis and interpretation	Interpreting findings; discussing implications; adding contextual depth and nuance to recommendations
5. Knowledge translation	Discussing implications of findings; issue prioritisation, planning and implementation of follow-up action; tailoring evidence to enhance community voice
6. Iteration and adaptation	Establishing ongoing community participatory M&E, social accountability mechanism to increase transparency of key service delivery outcomes

Source: Reproduced from[54], adapted from WHO Implementation Research Toolkit[55]

Users of evidence and interventions thus sit at the heart of implementation science, as reflected in many frameworks for implementation research. For example, a conceptual framework developed by Varallyay and colleagues (2020) sets out a model for embedded implementation research across three stages of stakeholder involvement: 1) Co-production of

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[51] Glandon D, Paina L, Alonge O et al (2017) 10 Best resources for community engagement in implementation research. Health Policy Plan. 32(10):1457–65

[52] Witter S, Palmer N, Balabanova D et al (2019) Evidence review of what works for health system strengthening, where and when? Available via https://www.rebuildconsortium.com/wp-content/uploads/2019/08/HSS-presentation-for-FCDO-03-03-21.pdf

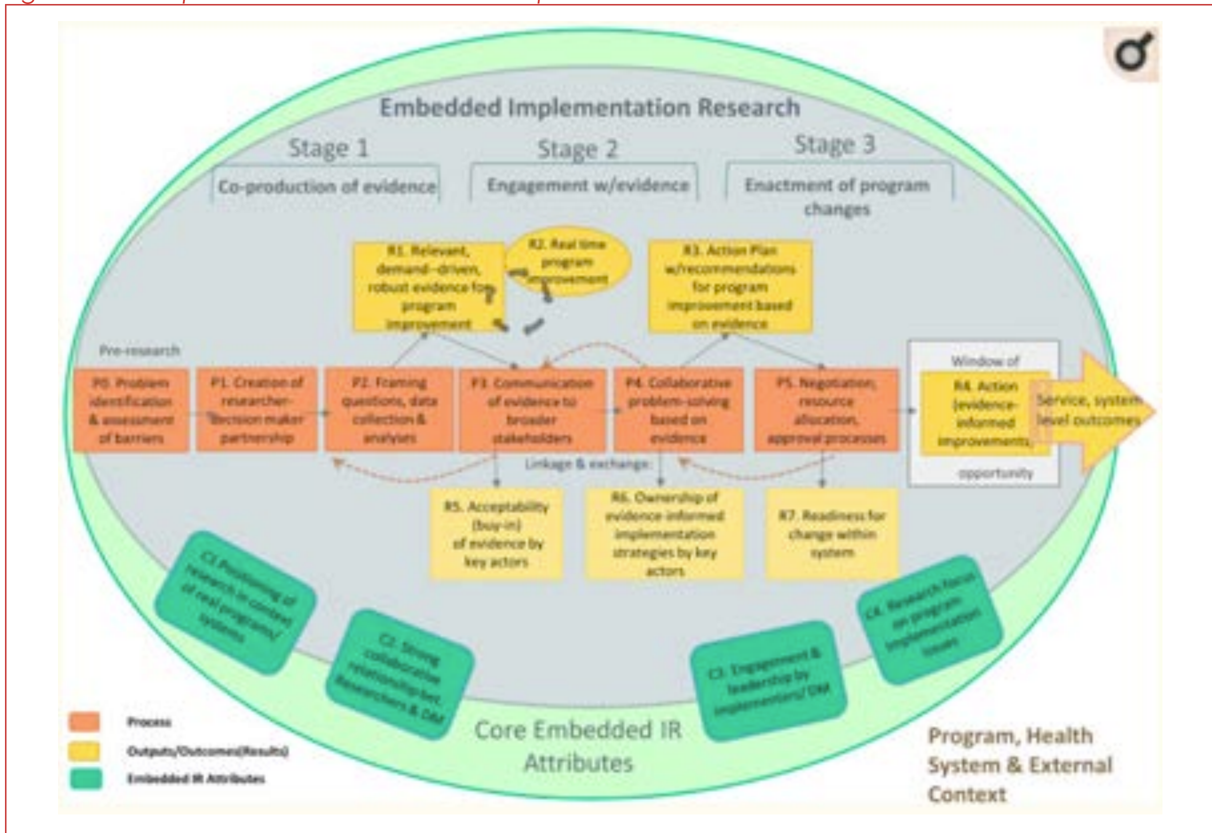
[53] Glandon D, Paina L, Alonge O et al (2017) 10 Best resources for community engagement in implementation research. Health Policy Plan. 32(10):1457–65

[54] Glandon D, Paina L, Alonge O et al (2017) 10 Best resources for community engagement in implementation research. Health Policy Plan. 32(10):1457–65

[55] WHO (2014) Implementation research toolkit: workbook

evidence, including problem identification and framing of data collection and analyses, 2) Engagement with evidence, including communication to the broader stakeholder universe and collaborative problem-solving based on research evidence, and 3) Enactment of programme changes, including negotiation, resource allocation, approval, and implementation (Figure 8).[56] Another commonly used framework, the Consolidated Framework for Implementation Research (CFIR), is organised into five domains, each of which includes the perceptions and motivations of individuals involved.[57,58,59]

Figure 8 Conceptual model for embedded implementation research



Source: Reproduced from[60]

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[56] Varallyay NI, Langlois E V., Tran N et al (2020) Health system decision-makers at the helm of implementation research: Development of a framework to evaluate the processes and effectiveness of embedded approaches. Heal Res Policy Syst. 18(1)

[57] Damschroder LJ, Aron DC, Keith RE et al (2009) Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. Implement Sci. 2009;4(1)

[58] Safaeinili N, Brown-Johnson C, Shaw JG et al (2020) CFIR simplified: Pragmatic application of and adaptations to the Consolidated Framework for Implementation Research (CFIR) for evaluation of a patient-centered care transformation within a learning health system. Learn Heal Syst. 4(1)

[59] Keith RE, Crosson JC, O'Malley AS et al (2017) Using the Consolidated Framework for Implementation Research (CFIR) to produce actionable findings: A rapid-cycle evaluation approach to improving implementation. Implement Sci. 12(1)

[60] Varallyay NI, Langlois E V., Tran N et al (2020) Health system decision-makers at the helm of implementation research: Development of a framework to evaluate the processes and effectiveness of embedded approaches. Heal Res Policy Syst. 18(1)

A recent review of the Joint Global Health Trials Initiative, a programme funded by the UK MRC, UK FCDO, Wellcome and the UK NIHR, examined enablers of and barriers to policy influence, implementation, and scale-up encountered.[61] The study found that strong engagement of decision makers supported the implementation of research findings. This led to the development of a model of conditions that enable policy and health outcomes based on the review findings (Figure 9). This model separates enablers into two categories:

- Enablers driven by utility of data and external conditions, dictating whether research evidence 'can' (in principle) be used and implemented
- Enablers driven by human factors (awareness, understanding, and buy-in), dictating whether individuals involved in the process 'want to' respond to the change warranted by the research evidence

Figure 9 Model of conditions enabling policy and health outcomes

	Policy	**Implementation**	**Scale-up**
Utility of research evidence	***"Can use"***	***"Can implement"***	***"Can scale up"***
	Research evidence: • Demonstrates conclusive option for uptake into policy • Is not in conflict with existing evidence OR • Is of sufficient strength to demonstrate superior policy option, over conflicting evidence • To avoid delay in uptake: is reported at the right point in the policy cycle	Implementing organisation: • Can afford the change/ intervention (if cost implication) • All necessary conditions to implement the change are in place, incl.: – community acceptance – necessary infrastructure – healthcare worker skills – communication channels and organisational change capacity – secure conditions, e.g. no war, environmental disasters	Research evidence: • Is relevant to and can be applied to other contexts; 'generalisable'
Stakeholder knowledge and buy-in	***"Want to use"***	***"Want to implement/adopt"***	***"Want to scale up"***
	Policy makers: • Are aware of / involved in research and understand options for take up into policy • Are aware of the health systems need the research addresses • Have prioritised the policy addressed in research • Feel a level of ownership over research and policy option (buy-in)	Implementing organisation: • Can overcome potential resistance to change within the system • Has bought into the policy change; feels a level of ownership	Policy makers and implementing organisations outside the study context: • Are aware and interested in intervention • Can overcome potential resistance present in other contexts

Source: Adapted from Technopolis[62]

Funders can play an important role in shaping research projects by setting the 'right' expectations and providing the necessary resources. The ESSENCE initiative review of 'good practice' in funding implementation research highlighted seven overarching approaches for

[61] Technopolis (2019) Review of the Joint Global Health Trials funding scheme

[62] Technopolis (2019) Review of the Joint Global Health Trials funding scheme

funding organisations to consider when investing in implementation research to enable impact.[63] These range from full stakeholder involvement and embedding of research into local systems, to partnerships with diverse stakeholders and across research communities, training opportunities, and flexibility in the face of evolving research methodologies (see Box 1). These approaches reflect the interconnected nature of implementation science and the need for extensive consultation, coordination and collaboration.

Box 1 Seven 'good practice' approaches to funding implementation research

1. Include all stakeholders from the inception of the research process. Funders are in a position to mandate and facilitate partnerships between researchers and end-users, but must remain alert to process issues and be willing to work iteratively and/or offer supplementary training for various stakeholders. This can also include funding new platforms that link funders and researchers with practitioners and policymakers.
2. Embrace the diversity of being involved in implementation research. Funders' investments tend to be guided by their organisations' strategic plans; however, implementation research may require a longer timeline and the ability to fund a broader range of organisational types. In the short term, a more ad hoc approach to funding implementation research can produce results; in the long-term, organisations may need to shift strategic thinking and planning to fully embrace this type of research.
3. Expect and enable implementation research practices to evolve. As new methodologies and frameworks for implementation research are emerging, funders and research institutions need to remain alert and responsive to the challenges and opportunities these offer.
4. International partnerships are important; join one or form one. By pooling expertise and resources, funders increase the likelihood that interventions will make an impact beyond discovery research and create sustainable health improvements.
5. Integrate training, mentoring and fellowships into implementation research programmes. There is a need for capacity building linked to implementation research, at the level of funders, researcher, health practitioners and policymakers.
6. Communicate funding criteria clearly. With many definitions and frameworks in use, it is crucial to clearly state the specifications and review criteria, and enable LMIC researchers to compete, in the absence of formal training or mentorship in proposal writing.
7. Embed implementation research into health systems. Outcomes of research projects must be envisioned and designed to become an integral part of health systems.

Source: ESSENCE on Health Research[64]

3.3.2 *Challenges to uptake of research evidence*

Given the complexity of the systems within which health interventions are delivered, with many interrelated components, unresolved issues in some areas can limit progress of implementation of an intervention. Barriers that impede scale-up of interventions were found to include the complexity of the intervention itself and a lack of a technical consensus, as well as capacity issues related to limited human resource, leadership, management, and health systems.[65] In addition, research evidence and developed interventions may not apply across different settings due to differences in context.

Complexity of implementation pathways: Interventions that target social determinants of health, i.e. conditions in the environments in which people live and work, often require collaboration with sectors outside the health system, including government departments such

[63] ESSENCE on Health Research (2020) Seven Approaches to Investing in Implementation Research in Low- and Middle- Income Countries

[64] ESSENCE on Health Research (2020) Seven Approaches to Investing in Implementation Research in Low- and Middle- Income Countries

[65] Yamey G (2012) 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. 8

as education, housing, and policing and the corporate sector.[66] However, nearly all systems of public administration are vertical and tend to make decisions in silos, prioritising actions that benefit the budget holder's 'core' area rather than health. In addition, the successful implementation of interventions is affected by how service delivery is structured, e.g. whether an NCD unit is in or outside a ministry. As such, an evaluation of the iPIER initiative found that political processes were among the main barriers to implementation and scale-up.[67] Successful implementation of interventions depending on multiple players in the system is also strongly dependent on the motivations of the various individuals involved (see also Figure 9). For example, a systematic review of barriers and enablers to guideline implementation strategies to improve obstetric care practice in LMICs found that "high" and "low" intrinsic motivation of health care professionals were overall enablers and barriers, respectively, of successful guideline implementation.[68]

Gaps in implementation research activity: Several studies have highlighted gaps in research activity addressing issues of implementation. A recent review found that while the body of implementation research on novel approaches to *delivery* of evidence-based practice in routine care is growing, including approaches to create higher-skilled health workers, task-shifting, new technologies and models of care, comparatively few studies investigate approaches to change the *behaviour and utilisation* of healthcare resources, e.g. strategies to change health worker behaviour, and political and institutional factors.[69] An analysis of 791 implementation research studies in LMICs identified over the 1998 to 2016 period found that less than 5% addressed problems of scale-up and sustainability of interventions.[70] This points to a disconnect between supply and demand: most studies centred on evaluating an intervention, while key implementation questions in most settings are concerned with how to scale up or sustain an intervention.

In addition, the review found that most implementation research studies in LMICs had not been conducted under 'real world' conditions for management and financing, i.e. researchers had considerable influence over how the intervention was implemented and provided extra resources.[71] This limits the extent to which learning can be applied to commonly found settings and available resources and reduces the level to which findings can be taken up into routine practice. Studies also tended to use 'traditional fixed research designs' rather than allowing for adaptation and learning to take account of changing conditions.

A lack of data for LMICs to inform research and implementation: The evidence base and routine health data collection gathered in LMICs is limited compared to HICs. For example, the disease burden of many NCDs is not known. Global burden of disease studies produced

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[66] Isaranuwatchai W, Teerawattananon Y, Archer RA et al (2020) Prevention of non-communicable disease: Best buys, wasted buys, and contestable buys. BMJ 368

[67] Langlois E V., Mancuso A, Elias V, Reveiz L (2019) Embedding implementation research to enhance health policy and systems: A multi-country analysis from ten settings in Latin America and the Caribbean. Heal Res Policy Syst. 17(1)

[68] Stokes T, Shaw EJ, Camosso-Stefinovic J et al (2016) Barriers and enablers to guideline implementation strategies to improve obstetric care practice in low- and middle-income countries: A systematic review of qualitative evidence. Implement Sci. 11(1)

[69] Yapa HM, Bärnighausen T (2018) Implementation science in resource-poor countries and communities. Implement Sci. 13(1)

[70] Alonge O, Rodriguez DC, Brandes N et al (2019) How is implementation research applied to advance health in low-income and middle-income countries. BMJ Glob Heal. 4(2)

[71] Alonge O, Rodriguez DC, Brandes N et al (2019) How is implementation research applied to advance health in low-income and middle-income countries. BMJ Glob Heal. 4(2)

modelled estimates derived from existing, but patchy, data of common risk factors trends.[72] For air pollution, minimal data exist on the exposure–risk relationships associated with high levels of pollution.[73] The WHO found that NCD surveillance systems are insufficiently robust to ensure the regular collection of national-level data on key risk factors.[74] Surveillance and monitoring systems need to be expanded to improve the data available and to monitor trends in LMICs. Little is also known about the quality of care in LMICs for a range of diseases, such as cancer, mental health, and respiratory diseases, and for some patient groups, such as care of adolescents and elderly people.[75] Other knowledge gaps in low-income country contexts include the area of social values, with few research studies focussing on this area.[76]

Capacity of end users: Policy makers and implementers need to be able (and motivated) to make use of the evidence generated (see Figure 9). However, in many instances, even though policies are drafted and in place, countries do not have the capacity to implement the interventions at scale (Breda et al., 2019).[77] For example, a systematic review of capacity building for policymakers and planners relevant to mental health systems in LMICs identified few interventions to enhance capacity of this stakeholder group.[78] If available, capacity building mostly combined brief training with longer term mentorship, discussions and/or the establishment of networks of support. However, the review found that the effectiveness of these capacity building activities was rarely assessed. One exception is DFID's Building Capacity to Use Research Evidence (BCURE) programme, 2013-2017.[79] BCURE's goal was "to increase the ability of decision makers in the South to use research evidence for decision making". The evaluation found that BCURE was initially framed as a technical programme, but that experiences in implementing the programme highlighted the strong political dimension in the use of evidence. The evaluation emphasises "the messy, political nature of evidence use in policymaking, and the importance of moving away from 'rational' understandings of policy processes towards a deeper understanding of the political and power dynamics that affect the extent to which evidence is used."

Capacity of LMIC researchers: NCD research needs to be locally relevant to inform policy and practice. Local researchers are fully embedded in the local context and thus best suited to

[72] Ebrahim S, Pearce N, Smeeth L et al (2013) Tackling Non-Communicable Diseases In Low- and Middle-Income Countries: Is the Evidence from High-Income Countries All We Need? PLoS Med 10(1)

[73] Shaffer RM, Sellers SP, Baker MG et al (2019) Improving and expanding estimates of the global burden of disease due to environmental health risk factors. Environ Health Perspect.127(10):105001-1-105001–16

[74] WHO (2020) Assessing national capacity for the prevention and control of noncommunicable diseases: Report of the global survey 2019

[75] Kruk ME, Gage AD, Joseph NT et al (2018) Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet 392(10160):2203–12

[76] Whyle E, Olivier J (2020) Social values and health systems in health policy and systems research: A mixed-method systematic review and evidence map. Health Policy Plan 35(6):735–51

[77] Breda J, Wickramasinghe K, Peters DH et al (2019) One size does not fit all: Implementation of interventions for non-communicable diseases. BMJ 367

[78] Keynejad R, Semrau M, Toynbee M et al (2016) Building the capacity of policy-makers and planners to strengthen mental health systems in low- and middle-income countries: A systematic review. BMC Health Serv Res.16(1)

[79] Vogel I, Punton M (2018) Final Evaluation of the Building Capacity to Use Research Evidence (BCURE) Programme

generate locally relevant evidence.[80,81,82] Capacity strengthening of LMIC researchers hence plays an important role in building a local evidence-base with which to inform policy, tailoring research to the needs and conditions of the local setting, and in ensuring the sustainability of research programmes addressing complex health issues such as NCDs.

A review of the academic and grey literature published between 2000 and 2013 found that capacity to conduct health research in Africa had increased considerably since 2000, exemplified by increases in the number of clinical trials conducted in LMICs, and reports of enhanced trial capacity and quality standards, and greater LMIC inclusion.[83] Despite this trend, global health research still predominantly originates in HICs. For example, an analysis of 236 articles published from 2013 to 2017 in The Lancet Global Health found that only around 35% of authors were affiliated with or came from LMICs, whilst 92% of these articles addressed interventions in these countries.[84]

There is little consensus on how best to design programmes aimed at developing capacity in global health.[85,86] Four main modalities for capacity building, each associated with reported advantages and issues, were identified through a literature review (Table 3).[87] However, their relative effectiveness remains unclear, as few empirical studies were available and monitoring and evaluation is lacking or not reported publicly. A second literature review found that research publications on health research capacity strengthening had increased exponentially between 2000 and 2016, but that most of these were perspective, opinion or commentary pieces. The study concluded that "a health research capacity strengthening research field with a focus on implementation science is emerging, although the conceptual and empirical bases are not yet sufficiently advanced to effectively inform programme planning".[88]

Table 3 Modalities for research capacity building in LMICs

	Description	Reported advantages	Reported issues
Vertical Research projects	HIC collaborator working in a LMIC to conduct applied, usually short-term research projects with narrow objectives	Maintains focus on a specific scientific mission Delivers research outputs quickly and to high quality	External management bypasses local research institutions, which do not receive investment Capacity building typically short term and project specific

[80] Dean L, Gregorius S, Bates I, Pulford J (2017) Advancing the science of health research capacity strengthening in low-income and middle-income countries: A scoping review of the published literature, 2000-2016. BMJ Open 7(12)

[81] Franzen SRP, Chandler C, Lang T (2017) Health research capacity development in low and middle income countries: Reality or rhetoric? A systematic meta-narrative review of the qualitative literature. BMJ Open 7(1)

[82] Haregu TN, Byrnes A, Singh K et al (2019) A scoping review of non-communicable disease research capacity strengthening initiatives in low and middle-income countries. Glob Heal Res Policy 4(1)

[83] Franzen SRP, Chandler C, Lang T (2017) Health research capacity development in low and middle income countries: Reality or rhetoric? A systematic meta-narrative review of the qualitative literature. BMJ Open 7(1)

[84] Iyer AR (2018) Authorship trends in The Lancet Global Health. Lancet Glob Heal. 6(2):e142.

[85] Dean L, Gregorius S, Bates I, Pulford J (2017) Advancing the science of health research capacity strengthening in low-income and middle-income countries: A scoping review of the published literature, 2000-2016. BMJ Open 7(12)

[86] Franzen SRP, Chandler C, Lang T (2017) Health research capacity development in low and middle income countries: Reality or rhetoric? A systematic meta-narrative review of the qualitative literature. BMJ Open 7(1)

[87] Franzen SRP, Chandler C, Lang T (2017) Health research capacity development in low and middle income countries: Reality or rhetoric? A systematic meta-narrative review of the qualitative literature. BMJ Open 7(1)

[88] Dean L, Gregorius S, Bates I, Pulford J (2017) Advancing the science of health research capacity strengthening in low-income and middle-income countries: A scoping review of the published literature, 2000-2016. BMJ Open 7(12)

	Research capacity building not usually among primary objectives Often strong expatriate leadership and management by external institutions	Develops capacity to deliver research outputs quickly	Local researchers often only have support roles At close of project, research sites and individuals are rarely left with skills or resources to conduct their own studies Leads to fragmentation of national research system
Centres of excellence	Investment in a few institutions that show potential to excel and become high-quality self-sustaining sites	Increase likelihood of high-quality research and renewed investment	Some result in 'annexed' research sites, led and managed by expatriate staff Creates research structures outside the national systems, depleting the local resource pool (unless emphasis on LMIC leadership and integration)
North-South partnership	Usually project specific More emphasis on sustainable research, shared leadership and mutual benefit than vertical research projects	Increase resource flows to LMICs Increased training and knowledge sharing Access to cutting-edge technology	Due to requirement to collaborate with HIC institutions, too few benefits are accrued by the Southern partner (e.g. little financial benefit, lack of recognition, loss of intellectual property rights)
Networks and consortia	Link multiple research departments, groups or institutions	Encourage less hierarchical leadership Enable working cooperatively on shared problems at regional or global levels Achieve critical mass through pooling of knowledge and resources Help focus on common research priorities Can lead to long-term relationships and sustainability	Most focus on specific research themes and do not develop capacity at research system level

Source: [89]

Transferability of research results: Given that much of the evidence in implementation originated in HICs, e.g. on WHO best buys[90], there are concerns that these study findings are not easily transferable to LMICs which differ in their disease profiles, population characteristics, economic structures, health systems platforms, and other distinctive local characteristics.[91] Determinants upstream of known causes of NCDs may differ between LMICs and HICs. For example, high blood pressure, dyslipidaemia, and smoking are important causes of CVD globally, but the upstream causes that influence behaviours and the social, fiscal, and legal environments determining these vary between HICs and LMICs.[92] Conditions with high

[89] Franzen SRP, Chandler C, Lang T (2017) Health research capacity development in low and middle income countries: Reality or rhetoric? A systematic meta-narrative review of the qualitative literature. BMJ Open 7(1)

[90] Allen LN, Pullar J, Wickramasinghe KK et al (2018) Evaluation of research on interventions aligned to WHO "Best Buys" for NCDs in low-income and lower-middle-income countries: A systematic review from 1990 to 2015. BMJ Glob Heal. 3(1)

[91] Isaranuwatchai W, Teerawattananon Y, Archer RA et al (2020) Prevention of non-communicable disease: Best buys, wasted buys, and contestable buys. BMJ 368

[92] Ebrahim S, Pearce N, Smeeth L et al (2013) Tackling Non-Communicable Diseases In Low- and Middle-Income Countries: Is the Evidence from High-Income Countries All We Need? PLoS Med 10(1)

prevalence in LMICs (but not HICs) also need to be taken into consideration. For example, strong associations have been demonstrated between HIV/AIDS and cardiometabolic disorders, smoking and tuberculosis, and diabetes and tuberculosis.[93] Generating context-specific knowledge for each country, setting, and target group is however time and resource-intensive, particularly when addressing the multidimensional determinants of NCDs.[94] This requires involvement from all levels of policy making, prevention, and management from the planning stages onwards to ensure appropriate and effective implementation.

In addition, the limited resources available in LMICs require novel solutions rather than adoption of HIC routine practice. But even where evidence may be transferable, there are no guidelines as to how international research findings can be implemented in different LMIC settings with varying implementation capacities.[95] Implementation research can generate the evidence needed to develop these solutions, inform practice, and make a positive impact on health across different contexts and implementation problems.[96]

[93] Ebrahim S, Pearce N, Smeeth L et al (2013) Tackling Non-Communicable Diseases In Low- and Middle-Income Countries: Is the Evidence from High-Income Countries All We Need? PLoS Med 10(1)

[94] Breda J, Wickramasinghe K, Peters DH et al (2019) One size does not fit all: Implementation of interventions for non-communicable diseases. BMJ 367

[95] Isaranuwatchai W, Teerawattananon Y, Archer RA et al (2020) Prevention of non-communicable disease: Best buys, wasted buys, and contestable buys. BMJ 368

[96] Theobald S, Brandes N, Gyapong M et al (2018) Implementation research: new imperatives and opportunities in global health. Lancet 392(10160):2214–28.

4 The GACD intervention logic

A programme logic model (PLM) is a structured schematic frequently developed to set out what a programme (or intervention) is intending to achieve and how, in response to the needs identified. It describes the causal relationships linking the programme's objectives, the resources used (inputs, e.g. funding, staff resources) to enable activities (e.g. delivery of research projects, networking activities and trainings), which lead to a set of expected results (outputs, e.g. new research data, improved skills of individuals involved). These in turn are expected to lead to changes (outcomes) within different timeframes after the activities are completed, in the medium-term (e.g. health professionals trained) and long-term (e.g. improved health interventions). Eventually, the outcomes contribute to addressing the needs the programme was intended to tackle – the impacts (e.g. patient and population benefit), based on a set of assumptions and influenced by external factors.

A simplified, linear model cannot capture the full complexity of how knowledge is translated and leads to impacts – for example, it can be expected that information and learning from outputs and outcomes feed back into the programme's activities, and that an increase in researchers' skills will lead to enhanced progress of future research projects. However, the PLM is an important tool to guide and structure the evaluation of the programme's impact: anticipated outputs, outcomes, and impacts can be linked to a set of indicators that evidence whether, and to what degree, the programme is progressing against its objectives.

4.1 Description of the GACD Logic Model

Based on the draft impact framework provided by GACD, review of available documentation and scoping conversations with GACD staff, a PLM for GACD was retrospectively developed. It is described in further detail below and summarised in Figure 10.

Within the PLM, each element is assigned to a 'domain' – the area for which it has most relevance. These are:

- The 'GACD research funding/programme domain'. These are aspects pertaining to direct GACD and Associate Member inputs and the design and implementation of GACD processes. They include governance and strategy development as well as project funding and staff resource (inputs).
- The 'Research domain'. These are aspects pertaining directly to the delivery of GACD research projects by researchers. They represent the core research pathway, i.e. based on interventions known to be effective (inputs), research activities funded by the GACD award (activities) lead to new methods and knowledge (outputs) which in turn inform and improve further research and help secure further funding (outcomes).
- The 'Capacity building domain'. These are aspects pertaining to building human capacity in NCD-IS. This includes existing expertise (input), through training and networking (activities), leading to knowledge exchange and career progression (outcomes) and ultimately to increased capacity to generate relevant knowledge in NCD-IS (outcome).
- The 'Societal/health domain'. These are aspects pertaining to collaboration with and knowledge creation for decision makers with the aim to generate benefits to patients and the public. Researchers and collaborators work with pre-existing structures and sometimes local collaborators' resources (input). Knowledge generated during projects can support decision making on multiple levels (locally, nationally, internationally), leading to improved

policies and systems and can also directly influence individual health behaviours. Jointly, these may ultimately lead to reduced NCD morbidity and mortality (impact).

Needs

Morbidity and mortality due to NCDs is on the rise globally and disproportionately affects people in LMICs and disadvantaged populations in HICs. While many interventions are proven to be effective at lowering NCD burden, they are not always implemented. There is a lack of understanding of why this is the case, and how evidence-based interventions can be adapted and scaled up in ways that are accessible and equitable. This is the need that GACD seeks to address.

Assumptions

GACD is based on the assumption that both research funding and capacity building can enhance the evidence base, and that this is most effective and efficient as a joint activity that is coordinated between funders. It is assumed that funding local researchers and involvement of local stakeholders increase the relevance of the research projects to the local context, which in turn enhances the chance for successful implementation of research results. Along the causal chain of events needed for the research evidence to contribute to the desired impact, there are a number of important assumptions, including a favourable social, cultural and economic environment facilitating implementation.

Objectives

The objectives of GACD are to **provide an evidence base that informs management of chronic diseases and policies to reduce the health burden attributable to NCDs.** GACD is focussed on LMICs and disadvantaged populations in HICs, **aiming to minimise the systematic and avoidable differences in the health status** of different population groups within and between countries. In scope are the **implementation and scale-up of proven interventions** and policies for the prevention, detection or management of NCDs in LMICs and disadvantaged populations in HICs.

It aims to achieve these objectives through

- Investing in impactful NCD-IS research
- Building capacity in NCD-IS
- Facilitating collaborations and partnerships

Inputs

Delivery of GACD activities is based on a number of inputs:

Associate Members make funding available to fund research projects and to support GACD operations and centrally organised capacity strengthening activities. Staff time and administrative systems, both from the GACD secretariat and from Associate Members directly, enable the delivery of the activities. Pre-existing knowledge about interventions with proven efficacy is needed as input from the research domain and forms the basis for assessing effectiveness of these interventions in context and barriers to implementation. Human capacity in the form of researchers that are experienced and knowledgeable in NCD-IS form the basis not only for quality proposals, but also for the peer review and committee selection processes. Collaboration with research users (e.g. policy makers, payers, health care workers) is desirable for GACD projects, and they may contribute in-kind or through direct financial support (e.g. staff time not funded through GACD grants, local authorities paying for the delivery of the intervention in question) to GACD projects.

Activities

Pre-award activities are mostly taking place in the funding / programme domain. A key feature of GACD calls is that each funding call has a specific thematic focus, which varies from call to call and is determined in a joint priority setting process across funders. Scope and selection criteria are jointly agreed in a single call text and disseminated via GACD as well as the funders' websites, to universities and more broadly via social media. GACD provides a call portal that gives an overview of all participating funding agencies with their respective requirements and allows researchers to submit their applications directly to GACD. The GACD secretariat then runs a central review process which underpins (most) funder's final funding decisions. The GACD secretariat also facilitates conversations between funding agencies to co-fund specific proposals where teams are based in multiple countries.

As GACD Associate Members come from different countries around the world, so do project researchers. Eligibility criteria of several funders from high income countries (e.g. European Commission, UK MRC) encourage or mandate research projects to be led by or in collaboration with researchers based in LMICs. These cross-regional (LMIC-HIC) collaborations are actively encouraged by many GACD Associate Members, with an explicit emphasis on equitable collaboration and joint project management. There are a number of other desiderata for GACD research team composition, including involvement of early career researchers, interdisciplinarity and user involvement. GACD does not currently facilitate networking among applicants prior to the formal application process but is considering doing so in the future.

Post-award activities concern the delivery of the actual research projects, which are expected to have a capacity building element, as well as a range of capacity building activities provided by GACD. The themed nature of GACD calls means that projects from each call have a shared thematic focus, and GACD further supports joint working, coordination and knowledge exchange among the projects funded in each call ('research programmes'). Representatives from the research programmes are convened annually in a dedicated session at the Annual Scientific Meeting. For each research programme, two co-chairs are elected by the research teams who will act as a conduit between GACD and the research teams, collecting and disseminating information on activities.

GACD puts strong emphasis on networking and training and provides a number of supportive activities. All GACD-funded researchers automatically become part of the GACD network, which gives them access to tailored communications, webinars as well as the Annual Scientific Meeting. GACD also supports GACD-funded researchers to work together in working groups that address key topics in NCD-IS with relevance across multiple disease areas. Working groups will generally work towards an agreed deliverable, such as a joint publication.

Since 2018, GACD organises an annual implementation science school for early- and mid-career researchers (GACD-funded researchers and others), in order to provide equitable access and learning for researchers from all regions. Costs for attending events are generally supported through the grant commitments made by Associate Members (for researchers involved in a GACD project, for others participation is free but they need to cover their own travel expenses), whereas costs for the organisation of meetings and speakers' expenses are covered out of the GACD secretariat budget.

Outputs

Outputs are the immediate results of the activities.

In the research domain, a key output is evidence that is new and relevant to decision makers and the dissemination of this knowledge through academic and non-academic channels.

Further outputs include new or enhanced datasets, methodological advances and tools and resources.

Outputs in the capacity building domain include training and knowledge sharing (incl. an e-learning platform and training materials) as well as new networks. The emphasis on user involvement in projects, as well as the applied nature of implementation science means research users such as policy makers, healthcare professionals and individuals are more aware of evidence-based interventions and implementation science and are likely to gain themselves new knowledge and skills (through formal training or informally) as part of the project.

Outcomes

Outcomes will accrue at different rates during or following the conclusion of a research project. Outcomes are usually beyond the direct remit of the funded research programme and progression from outputs to outcomes usually requires sources of further funding and all necessary skills and infrastructure to be available. As noted above, many GACD projects are still ongoing, or have only finished recently. While for many it may be too early for (some of) these outcomes to have occurred, some exceptional projects may be very applied in nature and embedded in decision making processes so that emergence of outcomes co-occur with the project.

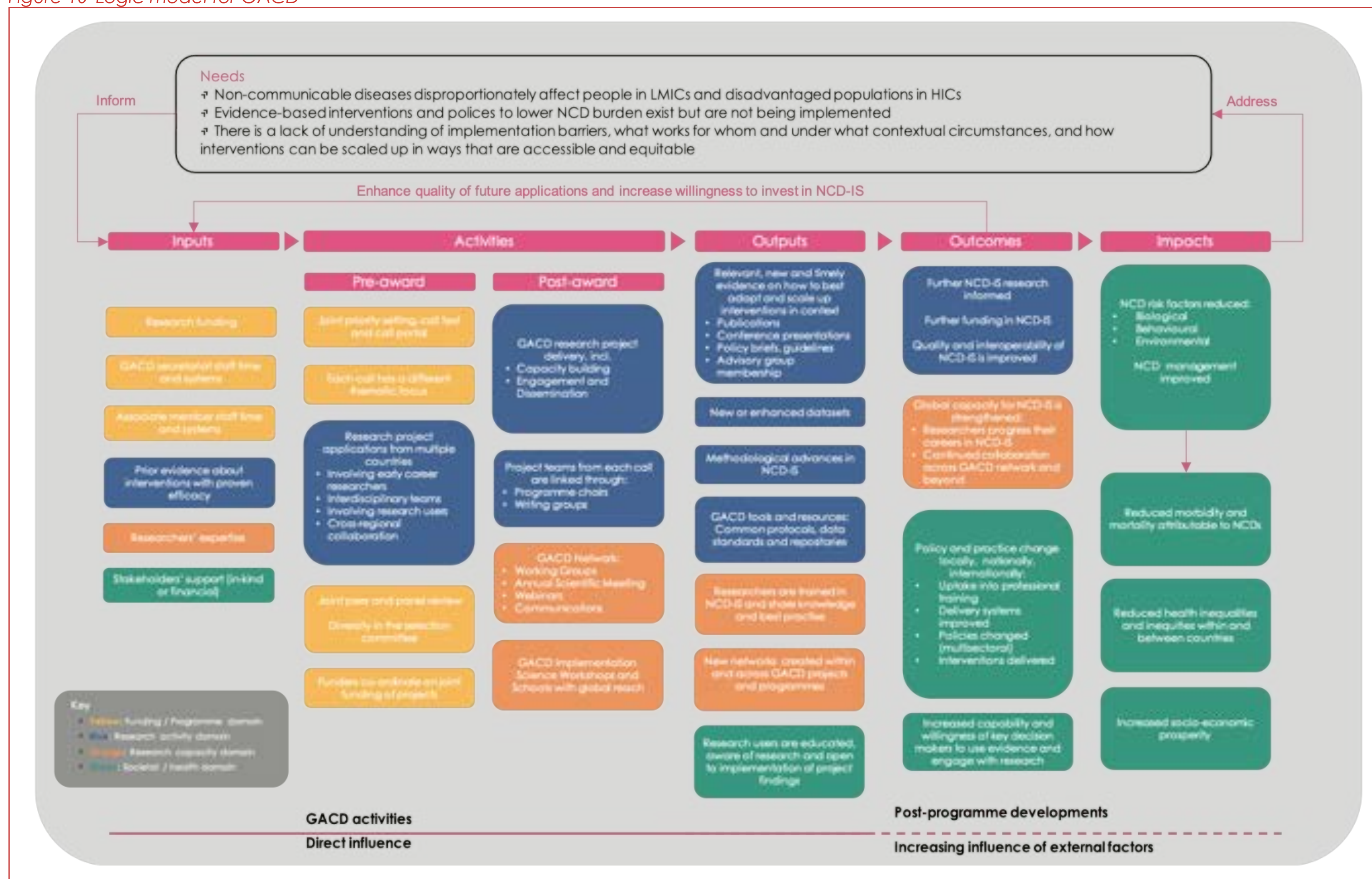
In the research domain, outputs from GACD-funded projects will inform further research and support further applications for funding. GACD-supported tools will enhance the interoperability of generated data and the utility of research findings across contexts. In the capacity building domain, researchers are expected to progress their careers in NCD-IS and continue to be able to access expertise by collaborating across the GACD Network and beyond. This will result in a larger number of better-trained and better-connected researchers working in the field of NCD-IS, able to contribute to further advances in the future. Given the focus on implementation science, GACD-funded research should influence policy and practice, and this could be at the local, national or international (e.g. WHO guidance) level. For example, GACD research results should help payers of health care deciding whether to cover interventions, health care providers reorganising care pathways, public health authorities deciding on new guidance and policies, and developing programmes on screening or health worker education.

Impact of GACD-funded research may go beyond the health sector and influence e.g. decisions about education curricula, employment, advertisement, taxation, and individual lifestyle. In addition to influencing decisions, engagement of research users in GACD activities is expected to lead to a culture shift over time, where key decision makers are more able and willing to engage with research. Some of these outcomes will have a positive impact on future GACD activities, e.g. through demonstrated outcomes in NCD-IS increasing the willingness of policy makers to invest in the area, better trained researchers submitting higher-quality proposals, and increased trust and understanding between researchers and research users making it easier to form effective partnerships and leveraging local resources.

Impacts

In the longer term the instigated changes are expected to lead to a reduction in risk factors for developing NCDs and to an improved management of patients living with NCDs, both reducing morbidity and mortality associated with NCDs. Through the focus on LMICs and vulnerable populations in HICs, it is expected that health inequalities and inequities will be reduced both within and between countries. Reduced NCD burden would further manifest itself in increased productivity and hence socio-economic prosperity.

Figure 10 Logic model for GACD



Source: Technopolis

This evaluation determines 'how far' the funded research has advanced within the model; later evaluations can use the same approach to trace further progress. A PLM is not meant to be a static framework and should be revisited at regular intervals to incorporate learning derived from the programme (e.g. whether the need is still relevant, activities are efficient and effective to drive research).

5 The Global Funding Landscape

5.1 Overview of funding in implementation science and NCDs

5.1.1 Levels of funding

Stakeholders consulted for this evaluation agreed (23 out of 25) that the levels of funding for NCD research could be increased globally. There were however differences of opinion with regard to funding available in different countries. It was suggested that funding in Australia and Germany is adequate, but funding in countries and regions including Mexico, Chile, India, and sub-Saharan Africa is insufficient.

One of the main explanations for the underfunding of NCD research was the dominance of communicable diseases in research funding allocations. Furthermore, interviewees pointed to the fact that funding across different NCD areas is variable (5 interviewees); e.g. cardiovascular diseases take precedence over mental health and lung related NCDs (3 interviewees)

The level of funding available for implementation science was also considered low. Specific issues raised included that funding streams often divided focus on biomedical research, e.g. molecular mechanisms or clinical intervention trials, and do not cover implementation science (2 interviewees). In addition, a lack of implementation research capacity was highlighted (1 interviewee).

The most commonly identified gaps in research funding for NCD implementation research are limited implementation research funding in LMICs and limited financial resources (raised by 4 interviewees each). These issues are closely connected in LMICs. Other funding gaps mentioned in by individual interviewees included funding for multidisciplinary research and methods development, and for research in Arabic countries.

Lack of research capacity, especially locally, was also highlighted as a barrier to efforts to reduce the NCD burden in LMICs and vulnerable communities.

5.1.2 Overview of key funding programmes

Comparator funders and programmes to GACD were identified through desk research and the interview programme of this evaluation and selected according to three criteria: the extent to which they focus on 1) NCDs, 2) LMICs (or disadvantaged populations in high income countries) and 3) implementation science. Notably, organisations included here met only one or two criteria, i.e. no direct comparators to GACD were identified. As such, GACD, as a funder of academic research with a focus on implementation science addressing NCDs, is somewhat unique. This was echoed in interviewees' comments; as one funder explained: "Non-communicable diseases is a very large subject. There is funding worldwide, but not so much on the implementation side, so this [GACD] is really unique. And GACD, I think, is doing a wonderful job pioneering [in this area]".

Table 4 provides an overview of six organisations and programmes which fund (at least some) applied NCD research, either spanning all NCDs or focussed on specific diseases, in LMICs and/or targeting disadvantaged or ethnic minority populations in HICs.

While none of the programmes identified were found to exclusively focus on implementation science, they required applicants to include aspects of implementation in their projects. For example, applicants to the UK Prevention Partnership (UKPRP) needed to demonstrate that mechanisms for influencing policy and practice are in place. The overview also includes an

initiative, Resolve to Save Lives (RTSL), which sits closer to an effort to support implementation rather than conducting research on implementation. However, funded projects include studies that would be considered 'research' – and many implementation projects conduct evaluation and learning activities as part of their delivery. Given the 'closeness' of implementation science to real-world implementation, it is difficult to draw a boundary between research and evaluation. The former is more often (but not exclusively) associated with academic experts producing generalisable findings published in scientific journals, while the latter is often commissioned work conducted outside the academic research community, may or may not enter the public domain, and focusses on effectiveness of a specific programme or model to inform future actions or decisions (Cohen, Manion, & Morrison, 2018; Patton, 2014).[97][98]

Table 4 GACD Comparator funders

Funder	Programme /s	Funding modality	Level of funding	Objectives	Types of research activities funded	Eligible locations	
						PI	Project
Indian Health Service (U.S Department of Health & Human Services)	SDPI (Special Diabetes Program for Indians)	Not stated	Total $150m annually (mainly for implementation projects)	To provide funds for diabetes treatment and prevention to IHS, Tribal, and Urban Indian health programs across the United States	Community directed grants Diabetes Prevention (DP) and Healthy Heart	US	US
Wellcome Trust	Mental health	Calls for proposals Commissions for specific research	Total of £200m of funding over 5 years	Find the next generations of treatments and approaches to help prevent or treat mental ill health	e.g. developing a databank about approaches to help manage mental health.	LMICs UK, Republic of Ireland. Rest of word as part of a team	Global
UK Prevention Research Partnership (UKPRP)	Consortia (focussed on specific NCD prevention challenge) Networks (focus on broad NCD prevention challenge)	Calls for proposals (2 rounds)	£50m total £4-7m over 5 years per consortium	Improve population health, and reduce health inequalities, through the primary prevention of NCDs	NCD research consortia and networks are funded	UK	UK
Resolve to Save Lives/WHO	LINKS catalytic grants	Small grants to implementers in LMIC	US$4.65 for 38 grants to date	Catalyse or improve country progress toward improvement of cardiovascular health	e.g. testing of implementation strategies in different LMIC contexts	LMIC	LMIC

[97] Patton, MQ (2014). Evaluation Flash Cards: Embedding Evaluative Thinking in Organizational Culture. St. Paul, MN: Otto Bremer Foundation, ottobremer.org

[98] Cohen L, Manion L, Morrison K (2018) Evaluation and research. In: Research Methods in Education, pp. 79-86

American Heart Association	Health Equity Research Network on Prevention of Hypertension	Calls for proposals (restricted to AHA members only)	US$20m in total	Advance the science of prevention of hypertension with a focus on health equity	e.g. Implementation and evaluation of interventions that target health education or connectivity gaps	US	US
The Healthy Brains Global Initiative	Programmes not yet published (but will be mental and brain health focussed)	TBC	Seeking to mobilize US$10bn (current funding levels public)	Broaden the focus of brain health research	Not yet funded but will cover basic research, translational research and implementation science	Global	Global

Source: Technopolis

The following sections provide a brief introduction to organisations with remits relevant to GACD.

5.1.3 US DHHS: Indian Health Service

The Indian Health Service (IHS) is an agency within the US Department of Health & Human Services (DHHS) focussed on the health of indigenous populations in the US. The mission of the agency is to 'raise the physical, mental, social, and spiritual health of American Indians and Alaska Natives to the highest level'.[99]

The IHS funding programmes include the Special Diabetes Program for Indians (SDPI), a grant programme established in 1997 in response to the diabetes epidemic among American Indians and Alaska Natives. The programme, totalling US$150m annually, is coordinated by the IHS Division of Diabetes with guidance from the Tribal Leaders Diabetes Committee.

The SDPI Community-Directed Diabetes Programme provides grants for the implementation of diabetes treatment and prevention services.[100,101] It employs a community-based public health approach and collaborates with the Tribal Leaders Diabetes Committee. In addition, the IHS can request input to major decisions through a national tribal consultation process. The programme provided 301 grants in 2020 to IHS, Tribal, and Urban Indian health programmes in 35 US states, serving over 780,000 indigenous people. Metrics used to demonstrate success of the programme in the SDPI Report to Congress 2020 are diabetes prevalence, diabetes-related mortality, kidney failure, hospitalisations for uncontrolled diabetes and diabetic eye disease [102].

The IHS has also funded research and demonstration projects. In recognition of the high prevalence of diabetes and its complications among American Indians and Alaska Natives, the US Congress directed the IHS in 2002 to establish a competitive grant programme to address the primary prevention of diabetes and CVD in this population. This provided funding

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[99] U.S. Department of Health and Human Services, Indian Health Service. About us. Available via https://www.ihs.gov//aboutihs/. Accessed 29 June 2021

[100] U.S. Department of Health and Human Services, Indian Health Service. Special Diabetes Program for Indians. Available via https://www.ihs.gov/sdpi/. Accessed 29 June 2021

[101] U.S. Department of Health and Human Services, Indian Health Service. Special Diabetes Program for Indians 2020 Report to Congress. Available via https://www.ihs.gov/sites/newsroom/themes/responsive2017/display_objects/documents/SDPI2020Report_to_Congress.pdf. Accessed 29 June 2021

[102] https://www.ihs.gov/sites/newsroom/themes/responsive2017/display_objects/documents/SDPI2020Report_to_Congress.pdf

for two initiatives, the SDPI Diabetes Prevention (DP) and Healthy Heart Initiatives, aimed at translating research-based interventions for diabetes prevention and CVD risk reduction into community-based programmes and health care settings.[103]

The SDPI DP adapted a lifestyle intervention that had previously been shown to reduce the incidence of type 2 diabetes in a diverse population of people at risk in a clinical trial funded by the US National Institutes of Health (NIH). The initiative then implemented the intervention in diverse American Indians and Alaska Natives communities from 2006 to 2016, enrolling a total of 8,652 participants.[104] The study found that the lifestyle intervention led to moderate to small weight loss, associated with substantially reduced long-term risk of diabetes in diverse American Indian and Alaska Native communities. As of 2018, the intervention continued to be deployed and a toolkit was made available on the IHS website. Further research articles on aspects of the programme have been published (e.g.[105]).

The SDPI HH grant programme tested an intensive case management approach to reduce CVD risk in individuals with diabetes. It funded 30 health care programmes serving 138 tribes in 13 states. Grantees implemented an intervention consisting of individual case management, disease management, and self-management education.[106] The study found that the intervention significantly reduced cardiovascular risk factors. The study team continued research into further aspect of the programme (e.g.[107]).

5.1.4 Wellcome Trust

The Wellcome Trust funds research addressing a wide range of health challenges. The trust provides funding for mental health research, investigating conditions across all ages. In 2019, Wellcome announced a relatively new (additional) research programme targeting mental health, committing £200m in funding over 5 years.[108] This new strategy focusses on 'finding effective, scalable and acceptable ways to prevent, intervene, stop relapse and manage anxiety and depression in young people age 14 to 24'.[109] The programme consists of three workstreams: 1) Mental health science cutting across disciplinary boundaries, 2) a databank and population data collection methods that supports long-term scientific findings while enabling end users to learn from the data and help them manage and monitor their own

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[103] U.S. Department of Health and Human Services, Indian Health Service. Special Diabetes Program for Indian 2014 Report to Congress. Available via https://www.ihs.gov/sites/newsroom/themes/responsive2017/display_objects/documents/RepCong_2016/SDPI_2014_Report_to_Congress.pdf. Accessed 29 June 2021

[104] Jiang L, Johnson A, Pratte K, et al. Long-term Outcomes of Lifestyle Intervention to Prevent Diabetes in American Indian and Alaska Native Communities: The Special Diabetes Program for Indians Diabetes Prevention Program. *Diabetes Care*. 2018;41(7):1462-1470. doi:10.2337/dc17-2685

[105] Gonzales KL, Jiang L, Garcia-Alexander G, et al. Perceived Discrimination, Retention, and Diabetes Risk Among American Indians and Alaska Natives in a Diabetes Lifestyle Intervention. Journal of Aging and Health. 2021;33(7-8_suppl):18S-30S. doi:10.1177/08982643211013188

[106] Moore K, Jiang L, Manson SM, et al. Case management to reduce cardiovascular disease risk in American Indians and Alaska Natives with diabetes: results from the Special Diabetes Program for Indians Healthy Heart Demonstration Project. *Am J Public Health*. 2014;104(11):e158-e164. doi:10.2105/AJPH.2014.302108

[107] Pratte KA, Beals J, Johnson A, et al. Recruitment and effectiveness by cohort in a case management intervention among American Indians and Alaska Natives with diabetes. *Transl Behav Med*. 2019;9(4):749-758. doi:10.1093/tbm/iby068

[108] Wellcome. Mental Health. Available via https://wellcome.org/what-we-do/mental-health. Accessed 29 June 2021

[109] Wellcome. Mental health programme strategy. Available via https://wellcome.org/what-we-do/our-work/mental-health-transforming-research-and-treatments/strategy. Accessed 29 June 2021

mental health, and 3) collaboration with policy makers, other funders, and educational organisations and workplaces.

As part of this programme, Wellcome commissioned ten global research teams in 2020 to look at the existing evidence behind ten promising approaches to supporting workplace mental health.[110] A second commission is open for applications until August 2021 looking at evidence on promising approaches for preventing or addressing mental health problems in the workplace. It encourages research 'focussed on people who may be marginalised within the workforce and workers in LMICs'[111] and states the ambition 'to fund a minimum of five projects from suppliers where the lead and lead's organisation are based in LMICs'.[112]

In addition, Wellcome supports Mindscapes, a cultural programme in partnership with organisations in India, Germany, the US and Japan, that combines diverse perspectives and expertise, including artist residencies, a documentary, exhibitions and events, to improve how we talk about mental health.[113]

5.1.5 UK Prevention Research Partnership (UKPRP)

The UK Prevention Research Partnership (UKPRP) is £50m initiative that supports research into the primary prevention of NCDs to improve population health and reduce health inequalities, focussed on the UK.[114] The partnership involves 12 funders UK-based funders including four UK Research Councils (Economic and Social Research Council, Engineering and Physical Sciences Research Council, Medical Research Council, Natural Environment Research Council), four government funders (National Institute for Health Research, Public Health Agency Northern Ireland, Scottish Government Chief Scientist Office, Health Care Research Wales), and four charities (British Heart Foundation, Cancer Research UK, The Health Foundation, Wellcome Trust). The MRC administers the programme on behalf of the partnership.

The UKPRP was established in 2017. It provides funding for consortia and networks that conduct research on prevention of NCDs:

- Consortia are large interdisciplinary collaborations that undertake research into a specific challenge in the primary prevention of NCDs, with funding between £4-7m over 5 years.[115] The SPECTRUM consortium, for example, focuses on health and health inequalities associated with tobacco, alcohol and unhealthy food and drink.
- Networks are interdisciplinary communities built around broad challenges in the primary prevention of NCDs, supported with £100,000 each year for up to 4 years. For example, the PHASE network uses models to develop insights on the interaction of processes that can result in NCDs.

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[110] Wellcome. Putting science to work: Understanding what works for workplace mental health. Available via https://wellcome.org/reports/understanding-what-works-workplace-mental-health. Accessed 29 June 2021

[111] Wellcome. Mental health: transforming research and treatments. Available via https://wellcome.org/what-we-do/our-work/mental-health-transforming-research-and-treatments. Accessed 29 June 2021

[112] Wellcome. Request for Proposal. Available via https://cms.wellcome.org/sites/default/files/2021-05/workplace-mental-health-rfp-2021.pdf. Accessed 29 June 2021

[113] Wellcome. Mindscapes. https://wellcome.org/what-we-do/our-work/mindscapes#about-mindscapes-ccd7. Accessed 29 June 2021

[114] UKPRP. Available via https://ukprp.org. Accessed 29 June 2021

[115] UKPRP. What we fund. Available via https://ukprp.org/what-we-fund/. Accessed 29 June 2021

The UKPRP published calls in 2017 and 2019 and currently funds four consortia and four networks. Information on future calls is not publicly available.

While UKPRP funding is not specifically aimed at implementation science, applications for consortia funding are required to demonstrate mechanisms for linking to policy and practice and for building long-term relationships between academic researchers and research users.

In 2021, the UKPRP awarded funding for a Community of Practice (CoP) to provide a structured mechanism for sharing learning and development across UKPRP-funded consortia and networks, interdisciplinary collaborations which address challenges in the primary prevention of non-communicable diseases.[116]

5.1.6 *Resolve to Save Lives*

Resolve to Save Lives (RTSL) is a 5-year initiative with US$225m in funding from Bloomberg Philanthropies, the Bill & Melinda Gates Foundation, and Gates Philanthropy Partners and implementing partners WHO, World Bank, Johns Hopkins, the Global Health Advocacy Incubator and the CDC Foundation.[117] The initiative works 'to fund and develop customised cardiovascular disease prevention programmes based on the most recent evidence-based practices'. RTSL activities are focussed on three areas: 1) hypertension control, 2) sodium reduction, and 3) elimination of artificial trans-fat.

RTSL assists LMICs across the globe to develop, implement and expand national and subnational programmes in the three focus areas.[118] The initiative also works with WHO and other partners to provide tailored tools, and offers one-time catalytic grant support to LMIC governments and NGOs through LINKS. LINKS is a collaboration between RTSL, WHO, and the US CDC Foundation, which shares toolkits and guidance for implementation of evidence-based strategies, aligned with the WHO's technical packages.[119] It also functions as a platform for connecting people working to improve cardiovascular health around the world, provides access to cardiovascular health experts, and offers monthly webinars.

Through LINKS, RTSL provides awards to catalyse or improve country progress toward improvement of cardiovascular health. Over three calls, this has led to 38 grants for a total of US$4.65m. The latest round of award was announced in June 2021 and supports nine programmes taking place in Cameroon, Costa Rica, El Salvador, Ghana, Guatemala, Kenya, Mexico and the Philippines.[120]

RTSL sits within Vital Strategies, an organisation which 'strengthens public health systems through designing and supporting scalable solutions to leading causes of death, disease and injury'.[121] Vital Strategies has offices in the HICs and LMICs (US, Ethiopia, China, India, France, Brazil and

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[116] UKPRP. UKPRP awards funding for Community of Practice, 3 February 2021. Available via https://ukprp.org/news-and-events/ukprp-awards-funding-for-community-of-practice/. Accessed 29 June 2021

[117] Resolve to Save Lives. How we work. Available via https://resolvetosavelives.org/cardiovascular-health. Accessed 29 June 2021

[118] Frieden TR, Varghese CV, Kishore SP, et al. Scaling up effective treatment of hypertension—A pathfinder for universal health coverage. J Clin Hypertens. 2019;00:1–8. https://doi.org/10.1111/jch.13655

[119] LINKS. Who are we? Available via https://linkscommunity.org/about. Accessed 29 June 2021

[120] Resolve to Save Lives awards over $1 million in grants to improve cardiovascular health during COVID-19 pandemic. Available via https://resolvetosavelives.org/about/press/links-grant-awards-2021. Accessed 29 June 2021

[121] Vital Strategies. Available via https://www.vitalstrategies.org/programs/. Accessed 29 June 2021

Singapore). Its current programmes include 'Air Pollution and Health', Cardiovascular Health (via RTSL), 'Partnership for Healthy Cities', and 'Tobacco Control'.

Vital Strategies and Resolve to Save Lives also spearhead PERC, the Partnership for Evidence-Based Response to COVID-19.[122] PERC is a public-private partnership that supports evidence-based measures to reduce the impact of COVID-19 on African Union Member States. Its research has been used to provide 20 African governments with real-time data to drive prevention guidelines and save lives. The evidence also highlighted the indirect burdens of the virus across Africa, such as skipped routine care and food insecurity, and offered recommendations on scaling up or down public health and social measures.

5.1.7 American Heart Association

The American Heart Association (AHA) is a non-profit research charity. Since its inception in 1949, the AHA has provided US$4.6bn dollars in funding for cardiovascular, cerebrovascular and brain health research. Funding is limited to US researchers. some calls targeted at disadvantaged or ethnic minority populations. [123] For example, the Health Equity Research Network (HERN) on Prevention of Hypertension aims to provide a mechanism for the advancing the science of prevention of hypertension with a focus on health equity. A total of US$20m is to be awarded. The call for HERN research grants ended in May 2021 with successful applicants being notified in October 2021.

5.1.8 The Healthy Brains Global Initiative

The Healthy Brains Global Initiative (HGBI) is a non-profit seeking to mobilise US$10bn for brain health research. HGBI was set up in 2020 and supported by a variety of organisations including the US National Academy of Medicine, One Mind, Wellcome, the World Economic Forum, pharma companies Otsuka and Johnson & Johnson and Bank of America (HGBI's lead underwriter).[124] It promises to use 'unprecedented financing models to supplement government basic science funding and private sector product development'. The intention is to 'make a paradigm shift from a siloed, underfunded and poorly representative research ecosystem to a multidisciplinary, harmonized, and global scale model'.

The HGBI has identified six areas for research: depressive disorders, anxiety disorders, schizophrenia, bipolar disorder, epilepsy (particularly in LMICs), and traumatic brain injuries. The initial focus of the HGBI is on adolescents and young adults, but will eventually extend to all populations. Funded research is expected to cover all technological readiness levels, from basic research to translational research and implementation science.

5.2 Other funding partnership models

Research funding partnerships take a variety of forms, ranging from discussion fora to align strategies and coordinate funding efforts of the individual organisations, to fully integrated joint calls for proposals, a centralised proposal review process, and/or a common pot of funding and joint investments.

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[122] Vital Strategies Annual Report 2020. Available via https://annualreport.vitalstrategies.org. Accessed 29 June 2021

[123] AHA. Health Equity Research Network on Prevention of Hypertension. Available via https://professional.heart.org/en/research-programs/strategically-focused-research/health-equity-research-network-on-prevention-of-hypertension. Accessed 29 June 2021

[124] The Human Brain Initiative. Available via https://www.hbgi.org/supporters-of-hbgi. Accessed 29 June 2021

The ERALEARN 2020 project 'Strengthening Joint Programming in Europe' assessed current approaches to alignment in the European context and explored options "for modalities to better align national and/or regional activities under common research agendas".[125] It described alignment actions across the research programming cycle and classified 30 European public-to-public alignment actions and instruments according to the research programming stage in which they usually occur (see Figure 11).

Figure 11 Alignment actions across the research programming cycle

Source: Reproduced from Strengthening Joint Programming in Europe - ERALEARN 2020 (2015-2018): Deliverable 4.1- Report on the Definition and Typology of Alignment (2015)

Alignment action	**Approach**	**Cooperation mode**	**Instruments**
RESEARCH PLANNING			
Conduct of joint foresight	Strategic	Joint analysis	e.g. joint foresight studies; standing committee for specific research areas
Conduct of joint mapping	Strategic	Joint analysis	e.g. joint mapping meetings; mapping of existing national research policies and agendas; development of an online database on research activities
RESEARCH STRATEGY			
Adoption of common strategic research priorities	Strategic	Strategic partnership	e.g. development of common vision and strategic research agendas
Adoption of a common strategic Implementation / Action Plan	Strategic Operational Financial	Strategic partnership	e.g. consultations at national level; development of implementation plans
Conduct of joint stakeholder consultations	Strategic	Strategic partnership	
Cooperation between with other R&I initiatives	Strategic	Cooperation across public-to-public initiatives	e.g. joint strategy meetings; joint advocacy activities; joint outreach activities
RESEARCH FUNDING			

[125] Deliverable 4.1 – Report on the Definition and Typology of Alignment, November 2015. Available via https://www.era-learn.eu/documents/d4-1_reportonthedefinitionandtypologyofalignment_inra_final_nov2015.pdf. Accessed 25 June 2021

Synchronisation of national calls for research proposals	Financial	Project coordination	includes standardised peer review system
Organisation of a joint transnational call for research proposals	Financial	Project cooperation	
Establishment of several interlinked and/or successive transnational calls	Financial	Project cooperation	
Joint calls between with other initiatives	Financial	Cooperation across public-to-public initiatives	
RESEARCH IMPLEMENTATION			
Establishment of an integrated joint research programme	Strategic Operational Financial	Programme integration	
Set-up of a network of individual researchers	Operational	Networking and capacity building amongst researchers	e.g. coordinated knowledge hub
Establishment of a loose network or association of research performing organisations	Operational	Institutional cooperation	e.g. Memorandum of understanding (MoU) outlining the mission and activities of the network
Establishment of a research alliance	Operational	Institutional cooperation	e.g. MoU and joint programme of work
Establishment of a joint research centre	Strategic Operational Financial	Institutional cooperation	Agreement on establishing a new legal entity
RESEARCH IMPLEMENTATION - Methodology			
Coordination of scientific techniques and methodologies	Operational	Project coordination	Consultations
Standardisation of scientific techniques and methodologies	Operational	Project coordination	Consultation; common research protocols and models
RESEARCH EVALUATION AND REPORTING			
Alignment of evaluation frameworks	Operational	Project/Programme cooperation	Common M&E framework
Harmonised reporting	Operational	Project/Programme cooperation	Standardised reporting template
TRAINING AND CAPACITY BUILDING OF RESEARCHERS			
Joint training of researchers	Operational	Networking and capacity building of researchers	e.g. joint workshops, training sessions, training and mobility grants
RESEARCH INFRASTRUCTURES AND DATA			

Shared use of existing national research infrastructures	Operational Financial	Common research infrastructure and data	Agreement on procedures, rules, fees for common use of research infrastructure
Establishment of a new joint transnational infrastructure facility	Strategic Operational Financial	Common research infrastructure and data	
Open access to national scientific research data	Operational	Coordination data management and storage	e.g. joint open data strategy and data management/sharing plan
RESEARCH DISSEMINATION AND UPTAKE			
Coordinated or joint dissemination of scientific results	Strategic Operational	Joint outreach	e.g. joint outreach and communications material
Joint outreach towards industry	Strategic Operational	Strategic partnership	e.g. joint public-private partnership (PPP) agreements, cooperation with PPP instruments
Joint policy actions	Strategic Operational	Joint outreach	e.g. position papers, lobbying

SOURCE: Adapted from [126,127]

The study also identified key enablers of and barriers to the alignment of national research programmes and activities. The main stumbling block was considered the degree of divergence of national rules and procedures for funding and executing research and innovation (the 'inter-operability problem'). Other barriers were a lack of common understanding and terminology, lack of sufficient national funding to support transnational coordination, and difficulties demonstrating concrete results from alignment in the short-term. Key factors for successful alignment were:

- A combination of bottom-up alignment actions involving researchers/research organisations, such as knowledge hubs and other researcher networks, and top-down alignment actions from Ministries and research funding organisations, such as joint, long-term integrated research programmes and the set-up of common research centres and infrastructures
- Strong political commitment from funders, including budgets
- Mutual trust and consensus-building at all levels (researchers and research organisations, funders and Ministries, etc.) via regular consultations and dialogue

Bringing together learning from the study, a 'Toolbox of current and novel alignment modalities and instruments' was developed.[128]

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[126] Deliverable 4.1 – Report on the Definition and Typology of Alignment, November 2015. Available via https://www.era-learn.eu/documents/d4-1_reportonthedefinitionandtypologyofalignment_inra_final_nov2015.pdf . Accessed 25 June 2021

[127] Analysis of Options for Future Platforms: Monitoring and Assessment Framework for P2P Activities, May 2011. Available via https://www.era-learn.eu/documents/era-learn-publications/d4-3-report-v2.pdf, p.8. Accessed 25 June 2021

[128] Toolbox of current and novel alignment modalities and instruments, ERA-LEARN2020 Project Task 4.3, December 2016. Available via https://www.era-learn.eu/documents/era-learn-publications/synthesis-report_alignment_sept2017_final.pdf Accessed on 25 June 2021

5.2.1 Examples of research funding partnerships

5.2.1.1 Partnership of global funders: The Belmont Forum

The Belmont Forum was established in 2009 as a partnership of funders of environmental change research and international science councils, and regional consortia. The Forum aims to "support international transdisciplinary research providing knowledge for understanding, mitigating and adapting to global environmental change", set out in a vision document, 'The Belmont Challenge'.[129] Its vision and actions are targeted at aligning and coordinating international resources for research, scoped in a cross-community framework, to serve the needs of development cooperation actors, end-users and beneficiaries, private sector stakeholders, civil society and policy makers. Recognising the importance of the UN SDGs, the Forum aims to make a considerable contribution to their implementation.

Members include agencies from 22 countries (with some countries represented by more than one organisation), as well as the European Commission and the Inter-American Institute for Global Change Research.[130] In addition, seven partner organisations subscribe to the aims of the Forum (the Belmont Challenge), but do not act as funders. It is coordinated by a central secretariat which is tasked with carrying out decisions made during the plenary meetings. A steering committee, comprised of eight Forum members headed by two co-chairs, advises Forum activities between plenary meetings.

The Forum issues international calls for proposals, called Collaborative Research Actions (CRAs). The themes for CRAs are decided upon at the annual Belmont Forum plenary meeting by member organisations.[131] Each CRA is then developed through stakeholder engagement, e.g. in scoping workshops, and seeks to connect with relevant non-member funding and resource providers. This process is administered by a Group of Programme Coordinators (GPC), composed of at least one representative from each organisation participating in the call.[132] The GPC appoints a Thematic Programme Office to provide oversight through the CRA development and implementation process. Organisations other than Forum members with an interest in a particular CRA can also participate in GPCs. Since 2012, the Forum has implemented 17 CRAs which support 99 projects.[133]

Project proposals must include – and be co-developed - by natural scientists, social scientists, and stakeholders from at least three countries (and eligible for support from three funding organisations participating in the CRA).[134] The research itself can take place within one or more countries anywhere in the world. Awards are made through coordinated funding for each CRA from individual organisations for project teams within their funding remit.

The responsible Thematic Programme Office coordinates project kick-off meetings (optional), mid-term meetings, and end-term meetings, and offers 'legacy steps' such as helping previous

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[129] The Belmont Challenge: A global, environmental research mission for sustainability, 2016. Available via https://www.belmontforum.org/wp-content/uploads/2017/04/belmont-challenge-white-paper.pdf . Accessed 25 June 2021

[130] The Belmont Forum. Available via https://www.belmontforum.org/about/#1491365116535-2d4eb980-a5ed4da7-4edf. Accessed 25 June 2021

[131] The Belmont Forum. Available via https://www.belmontforum.org/wp-content/uploads/2019/06/belmont_forum_external_evaluation_rfp.pdf Accessed 25 June 2021

[132] https://www.belmontforum.org/about/. Accessed 25 June 2021

[133] https://www.belmontforum.org/cras/. Accessed 25 June 2021

[134] https://www.belmontforum.org/about/ . Accessed 25 June 2021

awardees find additional resources to continue their work.[135] The Forum also supports coordination functions to increase both internal and external connectivity among projects within a given CRA. Award holders also have to submit and annual project report.

As the Forum identified additional needs to support progress in environmental change research, further activities have been added[136]:

- The Forum adopted an open data policy in 2015 to enhance access to and use of transdisciplinary research data, and established the e-Infrastructures and Data Management Initiative for implementation of the open data plan. Regardless of whether their own governance includes provisions for open data and access, all partners within a CRA have to adhere to the open data policy for awards made through the CRA.
- The Global Sustainability Scholars programme was established to develop an early career cohort with transdisciplinary expertise. The programme offers 8-week internships for undergraduate and graduate students working with Belmont Forum-funded projects.[137]
- New partnership modalities are being co-developed with philanthropies, the private sector, and global organisations to enhance coordination and enable joint working

In 2019, the Belmont Forum commissioned an external evaluation focussing on two aspects: the delivery of CRAs and the Forum's organisational processes.

5.2.1.2 Partnership focussed on European funders: Joint Programming initiatives

Joint Programming initiatives aim to tackle common European challenges more effectively by making better use of resources by enhancing coordination and cooperation of research programmes in strategic areas and pooling national and European R&D funds.[138]

In December 2008, Research Ministers of the European Union acknowledged the need for a new and strategic approach to coordinate European research activities to address societal challenges of common interest on a European and global scale.[139] National programmes were acknowledged as important contributors, but too small to address major societal challenges on their own and often resulting in unnecessary duplication.

JPIs were established to coordinate strategies and efforts between funders ('alignment') and to achieve the scope and depth required to make a significant impact in these major challenges. JPI member countries agree, on a voluntary basis, and in a partnership approach, on common visions and Strategic Research Agendas (SRA) to address major societal challenges and commit to implementing these. Implementation involves a range of instruments, including joint research calls on agreed topics for multi-national collaborative research. Member countries can choose to participate in a research call, and each participant country makes available funding to support researchers of the successful teams working within its national borders.

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[135] https://www.belmontforum.org/awardees/. Accessed 25 June 2021

[136] https://www.belmontforum.org/wp-content/uploads/2019/06/belmont_forum_external_evaluation_rfp.pdf. Accessed 25 June 2021

[137] https://www.gsscholar.org/scholars-program. Accessed 25 June 2021

[138] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/joint-programming-initiatives. Accessed 25 June 2021

[139] European Commission: Towards Joint Programming in Research: Working together to tackle common challenges more effectively. COM(2008) 468

There are currently ten JPIs: a first wave of four JPIs was launched in 2009/2010, and an additional six JPIs were launched in 2011.[140] Challenges targeted fall into three broad areas: challenges related to health and well-being (e.g. Neurodegenerative Diseases - JPND; antimicrobial resistance - JPI-AMR; and healthy diets - JPI-HDHL), environmental challenges (e.g. agriculture, food and climate change – FACCEJPI; water challenges – Water-JPI) and demographic challenges (e.g. Potential and Challenges of Demographic Change – JPI-MYBL; Sustainable cities – JPI Urban Europe).

Countries can select individuals JPIs they wish to join, as full members (which includes providing support for the JPI secretariat) or observers. As many of the challenges JPIs address are global in nature, membership of JPIs is not restricted to EU member states. A 2016 evaluation of the JPIs found that "most JPIs are interacting with third countries and multilateral organisations. Canada is the most active third country – all continents are currently associated to at least one JPI."[141] Non-EU countries can participate in JPIs either as non-voting members or as full members if certain criteria are met.[142] For example, the 30 country members of the JPND includes Canada, Australia, Albania and Switzerland.[143] The JPI-AMR has 28 member states, including the non-EU countries Argentina, Egypt, India, Israel, Japan, Korea, Moldova, Norway, South Africa, Switzerland, and Turkey, as well as the European Commission as a non-voting member. Multiple funders per country can be represented in a single JPI, reflecting the cross-cutting nature of societal challenges addressed at the intersection between research and policy.[144] For example, Estonia is represented in the JPI-AMR via its Ministry of Social Affairs and its Public Health Department. JPND board members from the Netherlands include representatives from the Ministry of Health, Welfare and Sport as well as the research funding agency ZonMw.[145]

Between 2009 and 2015, almost €265m had been committed to transnational projects as a result of 32 Joint Calls involving 37 countries.[146] The majority of this funding, nearly two-thirds, originated with seven countries (Germany, Sweden, Netherlands, France, UK, Italy and Norway). Individual JPIs launched a variety of joint calls, e.g. the JPI-AMR launched four calls between 2014 and 2016, with a commitment of up to €55m, and the FACCE-JPI launched ten joint research actions in its first six years, mobilising around €110m for transnational research activities.[147,148]

JPIs are governed by governing boards, responsible for the overall coordination, supervision, implementation and progress of the JPI, with representation from each participating country. While individual JPIs differ in their governance structures, governing boards are commonly

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[140] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/joint-programming-initiatives. Accessed 25 June 2021

[141] European Commission (2016) Evaluation of Joint Programming to Address Grand Societal Challenges: Final report of the expert group

[142] https://www.neurodegenerationresearch.eu/wp-content/uploads/2012/03/JPND-Policy-on-Engagement-with-Third-Countries.pdf. Accessed 25 June 2021

[143] https://www.neurodegenerationresearch.eu/programme-committee/. Accessed 25 June 2021

[144] https://www.jpiamr.eu/about/organisation/management-board/. Accessed 25 June 2021

[145] https://www.neurodegenerationresearch.eu/programme-committee/. Accessed 25 June 2021

[146] European Commission (2016) Evaluation of Joint Programming to Address Grand Societal Challenges: Final report of the expert group

[147] https://jpi-urbaneurope.eu/wp-content/uploads/2016/12/Joint-Programming-Initiatives_leaflets.pdf. Accessed 25 June 2021

[148] In addition to national contributions, these figures may include European funding such as ERA-NET

supported by Scientific Advisory Boards, which is tasked to ensure scientific excellence and provides scientific advice, helping to shape JPI strategy, plans for implementation, communication and dissemination of the initiative's results, and mediating the contact with the scientific community. In addition, the JPI may include a societal advisory structure, e.g. a board that advises on the societal dimensions of the challenge to be addressed.

The main risk to JPIs, as highlighted in the 2016 evaluation of JPIs[149], is a lack of long-term commitment and stability of support from national members, e.g. due to political or financial issues. A related issue is the delegation of national representation to lower levels within the member organisations, and/or a lack of supportive national structures to align in-country stakeholders with the JPIs. This can lead to delays in JPI decision-making processes, as representatives are not able to act independently on behalf of their country. Other risks mentioned are issues with sharing of infrastructure, such as databases, networks, and platforms, between countries; and excessive administration required to implement joint actions and take important decisions.

5.2.1.3 Partnership under the umbrella of the EU: The European & Developing Countries Clinical Trials Partnership (EDCTP)

The European and Developing Countries Clinical Trials Partnership (EDCTP) was established as a not-for-profit partnership in 2003 under the European Commission's Sixth Framework Programme (FP6) for Research and Technological Development. The partnership aimed "to accelerate the development of new clinical interventions to fight HIV/AIDS, tuberculosis and malaria in developing countries, particularly sub-Saharan Africa, and to improve the quality of research in relation to these diseases through European research integration and in partnership with African countries".[150] The partnership progressively developed into a collaboration of 16 African countries and 14 European Union member states plus Norway and Switzerland.

A second phase of the partnership was approved in 2014 for the 2014-2024 period.[151] Implemented as part of Horizon 2020, EDCTP2 draws on a budget of up to €1.36bn, half of which is provided by member countries which is then matched by the EU. By December 2019, EDCTP2 had allocated €608m for 84 clinical studies, 130 fellowships for African researchers, and 57 projects to strengthen the enabling environment for the conduct of clinical trials and research (including 31 ethics and regulatory projects).[152] While the overarching strategy has not changed for the second phase, the focus has been extended to include neglected infectious diseases and all clinical trial phases (I-IV) including research investigating health services optimisation.[153]

The EDCTP is governed by the General Assembly (GA), with representation from each of the participating states (currently 14 European and 16 African member countries). Selected members of the GA form the EDCTP Board (5 individuals), responsible for ensuring that resources are properly and efficiently managed. A secretariat, located in The Hague and Cape Town, executes the activities of the programme. In addition, the GA and Secretariat are advised on

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[149] European Commission (2016) Evaluation of Joint Programming to Address Grand Societal Challenges: Final report of the expert group

[150] Technopolis Group (2014) Assessment of the performance and impact of the first programme of the European & Developing Countries Clinical Trials Partnership (EDCTP)

[151] https://www.edctp.org/get-know-us/. Accessed 25 June 2021

[152] EDCTP (2019) EDCTP2 portfolio: Collaborative research and development 2014-2019

[153] https://www.edctp.org/get-know-us/strategy/. Accessed 25 June 2021

technical and scientific matters by a Scientific Advisory Committee, composed of independent scientific experts from Europe and Africa.

Calls for proposals are centrally managed by EDCTP.[154] Other relevant activities – so-called Participating States' Initiated Activities (PSIAs) – are the main mechanism for states to make in-kind contributions. PSIAs comprise activities in the scope of EDCTP2 that are funded and implemented independently from EDCTP by one or more Participating States. In addition, third parties, including industry, product development partnerships, development organisations, and research institutions, make cash or in-kind contributions to EDCTP calls. A number of joint calls have taken place, e.g. a call in partnership with the Coalition for Epidemic Preparedness Innovations (CEPI) in November 2019, and a call in partnership with GlaxoSmithKline (GSK) in November 2018[155]. Calls range from fairly broad topical remits (e.g. 'Diagnostics tools for poverty-related diseases – 2018' to more specific actions (e.g. Strategic action for overcoming drug resistance in malaria').[156] Proposals for research grants require the team to comprise at least three different partners, two established in two different European Participating States and at least one in a sub-Saharan African country.[157]

The partnership supports three core aspects to address the key infectious diseases affecting Africa: 1) clinical research, 2) development of research capacity and 3) strengthening of the enabling conditions for clinical research including infrastructure and international networking.[158] Hence, in addition to research grants, other types of funding are available (see Figure 12). For example, the EDCTP funds regional networks in central, Eastern, Southern, and West Africa to promote African co-ownership of the EDCTP projects and strengthens clinical research capacity, scientific leadership and networking.[159] A range of fellowships and funding for training as well as grants for laboratory and clinical facilities are available to build research capacity.[160] Research capacity is also supported by enabling researchers from LMICs to become principal investigators of EDCTP-funded projects. An evaluation of the first phase of the partnership concluded that: "EDCTP has become a more equal and transparent partnership in which African countries have a much stronger voice than in the early days. The programme has increased African engagement over the whole spectrum of clinical research and has helped structure clinical research capacity in Africa."[161] A recent evaluation of the Swedish International Development Agency's (SIDA) support to projects in the scope of the EDCTP2 programme found that 71% of research-related projects receiving SIDA funds were coordinated form LMICs (41 of 58), and 33% were coordinated by a female PI based in an LMIC.[162]

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[154] EDCTP (2020) EDCTP Strategic Research Agenda, Version 4

[155] Joint call with CEPI: 'Vaccines against Lassa virus disease', November 2019, budget: €40m; joint call with GSK: 'EDCTP-GSK Senior Fellowships for co-morbidities between poverty-related diseases and non-communicable diseases', November 2017, budget: €3m

[156] https://www.edctp.org/funding/calls-for-proposals/. Accessed 25 June 2021

[157] http://www.edctp.org/funding/faqs-on-calls-2/. Accessed 25 June 2021

[158] EDCTP (2018) EDCTP Strategic Business Plan for 2014-2024, 2nd edition

[159] Ghannem H, Mugwagwa J, Allen E, Karbwant J (2019) Mid-Term Independent Evaluation of the EDCTP Regional Networks 2017-2020

[160] EDCTP (2018) EDCTP Strategic Business Plan for 2014-2024, 2nd edition

[161] Technopolis Group (2014) Assessment of the performance and impact of the first programme of the European & Developing Countries Clinical Trials Partnership (EDCTP)

[162] Hanlin R, van't Hoog A, Kruger M et al (2020) An independent evaluation of SIDA's support to projects in the scope of the EDCTP2 programme

Figure 12 Overview of the integrated EDCTP approach

Source: Reproduced from (EDCTP, 2018)

While implementation research is in scope for EDCTP2, only one grant specifically focussed on this area. While remaining focussed on infectious disease, two calls have targeted research on the interplay between infectious disease treatment in the presence of NCDs, e.g. 'Advances in product development for effective prevention, treatment and management of co-infections and co-morbidities' (June 2018), which led to two clinical trials involving patients with diabetes, and the 'EDCTP-GSK Senior Fellowships for co-morbidities between poverty-related diseases and non-communicable diseases' (November 2017), which led to five fellowships.

EDCTP has undergone several internal and external assessments. An independent performance and impact assessment of EDCTP1 was carried out by Technopolis in 2014.[163] In 2017, an interim evaluation of EDCTP2 was completed based on extensive desk research and document review, a programme of stakeholder interviews, and consultation with an expert group.[164] This evaluation included an assessment of efficiency, relevance, coherence, effectiveness and added value. The report also noted the indicators that will be used to measure EDCTP2's ability to meet its specific targets. These include short term outputs such as the number of supported clinical trials and the number of interventions that have progressed along the clinical trial pathway; medium term outcomes such as the number of publications resulting from funded projects; and longer-term impacts such as the number of new interventions, improved policies and guidelines and patents or patent applications. Specific

[163] Technopolis Group (2014) Assessment of the performance and impact of the first programme of the European & Developing Countries Clinical Trials Partnership (EDCTP)

[164] Experts Group Report (2017) Evaluation of the Second European and Developing Countries Clinical Trials Partnership Programme (2014-2016)

aspects of EDCTP2 have been evaluated in separate studies. The project portfolio receiving contributions from SIDA was assessed as to project progress, outcomes and impacts, as well as gender balance, through document review and stakeholder interviews.[165] An interim evaluation of the EDCTP Regional Networks conducted desk research, stakeholder interviews and site visits to assess the level to which networks were achieving their intended deliverables, and reported on stakeholder perceptions of the networks' relevance, efficiency, effectiveness and added value.[166]

5.2.1.4 Partnership of national funders and foundation: The Joint Global Health Trials Initiative (JGHT)

The Joint Global Health Trials funding scheme (JGHT) was established in 2009 as a partnership of funders, the UK Medical Research Council (MRC), the Foreign, Commonwealth & Development Office (FCDO), Wellcome, joined in 2016/17 by the Department for Health and Social Care (DHSC). The aim of the JGHT is "to support the best proposals to generate new knowledge about interventions that promise to contribute to the improvement of health in LMICs, addressing a major cause of mortality or morbidity". It makes available two types of funding: Full trial awards, which support late-stage and health intervention trials (Phase III /IV) and development awards, which enable studies to carry out formative work in preparation for a trial. The scope of the scheme is broad and includes behavioural interventions, complex interventions, disease management, drugs, vaccines and hygiene and diagnostic strategies. The funders of the JGHT agreed to commit up to £120m for 2011-2016 period, and a further £100m for the 2016-2020 period.

Roles for the management of the JGHT are assigned to individual funders (Technopolis, 2019). The MRC is the lead administrative partner, responsible for processes such as coordinating the calls for proposals, handling preliminary and full applications, arranging external referee reports, and grant management post-award. The Wellcome Trust leads on the administration of Joint Funders Review Committee meetings, supports referee selection, and convenes the review panel (which shortlists outlines for invitation to submit full proposals, and selects full applications for funding). FCDO and DHSC provide strategic oversight and financial resources.

The JGHT funds projects through annual calls for proposals, with up to £20m available per call. In the first seven calls of the scheme, 96 awards were made (63 full trial / 33 development awards) for a total of £138.8m (Technopolis, 2019); another 7 full trials and 11 development awards were funded through call 8.[167] Studies funded through the JGHT have to be located in LMICs. The PI can be employed either by a research institution in the UK or in a LMIC, while co-investigators can be located in any country (including other HICs). The scheme is aimed at funding trials, but also encourages inclusion of other types of methodologies, such as economic evaluations and social science research, to explore implementation and operational issues alongside the trial and to pave the way to implementation and impact.

Based on Health Research Classification System (HRCS) Codes, the largest share of JGHT awards was in the area of 'Infection' (44%) (Technopolis, 2019). However, research also addressed chronic diseases, e.g. the areas 'Mental Health' and 'Cardiovascular' represented

[165] Hanlin R, van't Hoog A, Kruger M et al (2020) An independent evaluation of SIDA's support to projects in the scope of the EDCTP2 programme

[166] Ghannem H, Mugwagwa J, Allen E, Karbwant J (2019) Mid-Term Independent Evaluation of the EDCTP Regional Networks 2017-2020

[167] https://mrc.ukri.org/documents/pdf/jght-funded-projects/. Accessed 25 June 2021

around 9% each. Some of the JGHTI-funded trials test avenues for implementing existing interventions, e.g. a trial testing delivery of de-worming medication through schools rather than the healthcare system.

5.2.1.5 Partnership for information exchange and coordination: The Global Research Collaboration for Infectious Disease Preparedness (GloPID-R)

The Global Research Collaboration for Infectious Disease Preparedness (GloPID-R) is a network of research funding organisations (currently 29). Its aim is to support research of a significant outbreak of a new or re-emerging infectious disease with epidemic and pandemic potential.[168]

The alliance's objectives are to:

- Facilitate information exchange
- Address scientific, legal, ethical and financial challenges
- Implement a 'One Health' approach with close cooperation between human and animal health researchers
- Establish a strategic agenda for research response
- Connect infectious disease research networks
- Involve developing countries

GloPID-R coordinates and shares information among the funding organisations but does not fund projects directly. It keeps members updated on each other's research results and aware of potentially emerging epidemics. The research funders can then decide to target funds to specific infectious disease research programmes, individually or in partnership.

5.2.1.6 Research capacity strengthening initiatives

A review of 14 research capacity strengthening initiatives aimed at NCD researchers in LMICs (including GACD's efforts) found that most of these initiatives were arranged as a collaboration between developed countries and institutions based in LMICs, with HICs as the source of funding and as a prime implementing partner, and LMICs as sub-grantee or local partner (Haregu et al., 2019).[169] Many of these initiatives were (co-)funded by the US NIH (coordinated by the Fogarty International Centre), and IDRC, Canada. Most initiatives focussed on building individual and team-level NCD research capacity, with less than half also targeting institutional-level capacity building and four at research network level (including GACD). The most common approaches were face-to-face sessions, online training and learning by undertaking research. However, the review concluded that there is little evidence on the continuity and sustainability of the results of the initiatives, as most did not collect information on the outputs of the trainees after completion of the programme.

5.3 Role of GACD in the global funding landscape

Interviewees were overwhelmingly positive about GACD's role in the global NCD implementation science landscape (23 of 27 interviewees). This is because it has an explicit focus on implementation science, which is often lacking elsewhere. One interviewee described GACD as a "unique driver for implementation science projects". Five interviewees also cited

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[168] GloPID-R. Available via https://www.glopid-r.org/about-us/. Accessed 25 June 2021

[169] Haregu TN, Byrnes A, Singh K et al (2019) A scoping review of non-communicable disease research capacity strengthening initiatives in low and middle-income countries. Glob Heal Res Policy 4(1)

the important role of GACD in influencing funders, for example, GACD ensures that funders ringfence portions of their money for implementation research, which otherwise might be absorbed into other programmes or research areas.

GACD's other roles in the global funding landscape are:

- Championing NCD implementation research in LMICs. Four interviewees remarked that implementation research in LMICs would be impacted if GACD did not exist
- Generating attention towards NCD implementation research (3 interviewees)

GACD is also seen as contributing to the increasing demand for implementation science research in NCDs. Most interviewees (15 of 24) agreed that this demand has gradually increased over time worldwide. GACD's contribution has been attributed to its training and networking activities (4 interviewees), dedicated NCD-implementation science calls (2), and bringing funders together (1).

GACD's presence in the broader funding landscape was much valued by most interviewees. A small minority (3) thought that its absence would not have a significant impact because GACD does not distribute funding itself. One interviewee stated that implementation science would continue to be funded but under a different name. Another interviewee was unsure of the consequences.

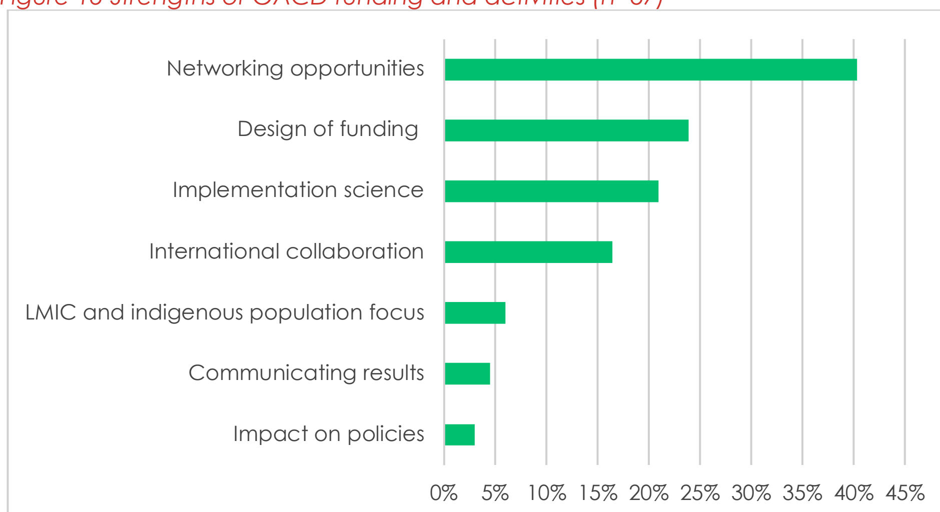
GACD could have general added value in helping to promote a culture of evidence-based policy making alongside other similar initiatives in the landscape. So, even if individual projects fail to achieve direct policy or practice impacts, there is capacity building of the academic and non-academic stakeholders involved or engaged. However, interviewees believe such impacts will take considerable time and will be achieved to a larger extent through the combined forces of multiple research projects.

5.3.1 Strengths and weaknesses of GACD

5.3.1.1 Main strengths

The most commonly mentioned strength of GACD in the project team survey (Figure 13) was the networking opportunities provided (40%). These networking opportunities were appreciated for the capacity to link researchers together ("*Ability to network with others around the world to identify those with similar interests, both in terms of content areas as well as methodologies*") and translate the expanded networks into research collaborations ("*The network of professionals that has been created, because it promotes research collaborations*").

Figure 13 Strengths of GACD funding and activities (n=67)



Source: Technopolis analysis of GACD survey

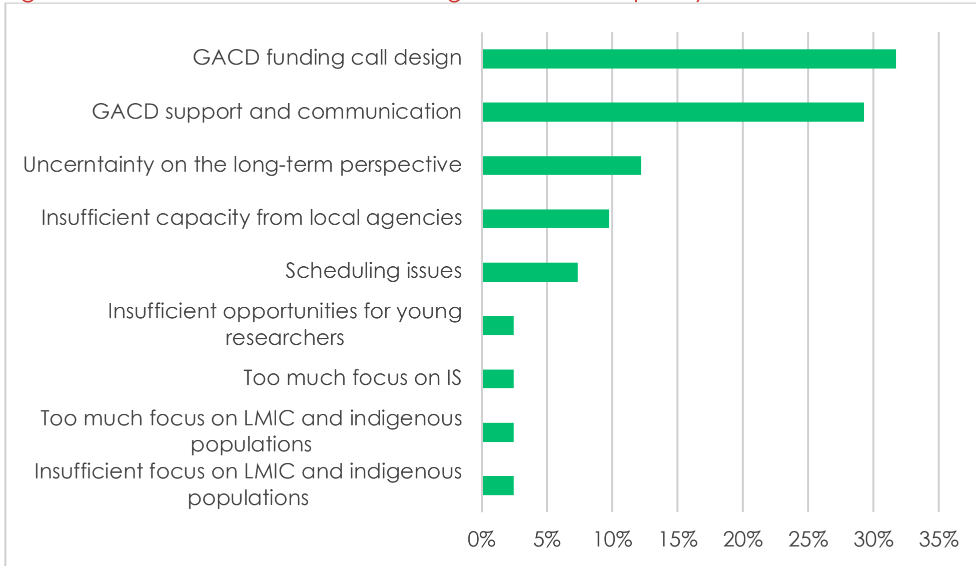
The GACD funding design was also a commonly mentioned strength (24%). Some respondents noted that GACD addresses funding gaps ("*It fills the gap by funding the projects on topics that may be not funded by other schemes, especially at national level*") while others appreciated how GACD creates a network of funding agencies and introduces common funding themes internationally ("*A major strength of the GACD is its network approach including launching a similar call in collaboration with several international funding agencies*").

Another noteworthy strength was the focus on implementation science (21%). Here, GACD's contribution was linked to increasing implementation science uptake – either in NCD research specifically ("*Provide platform & opportunities to help researchers for collaboration and training for implementation research (NCDs)*") or in general ("*Building common understanding of implementation science and a forum for people to share*").

5.3.1.2 Main weaknesses

There was less agreement among the respondents regarding weaknesses of GACD funding design and activities. The 2 most commonly discussed weaknesses were firstly the design of the GACD funding calls (32%) and secondly GACD support and communication (29%). Weaknesses related to funding calls were often connected to other issues, for example, inequalities in participation due to the funding being linked to national agencies ("*Differences in funding mechanisms make it difficult for all countries to participate in the same way*"), or variable performance of national funding agencies within GACD ("*GACD not having control over funding, some funders are unreliable*"). Insufficient capacity within local funding agencies is also among the weaknesses of GACD (10%) (Figure 14).

Figure 14 Weaknesses of GACD funding and activities (n=56)



Source: Technopolis analysis of GACD survey

Weaknesses related to GACD support and communication linked to limited GACD involvement in the funding process ("*Communication and processes during application process could be complex and demanding with actual funding agencies in different parts of the world*") and the management of the projects ("*Projects could have benefited from more engagement with one another and it would have been helpful to have a clearer understanding from GACD what their role in projects are and to have more active facilitation in our work*")

6 GACD activities, outcomes and impact

6.1 GACD Projects

6.1.1 *Outline of the investment to date*

In total, 110 projects have been funded under GACD thus far, grouped into five programmes as shown in Table 5, and with an overall funding volume of US$223m. Projects are generally between three and five years in duration.

Table 1 Overview of the GACD funding programmes

Programme	Year of Call	Number of Projects	Total funding amount (US$)
Hypertension	2011	15	23,127,854
Diabetes	2013	17	29,781,572
Lung diseases	2015	17	59,902,869
Mental health	2016	34	58,438,860
Scale up (hypertension & diabetes)	2018	27	51,502,144

Source: Based on data provided by GACD.

98% (108) of the projects are fully or partly funded by HIC funders as shown in Table 6. Upper or lower middle income country funding agencies have provided funding to a quarter (25%, 27) of the projects. GACD members such as Canadian Institutes of Health Research and NIH Fogarty International Center are helping to leverage more funding into GACD projects through their own networks and partnerships.

Table 2 Overview of projects funded by funder

Funding Agency Name	Funding Agency Country / Region	Country Income Group	Number of Projects Funded
National Health and Medical Research Council	Australia	High income	20
Canadian Institutes of Health Research	Canada	High income	16
Canadian Stroke Network*	Canada	High income	3
Grand Challenges Canada*	Canada	High income	3
International Development Research Canada*	Canada	High income	6
European Commission	Europe	High income	21
Japan Agency for Medical Research and Development	Japan	High income	4
Health Research Council	New Zealand	High income	3
UK Medical Research Council	United Kingdom	High income	15

Funding Agency Name	Funding Agency Country / Region	Country Income Group	Number of Projects Funded
National Institutes of Health	United States	High income	17
Ministry of Health	Argentina	Upper middle income	4
São Paulo Research Foundation	Brazil	Upper middle income	1
China Academy Medical Sciences	China	Upper middle income	2
National Natural Science Foundation*	China	Upper middle income	7
Mexico's National Council of Science and Technology	Mexico	Upper middle income	6
South Africa Medical Research Council	South Africa	Upper middle income	5
India Council for Medical Research	India	Lower middle income	2

Source: Based on data provided by GACD. Funding Agencies in **bold** are current or past members of the GACD; Funding agencies * have partnered in projects with Canadian Institutes of Health Research;

6.1.2 Research location

Analysis of the GACD funding portfolio shows that, in line with GACD's global scope, projects are located in 73 different countries on all continents (see Figure 15). 40 of the 110 projects (36%) involve two or more countries and 19 of the projects (17%) involve more than one continent.

Looking at the project location by country income group, 89 projects involve HICs, and 78 involve upper-middle income countries. 62 projects involve countries in the lower-middle income group, and 10 projects involve low-income countries.

China and India are the settings for the most GACD projects (16 and 12 projects respectively), followed by Mexico, South Africa and the UK (with 9 projects each).

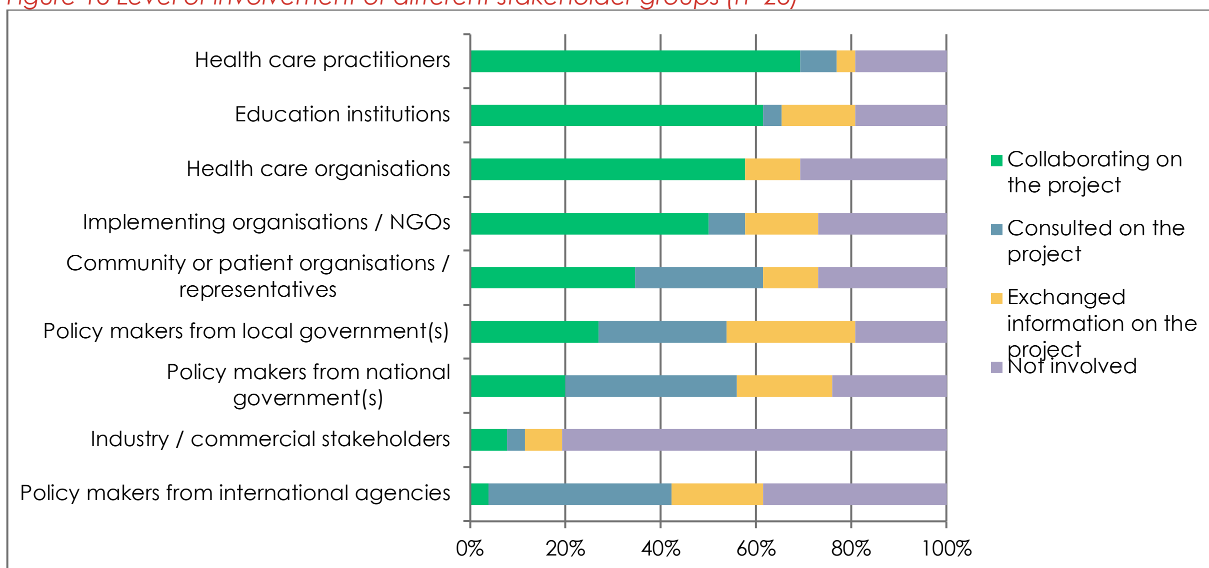
Figure 15 GACD Project Locations

Source: Based on data provided by the GACD Secretariat

6.1.3 Stakeholder involvement

Health care practitioners, education institutions, health care organisations and implementing organisations / NGOs were mostly likely to be collaborating on projects (close involvement) with 50% or more survey respondents stating that they collaborate with these stakeholder types in their projects. The lowest level of involvement was attributed to industry/commercial stakeholders (75% respondents report no involvement of this stakeholder type in their projects). Policy maker involvement was most varied with cooperation ranging from collaboration to consultation or information exchange. Policy makers from local government(s) were more likely to be collaborating than policy makers from national government(s) or international agencies who were more likely to be consulted on the project. Moreover, local policy makers were more frequently involved in projects, followed by national policy makers and then international policy makers (Figure 16).

Figure 16 Level of involvement of different stakeholder groups (n=26)



Source: Technopolis analysis of GACD survey

Not all of the partnerships were new. Many of the survey respondents indicated that they had prior relationships with the stakeholders before the GACD funding opportunity came up (73%, Figure 37). However, nearly half of the respondents also showed that their projects involved new stakeholders that their research team actively approached (46%). This shows that while projects tended to leverage existing relationships, GACD fostered new relationships as well. In fact, over a quarter of the respondents (27%) stated the relationships with stakeholders were facilitated by GACD.

6.2 Scientific outputs and outcomes

As described in the programme logic model (see section 4), outputs and outcomes expected from GACD-funded activities in the scientific domain centre on new knowledge and research methods, which in turn inform and improve further research and help secure further funding. This section summarises the evaluation findings regarding the quality, relevance and volume of GACD-funded research, e.g. publications, stakeholder views, and take-up of findings in further research projects.

It should be noted that many of the ongoing projects are experiencing changes to their planned timelines due to the COVID-19 pandemic, e.g. 65% of researchers responding to the survey indicated that COVID-19 related restrictions had impacted on the delivery of their research. As a result, outputs and outcomes from ongoing projects are likely to require more time to fully accumulate.

6.2.1 Quality and relevance of research funded through GACD

The quality of GACD projects was well regarded by most interviewees, owing to the peer review process which was viewed as ensuring that the highest quality research gets funded. Those who have a longer experience with GACD feel the proposal quality has gone up over the years. Moreover, the quality requirements built into the application process is seen to promote strong proposals.

Interviewees broadly agreed that the focus on implementation science had improved over the first five GACD calls, demonstrating an increase in capacity of the research community,

review panel members, and funders alike. While some of the funded projects do not fully align with the 'purist' definition of implementation science, this was not identified as a cause for concern – interviewees felt it was more important that the research was of a high quality.

Interviewees widely agreed on the added value of research on vulnerable populations in HICs, which many interviewees saw as having some parallels to research questions in LMIC contexts. Interviewees also saw this as a way for HIC funding agencies to justify their participation in GACD as it allows them to align the funding with national priorities, strategies, and actions.

6.2.2 Research findings and follow-on funding

Half of the survey respondents (50%, n=26) indicated that their GACD-funded project resulted in research findings. Examples of research findings reported related to tobacco control ("*At least 20 research publications; key finding: the poor are not hurt by tobacco control, but they are hurt by tobacco use*"), mental health research ("*Implementation of a community intervention to improve effective access to mental health services in the communities of Chiapas*"), and healthcare worker training ("*Training primary health care providers increases the proportion of their patients whose alcohol consumption is measured ten-fold*").

Less than a fifth of survey respondents (17%, 12 of 70) indicated that their GACD project had led to follow-on funding. Sources included MRC, Australian Medical Research Future Fund, Mental Health First Aid International and internal university funding. The low number of respondents who have acquired follow-on funding may reflect the fact that most of the respondents had 'active' projects.

6.2.3 New research resources

Half of the survey respondents (50%, n=26) were in projects where team members were involved in activities to develop new research resources, while nearly a fifth (19%) had personnel who were part of GACD working groups developing research resources. The most common type of research resources being created were data sets, followed by training material and research protocols.

6.2.4 Uptake of project results by other researchers

When asked whether they were aware of other researchers taking up project findings, or using new tools, databases, training materials, implementation pathways or methodologies developed as part of their GACD-funded project, 32% (n=25) of the survey respondents indicated they knew of such researchers while 68% were not aware. Notable examples of such uptake include contributing to existing research ("*Our project has contributed to improvement of methods of the Global Burden of Disease project*") and providing material that is adapted for training ("*Other researchers have used our training materials as a template to deliver their own education*").

6.2.5 Publication outputs

Bibliometric analysis identified 405 GACD-funded publications between 2014 and 2019. These mainly corresponded to publication outputs from the first three GACD funding calls specifically targeting hypertension, diabetes, and lung diseases. The mental health thematic call was associated with less than 30 GACD publications and had limited time to accrue citation statistics, and were therefore removed from the final thematic filter employed in the computation of the bibliometric indicators.

Keyword-based searches for the three SCD identified a subset of 300 GACD-funded publications, and 100 of those also fell into the IS area. Although a share of one-third of SCD-IS

publications may seem low given GACD's explicit focus on implementation science, when one compares this share (33%) to that of other funders (2-4%), using the same narrow definition of the discipline, GACD-funded publications appear highly enriched in SCD-IS publications. This enrichment of publication outputs in implementation science can be expressed in terms of a specialisation index (SI), where SI of 1 represents the world average level. GACD has SI of 12.0, compared to 1.3 for (non-GACD publications of) selected GACD members and 0.6 for three non-GACD funders (Table 7). **This data provides evidence that GACD-funded research has specific focus on implementation science within selected chronic diseases.**

Table 7 Publication output in selected chronic diseases (2014-2019)

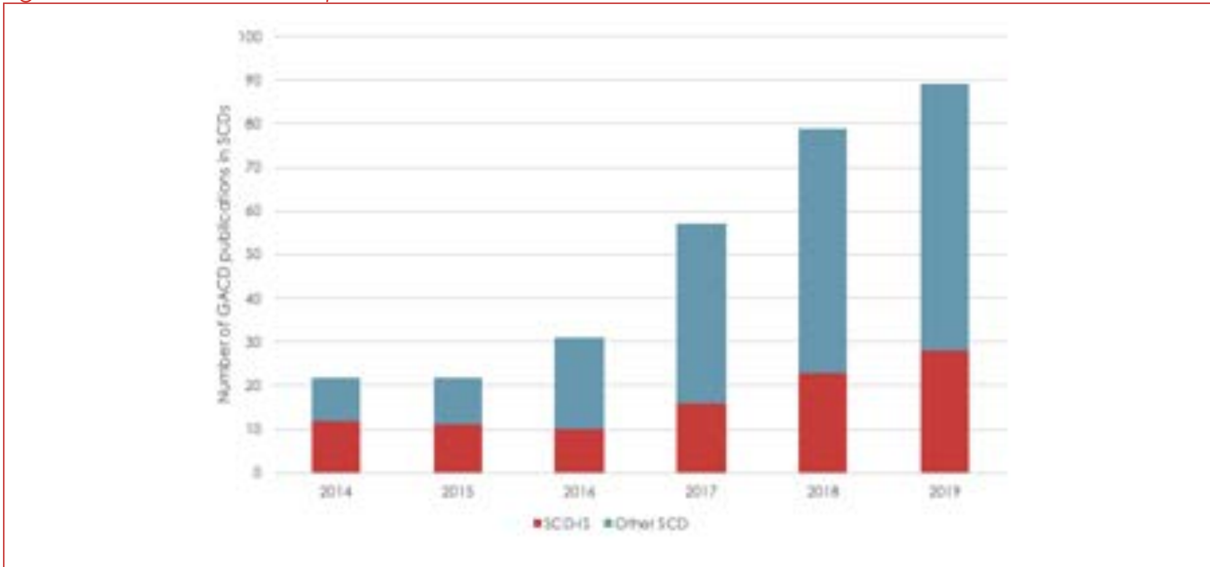
	2014-2019			
	Papers	Trend	CAGR	Ratio to world
	Number of papers			
GACD-funded publications	405		37.3%	0.1%
SCD	300		32.2%	0.1%
SCD-IS	100		18.5%	0.7%
World Level				
SCD	501,396		4.6%	N/A
SCD-IS	13,918		9.8%	N/A
HICs				
SCD	343,340		2.7%	68.5%
SCD-IS	11,644		8.1%	83.7%
LMICs				
SCD	208,465		9.6%	41.6%
SCD-IS	4,077		19.5%	29.3%
3 GACD members (based on funders lists of publications)				
SCD	62,717		-1.1%	12.5%
SCD-IS	2,290		2.4%	16.5%
3 non-GACD members (based on Scopus Acknowledgements)				
SCD	8,304	N/C	23.0%	1.7%
SCD-IS	134	N/C	58.5%	1.0%
	Share of IS papers (within SCD papers)			
GACD	33%		N/C	12.0
World Level	3%		4.9%	1.0
HICs	3%		5.3%	1.2
LMICs	2%		9.1%	0.7
3 GACD members (based on funders lists of publications)	4%		3.6%	1.3
3 non-GACD members (based on Scopus Acknowledgements)	2%	N/C	28.9%	0.6

Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

We also analysed publication outputs by disease areas (hypertension, diabetes and lung diseases; Table 14 to Table 16 in Appendix B). This shows that GACD publications displayed a high level of specialisation on implementation science in all three areas relative to benchmark data: hypertension (SI 15.0), diabetes (SI 10.8), and lung diseases (SI 8.7).

Next, we investigated the publication trend over time in the selected chronic diseases. For context and comparison, we note that at the overall world level, research volumes of SCD publications have increased over the analysis period (with a compound annual growth rate or CAGR of 4.6%), and even more so in the subset focussed on implementation science, with a CAGR of 9.8% over the time period 2014-2019. GACD publications in these areas increased relatively faster; SCD publications with CAGR of 32.2% and SCD-IS publications with CAGR of 18.5%. The absolute number of GACD publications for SCD and SCD-IS subsets are shown over time in Figure 17.

Figure 17 Number of GACD publications in SCD-IS vs other SCD research over time



Source: Prepared by Technopolis based on data provided by Science-Metrix using Scopus (Elsevier) data.

Finally, we looked at authorship affiliation to HICs and LMICs of SCD and SCD-IS publications.[170] Overall, of the approximately 500,000 SCD papers published worldwide between 2014 and 2019, 69% included at least one author based in a HIC, and 42% of papers had at least one author based in an LMIC. This difference is more pronounced in the SCD-IS publications, where 84% of papers included at least one HIC author, but only 29% included an LMIC-based author. Interestingly, growth in publications with LMIC authors outpaces those with HIC authors, both for SCD overall (9.6% vs. 2.7%) and for SCD-IS (19.5% vs. 8.1%).

When looking specifically for share of LMIC authorship among the GACD-funded publications and their benchmarks (see Table 13 in Appendix B), we observe GACD shares of LMIC authorship are close to the overall world level and much higher (2-4 times) than those in publications by comparator funders (GACD members' non GACD outputs or non-GACD members). **This shows that GACD has managed to increase the representation of LMIC authors in their funded publications beyond the usual shares seen in publications supported by the 3 selected GACD funders.**

Table 13 in Appendix B additionally gives a country-level breakdown of LMIC papers in individual diseases, SCD, and SCD-IS, with a specific focus on GACD Associate Member countries in the LMIC income group.

6.2.6 *Scientific outcomes from publications*

Citations of publications may be used as data to construct proxy indicators for scientific outcomes, assuming citations acknowledge contribution to scientific knowledge (which on occasion may not be the case). Citations of publications may also be interpreted as contributions to and visibility within scientific discourse. In the following, we analyse the field weighted CiteScore (FWCS), average of relative citations (ARC), highly cited publications ($HCP_{10\%}$), citation distribution index (CDI) and chart (CDC). For a full description of indicators, see Appendix A.2.

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[170] If there is at least one author affiliation in HIC and LMIC, the publication would be counted to both.

Table 8 Scientific outcomes through publications by GACD and comparators (2014-2019)

	Papers	FWCS	ARC	$HCP_{10\%}$	CDI	CDC
SCD						
GACD	300	1.54	2.48	1.85	18.84	
World level	501,396	1.04	1.16	1.19	3.65	
HICs	343,340	1.19	1.37	1.44	8.03	
LMICs	208,465	0.85	0.96	0.87	-2.12	
3 GACD members (non-GACD output)	62,717	1.62	2.16	2.49	21.60	
3 non-GACD members	8,304	1.60	1.96	2.09	17.86	
SCD-IS						
GACD	100	1.37	1.60	1.74	25.04	
World level	13,918	1.19	1.47	1.50	8.42	
HICs	11,644	1.27	1.60	1.64	10.53	
LMICs	4,077	1.07	1.41	1.27	3.50	
3 GACD members (non-GACD output)	2,290	1.58	2.29	2.41	20.89	
3 non-GACD members	134	1.93	2.61	2.29	25.42	

Abbreviations: Number of papers, field weighted CiteScore (FWCS), average of relative citations (ARC), highly cited publications (HCP) (10%), citation distribution index (CDI) and chart (CDC). Source: Prepared by Science-Metrix using Scopus (Elsevier) data

GACD-funded scientific outcomes compare favourably to the overall world level in the SCD across all indicators (Table 8). Comparison with non-GACD scientific outcomes of selected GACD members and those of non-GACD funders suggests that scientific knowledge generated by GACD appear to have similar level of visibility and utility as measured through the various citation-based indicators.

Specifically, the CDI score and associated chart, which give a balanced view of GACD-funded scientific outcomes as a whole, suggest GACD publications recorded a favourable overall citation performance, with a CDI score of 19, compared with selected GACD funders' non-GACD publications score of 22 and non-GACD funders publications score of 18. GACD publications also achieved a high ARC score, which (combined with the other observations found in the table) indicates that a small number of GACD publications have achieved high levels of citation performance, pulling the mean score upwards. Although at face value, GACD scores somewhat lower than comparators on the FWCS, measuring the quality of the journals where GACD papers are published) and the top $HCP_{10\%}$, stability intervals, which give insights into the uncertainty associated with the data, overlapped in all comparisons between GACD publications and those of benchmarking funder groups, meaning that the difference is not significant.

A similar picture emerges when looking at SCD-IS specifically and looking at disease areas specifically (see Appendix B, Table 17-16). Interestingly, scientific outcomes of GACD publications in the area of diabetes perform particularly well. Note that some of the scientific outcome indicators in lung diseases could not be provided due to the small number of publications.

Overall, these findings suggest that GACD-funded research output is consistently well-cited and of a similar level than that of comparators. It is interesting to note in Table 8 that publications with at least one HIC-based author tended to record higher citation impact measurements (for instance, 8.0 on the CDI) than publications with at least one LMIC author (CDI of -2.1). This need not necessarily imply lower research quality and is likely to be driven by a combination of factors including networks and citation culture.

In light of this, and the fact that a large proportion of GACD's output has an LMIC thematic focus and LMIC authors, GACD impact scores can be seen to compare favourably to the scientific outcomes of comparator funders.

6.3 Collaboration

6.3.1 International collaboration

Of the 300 unique GACD SCD publications included in the bibliometric analysis, 81% involve authors from at least 2 countries. This number is 37% for non-GACD output of selected GACD associate members and 46% for the selected non-GACD members. **For SCD-IS papers, 83% of all GACD-funded papers involve international collaboration, compared to 29% for non-GACD output of the selected GACD members, and 60% for the three non-GACD members.**

GACD publications stand out particularly in their high share of HIC-LMIC collaboration: 60% of the 300 publications involve collaboration between authors from both HICs and LMICs (76% of the 100 SCD-IS publications). HIC-LMIC co-publication rate is much lower for the comparators (see column ICR-HICs-LMICs in Table 9. **Thus, there is evidence that GACD successfully fosters internationally collaborative research across countries with different income levels**.

Looking at the position of LMIC authors in papers with HIC-LMIC collaborations allows to measure the degree to which these collaborations are equitable. **LMIC authors take the role of first, last or corresponding author in 48% of all GACD SCD papers that are HIC-LMIC collaborations.** Looking at each of these roles individually, the percentages are somewhat lower, with 37% of papers having an LMIC first author, 34% an LMIC last author, and 31% an LMIC corresponding author. A similar picture emerges within the subset of SCD-IS publications.

It is interesting to note that GACD publications score lower on these indicators than the comparators (e.g. GACD SCD 48% LMIC first, last or corresponding authors vs. 57% and 60% for the comparators) and also lower than the world level of global HIC-LMIC co-publications (74% LMIC first, last or corresponding authors). This finding indicates the possibility that even while GACD greatly fosters HIC-LMIC collaboration overall, the GACD model may favour HIC authors' position within the collaborations.

Table 9 Co-publication in publications funded by GACD and comparators (2014-2019)

	Papers	ICR	ICR-HICs	ICR-LMICs	ICR-HICs - LMICs	Position of LMIC authors in papers with HIC LMIC collaboration (%)				DDA	DDR
						FA	LA	CA	F L CA		
SCD											
GACD	300	81%	80%	61%	60%	37%	34%	31%	48%	1.83	1.09
World level	501,396	22%	21%	11%	10%	65%	48%	53%	74%	1.24	1.05
HICs	343,340	31%	31%	14%	14%					1.27	1.04
LMICs	208,465	26%	24%	26%	24%					1.26	1.08
3 GACD members (non-GACD output)	62,717	37%	37%	16%	15%	47%	31%	33%	57%	1.41	1.08
3 non-GACD members	8,304	46%	46%	17%	17%	49%	40%	41%	60%	1.40	1.10
SCD-IS											
GACD	100	83%	83%	76%	76%	31%	35%	29%	48%	1.91	1.18
World level	13,918	26%	26%	13%	13%	55%	42%	48%	69%	1.47	1.06
HICs	11,644	31%	31%	15%	15%					1.50	1.05
LMICs	4,077	46%	44%	46%	44%					1.46	1.09
3 GACD members (non-GACD output)	2,290	29%	29%	15%	15%	42%	37%	38%	58%	1.63	1.06
3 non-GACD members	134	60%	60%	42%	42%	70%	50%	66%	77%	1.66	1.12

Abbreviations: International collaboration rate (ICR), international collaboration rate with at least one author from a HIC, LMIC, or both (ICR-HICs, ICR-LMICs, ICR-HICs - LMICs), position of LMIC authors in papers with HIC-LMIC collaboration (%) - first author (FA), last author (LA), corresponding author (CA), or any of previous positions (F L CA), disciplinary diversity of authors (DDA), disciplinary diversity of references (DDR). Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

6.3.2 *Gender balance*

Considering the role of gender, GACD publications did as well or slightly better than those of comparators for their share of women authorships (41%, against 41% for selected GACD members and 37% for selected non-GACD members) and the share of these publications that were written by mixed-gender teams (89%, against 88% for selected GACD members and 89% for selected non-GACD members, see Table 10).

Findings on the authorship role and career stages of women contributors to GACD publications, indicate, however, that the share of women in key authorship roles as well as their levels of seniority tend to be lower than for the comparators. GACD publications had the lowest shares of women in last author (24%) and corresponding author positions (31%). In comparison, the selected non-GACD funders had 31% women last authors and 34% women corresponding authors. In GACD publications, 33% of researchers with 6 to 10 years of experience were women (against 38% to 48% in the comparator groups). This share was 19% for researchers with more than 10 years of experience, against shares of 31% and 35% for the comparators. Overall, these patterns also hold in the subset of SCD-IS publications.

Table 10 Women authorship among GACD papers and those of comparators (2014-2019)

	Share of women authorship	Share of mixed-gender papers	Share of women authorship by author position in papers			Share of women authorship by career stage (number of years since 1st publication)		
			FA	LA	CA	0 to 5	6 to 10	more than 10
SCD								
GACD	40.9%	89.4%	40.4%	23.8%	30.9%	61.2%	32.8%	18.9%
World level	38.6%	79.4%	41.6%	32.7%	36.2%	45.7%	40.2%	29.8%
HICs	38.0%	79.1%	41.4%	31.1%	35.5%	48.0%	41.7%	28.8%
LMICs	39.2%	82.0%	41.5%	35.2%	37.0%	42.6%	37.4%	32.6%
3 GACD members (non-GACD output)	41.3%	87.6%	47.1%	34.3%	40.0%	51.8%	47.9%	34.8%
3 non-GACD members	37.1%	88.7%	41.6%	31.4%	34.1%	44.4%	37.8%	31.4%
SCD-IS								
GACD	47.5%	93.4%	48.3%	26.4%	38.4%	71.0%	40.3%	22.4%
World level	45.7%	77.7%	48.8%	40.0%	45.9%	53.6%	47.1%	37.9%
HICs	46.4%	78.3%	50.1%	40.3%	46.9%	56.5%	49.2%	38.3%
LMICs	41.6%	81.2%	43.5%	37.4%	41.2%	45.6%	39.7%	35.0%
3 GACD members (non-GACD output)	50.3%	87.4%	55.1%	43.6%	52.1%	59.9%	56.6%	44.8%
3 non-GACD members	40.6%	83.7%	40.6%	38.2%	40.9%	43.4%	47.6%	36.6%

Note: The process of assigning a gender to researchers works well for most countries. For some countries, however, using Latin characters results in the loss of gender-related nuances for some names, introducing additional uncertainty. This should have more effect in the indicators computed for the groups LMICs and 3 non-GACD members which contains higher shares of publications from Asian countries.
Source: Prepared by Science-Metrix using Scopus (Elsevier) data

6.3.3 *Multi- and inter-disciplinary collaboration*

The disciplinarity diversity of GACD publications can be assessed using two lenses: the disciplinary diversity of authors (DDA) and the disciplinary diversity of references (DDR). As shown above in Table 9, **the disciplinary diversity of authors is consistently higher for GACD papers than comparators**, both for GACD SCD output (DDA of 1.8, above 1.4 for comparators), and the subset of papers classed as SCD-IS (DDA of 1.9 vs. 1.6 for comparators). The disciplinary diversity of references, on the other hand, which indicates levels of integration of ideas and approaches from different disciplines is similar between GACD-funded papers and comparators.

6.3.4 *Extent of co-creation between sectors*

Each author on the publications contained in GACD and comparator SCD dataset was assigned to a sector according to their affiliation (i.e. academic, medical, government,

private, research institute, other). Note that the semi-automated process of sectorial categorisation is associated with higher level of uncertainty for groups Government, Research Institute and Other, given the challenges to code unambiguously those sectors. Results are available in Table 20 in Appendix B.

We observe that almost all publications have an author with academic affiliation and about half of all publications have at least one author with a 'medical' affiliation, for both GACD-funded papers and those of the comparators. However, **GACD-funded publications have more diverse authorship from non-academic categories than comparators, i.e. authors are affiliated with Government and Research Institutes to a larger extent.**

6.3.5 The GACD network

GACD invests significant resources in networking researchers beyond the individual projects. In the following, we present data on the GACD network as a whole, including all funded researchers, and all 470 GACD-supported publications since 2007, regardless of the disease area.

9,690 distinct collaborations (pairs of co-authors) were identified among GACD researchers on GACD-funded publications. Of those, 9,295 were new collaborations, meaning that researchers had not published together prior to a GACD-funded publication.[171] These new collaboration links were then classified as "through projects" (i.e. collaborations between researchers from the same projects, or collaborations between researchers from projects sharing common researcher) or "not through projects" which are likely attributable to GACD networking activities.

Networks of new collaborations "not through projects" and "through projects" are depicted in Figure 18. Figure 18 (top image) shows a network of the 6,980 new collaborations that were classified as "not through projects". Of these, 96% (6,534) referred to collaborations in only 1 or 2 papers, the majority of which are highly collaborative papers (average of authors per paper > 40). It is apparent that hypertension projects are most central to the network, which is in line with the fact that hypertension is GACD's earliest and most active area of research. Closer inspection of the network reveals that researchers bridging different GACD research programmes are often the ones involved in the scale-up call, which is to be expected given this call focussed on hypertension and diabetes. **Overall, this network of new connections formed among GACD-funded researchers outside of project-related connections suggests that GACD networking activities are highly effective at enhancing researchers' networks.**

Figure 18 (bottom image) shows the 2,315 new connections among GACD-funded researchers on GACD publications that were considered as likely to be established through project links.[172] While overall, these were fewer of the new connections established through GACD, the average strength of the connections (number of co-publications) was higher among collaborations formed "through projects" (2.56) than among those formed not through projects (1.86 co-publications on average). This is to be expected given that projects usually result in a number of joint publications, but nevertheless **confirms that links formed through projects result in strong connections between researchers**.

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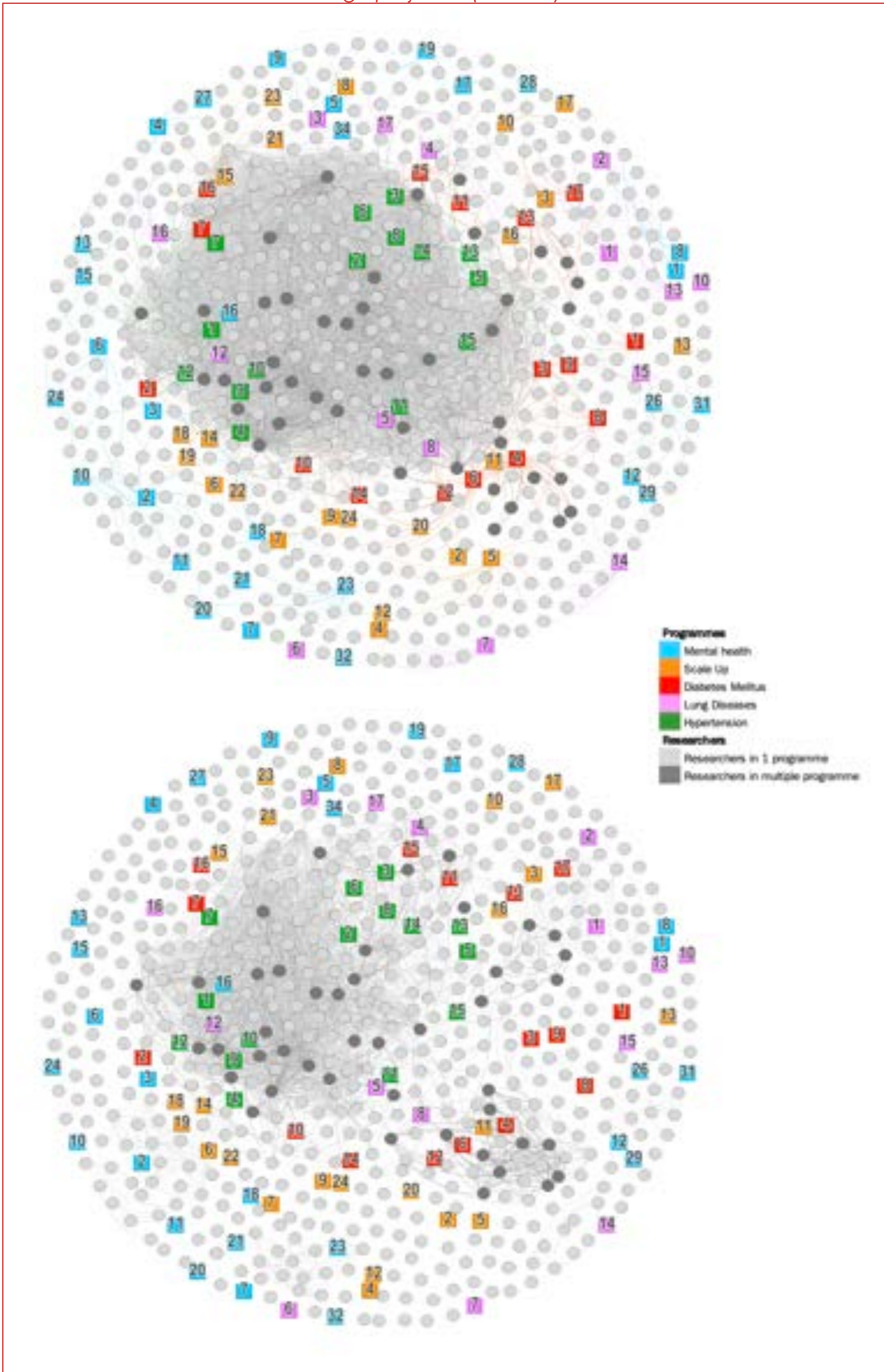
[171] Based on Scopus. Some collaborations marked as new in Scopus could have existed before 2014 in publications that are not indexed in Scopus. Even in these cases, it could be interpreted as "rare" collaborations that become common among GACD.

[172] Project links include not only researchers funded on the same project, but also researchers working on projects that have overlapping team members.

Figure 18 Co-publication network of researchers - new connections "not through projects" (top) and new connections "through projects" (bottom)



Note: Each circle node represents a researcher, and each square node represents a GACD research project, with numbers corresponding to GACD project IDs and colours indicating the research programme. Dark grey nodes represent researchers who are funded through more than one research programme. Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

6.3.5.1 The role of GACD networks in the field

Constructing a social network based on all publications in the area of implementation science within the selected chronic diseases globally allows us to describe the role of GACD-funded researchers in more detail and to quantify this role using network indicators. Given GACD's aim of connecting researchers from different backgrounds and building collaborative networks, an indicator of particular interest is 'betweenness centrality'. It indicates how often a researcher is on the shortest path connecting other researchers in the network, demonstrating that a researcher is a key link connecting other nodes in the network.

Scores in average betweenness centrality (Table 11) clearly show that **GACD-supported researchers act as central hubs or key connectors in the network of SCD-IS.** GACD researchers from HICs collectively held an average betweenness centrality of 39.8, GACD researchers from LMICs achieved a score of 20.9. Both scores are much above those of non-GACD researchers, whether from HICs (average betweenness centrality of 1.6) or LMICs (0.4).

The network graph (Figure 20 below) visually represents this centrality of GACD researchers by showing their concentration in the central co-publication clusters. GACD-LMIC researchers are part of what is possibly the cluster with the highest centrality in the subfield. It is also possible to observe, through visual examination, a relative segregation of HIC and LMIC researchers. GACD researchers tend to be present in those clusters that combine both HIC- and LMIC-based researchers.

Table 11 Summary of co-publication network for implementation science in selected chronic diseases

	2014-2019 With GACD papers			2014-2019 no GACD papers			2008-2013 no GACD papers		
	Researchers	Avg BC	HIC/LMIC	Researchers	Avg BC	HIC/LMIC	HIC/LMIC	Avg BC	HIC/LMIC
non-GACD researchers	**93.2%**	**1.439**	**4.10**	**94.6%**	**1.155**	**6.68**	**96.2%**	**1.165**	**7.92**
HIC	83.2%	1.566		85.5%	1.269		93.0%	1.201	
LMIC	10.0%	0.382		9.1%	0.190		3.2%	0.152	
GACD researchers	**6.8%**	**32.380**	**1.91**	**5.4%**	**2.934**	**1.23**	**3.8%**	**0.154**	**N/C**
HIC	4.1%	39.802		3.8%	3.111		3.0%	0.194	
LMIC	2.6%	20.846		1.6%	2.536		0.8%	0.000	
	100%			**100%**			**100%**		

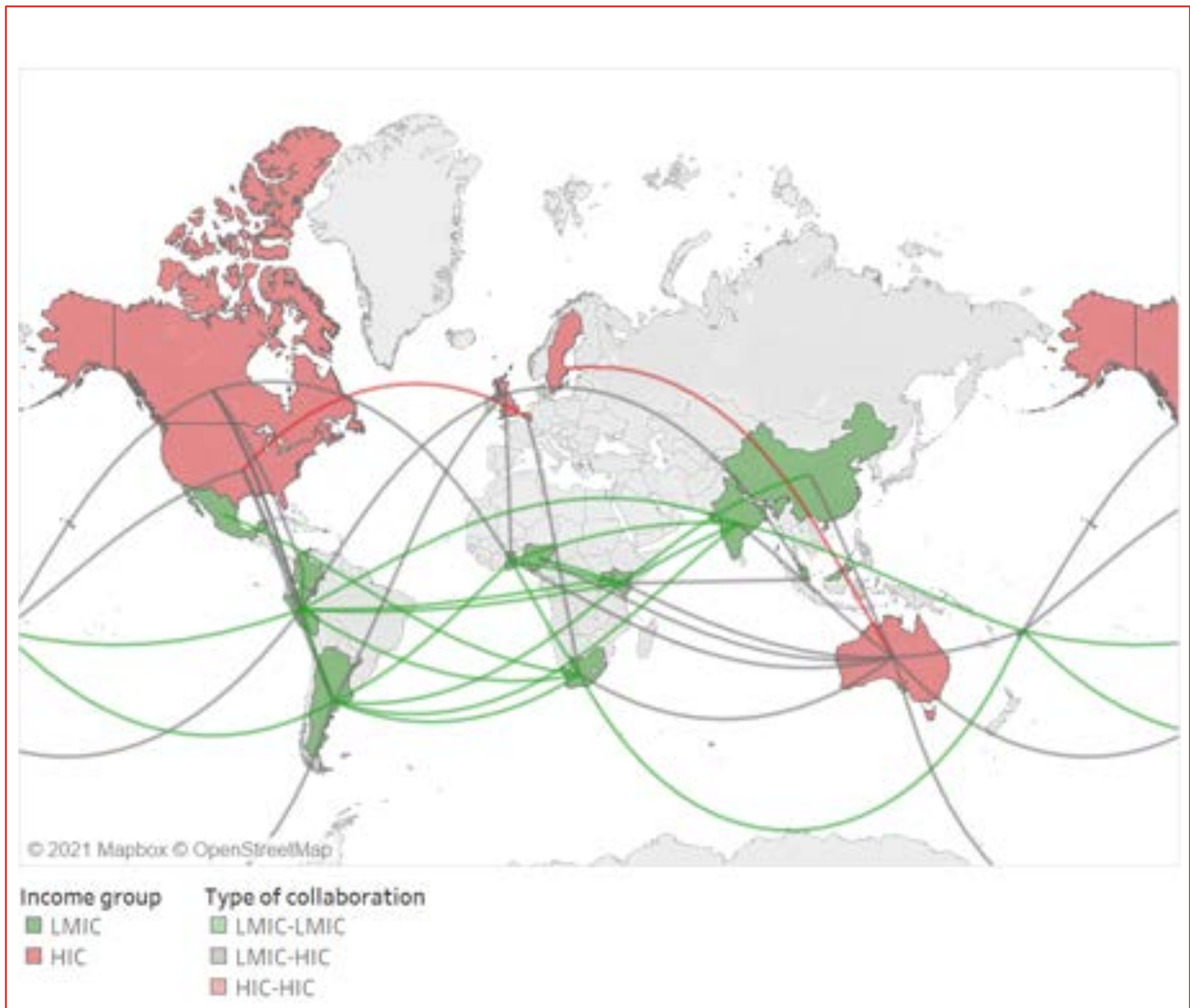
Abbreviations: Share of researchers by each group (researchers), average betweenness centrality (Avg BC), and ratio between the average betweenness centrality of HIC and LMIC researchers (HIC/LMIC)
Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

GACD-funded publications specifically (within the corpus of global SCD-IS publications) involve researchers (from both HIC and LMIC) with a greater proportion of connectors than non-GACD researchers (average betweenness centrality scores). Moreover, GACD-LMIC researchers' score dropped to 2.5 (from 20.9) when GACD-funded publications were removed. This score without GACD publications remained above the average betweenness centrality for non-GACD researchers in the analysis, implying that GACD beneficiaries are well-linked also outside of GACD publications. Thus, **while GACD funding allows researchers to make significant gains in network centrality, there is also the element of GACD funding calls selecting already relatively well-linked researchers**.

Collaboration links between pairs of countries were also investigated (Figure 19). The number of unique pairs of researchers with at least 2 co-publications was used to compute the share of the number of researcher pairs for the GACD network (in implementation science) and for the entire implementation science network (including both, GACD and non-GACD researchers) for each country pair. This helped to assess the relative strength (or frequency) of the collaborations between GACD researchers in relation to the overall implementation science network for a given country pair. Figure 19 shows only those links with relative strength

scores of 2.5 and higher, i.e. the country-to-country links between GACD researchers shown are 2.5 times more frequent than those for the same pair of countries when all researchers in the implementation science network are included. **This illustrates that many LMIC-LMIC and LMIC-HIC links are dominated by GACD researchers in implementation science**.

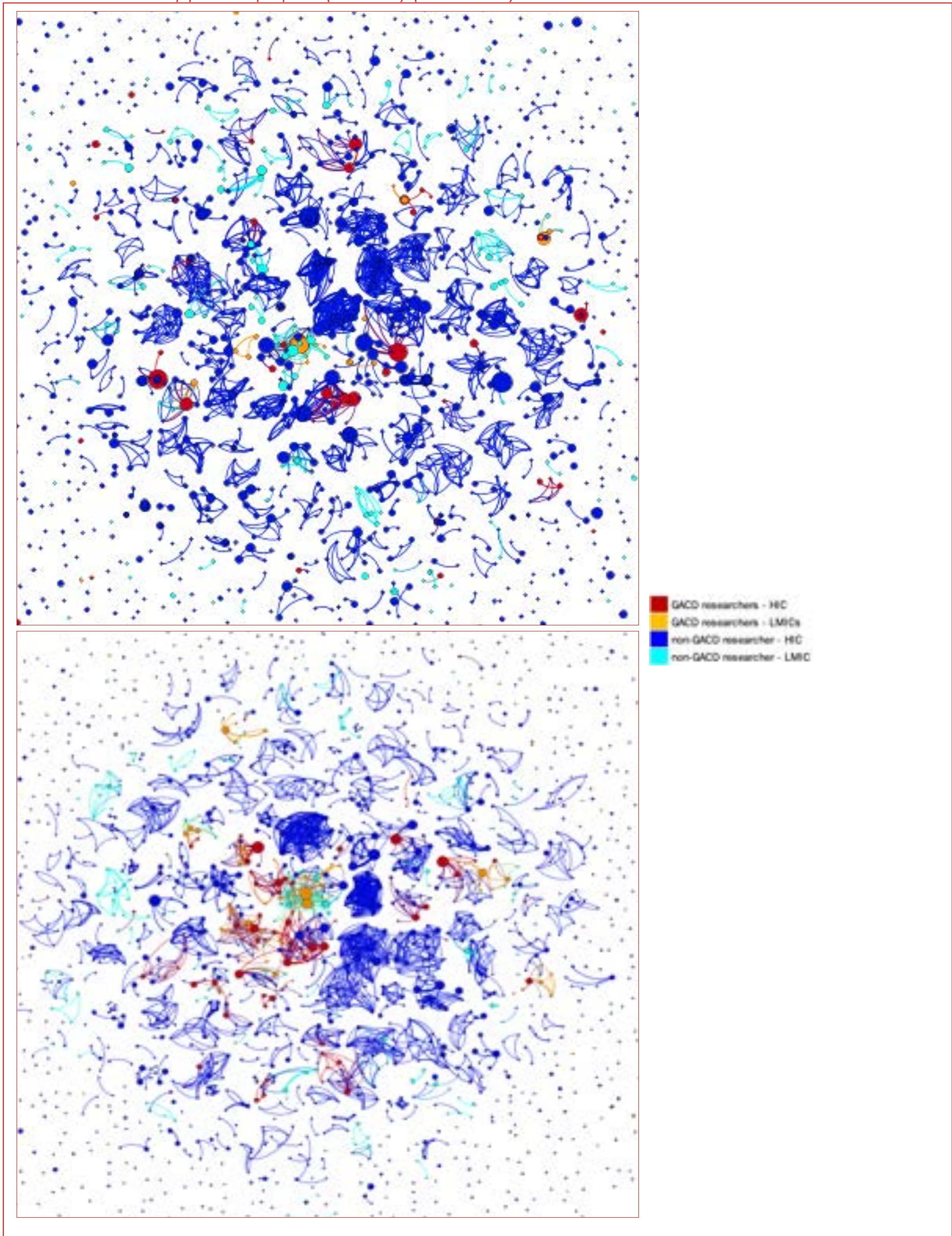
Figure 19 Country-to-country networks fostered by GACD (2014-2019)



Note: The links between each pair of countries are based on pairs of GACD researchers sharing at least 2 co-publications. Links between countries were filtered based on their strength relative to the overall implementation science network (including GACD and non-GACD researchers). Only links with relative strength greater than 2.5 are shown. Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

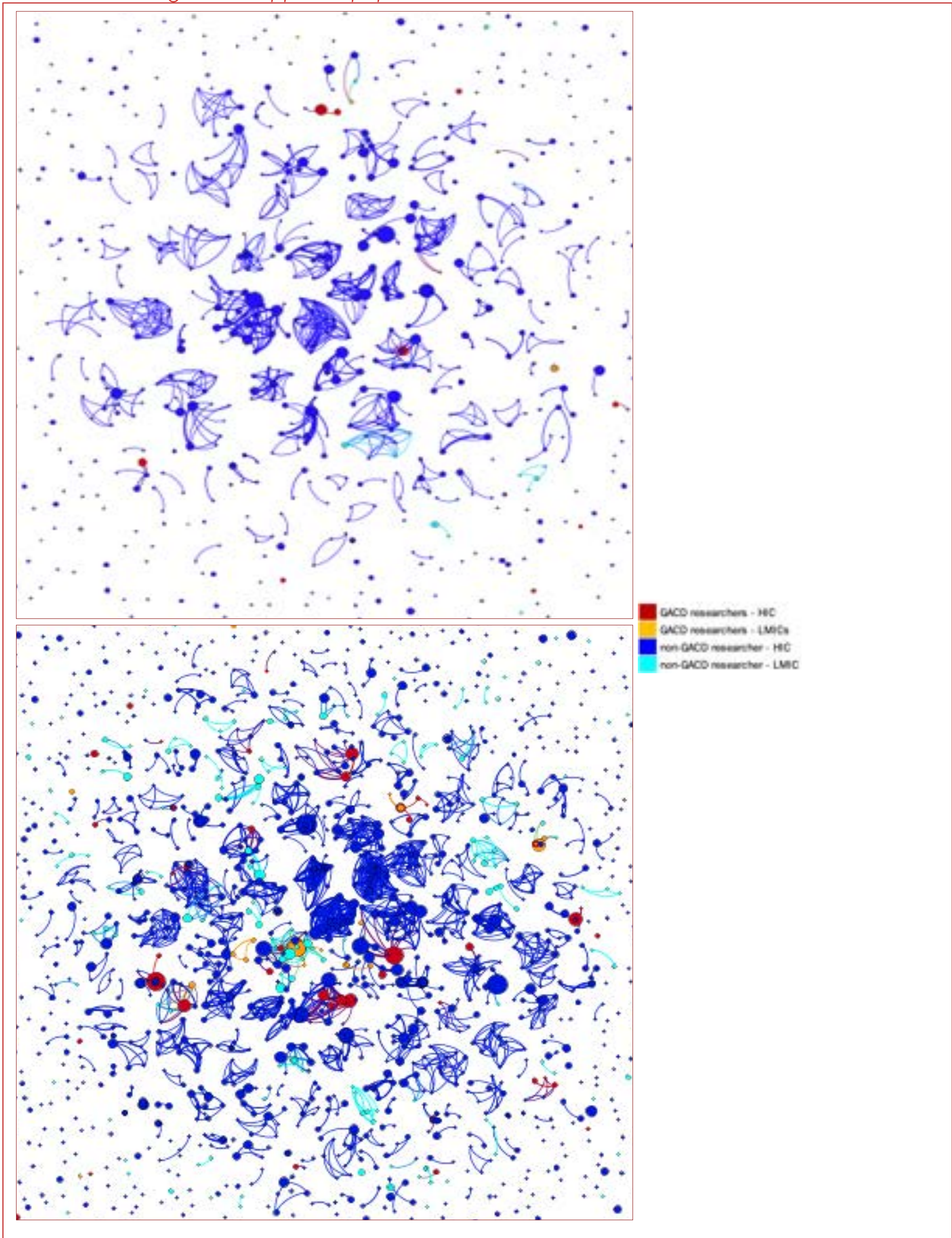
Inspecting SCD-IS network graphs over time (Figure 21, GACD papers removed) show the evolution of the co-publication networks; the network in 2014-2019 is denser and appear to have more cohesive communities. The graphs show signs of joining of GACD researchers (even if GACD papers are not included in these graphs). The level of collaborations between LMICs and HICs seems to hinge on GACD researchers to some extent – few communities of such type are present in the 2014-2019 network when GACD papers are eliminated, compared with the network presented in Figure 20.

Figure 20 Co-publication networks in SCD-IS excluding GACD-supported papers (top) and including GACD-supported papers (bottom) (2014-2019)



Note: Each circle represents an individual researcher (nodes), and the size of the circle indicates their number of SCD-IS publications. Lines represent co-publications between researchers. GACD researchers are identified as such independent of the date at which they became funded. Only researchers with at least 4 papers and links with at least 4 co-publications are represented in the graphs to reduce noise. Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

Figure 21 Co-publication networks in SCD-IS over time 2008-2013 (top) and 2014-2019 (bottom), excluding GACD-supported papers



Note: Each circle represents an individual researcher, and the size of the circle indicates the number of publications. GACD researchers are identified as such independent of the date at which they became funded. Only researchers with at least 4 papers and links with at least 4 co-publications are represented in the graphs to reduce noise. For these graphs, GACD-supported papers are excluded from the computation of nodes and links. Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

6.4 Networking activities and outcomes

GACD is fostering truly international networks and collaboration. It supports not just global North-led activities, but ones that are genuinely led by people from all over the world. It is creating implementation science communities not only within particular disease areas e.g. through the Programme Groups, but also in cross-cutting areas through the Working Groups. Wider networks are built in the Annual Scientific Meetings between researchers and funders from different countries, working in different areas and at different career stages.

When asked to consider the value of GACD activities (results presented as weighted averages where a high score equals a higher value, Figure 53), opportunities to interact with researchers working on other projects in the same GACD programme (weighted average of 3.8), annual scientific meetings (weighted average of 3.6) and GACD working groups (weighted average of 3.4) were among activities that the respondents considered most valuable.

GACD has formed an alumni network for previous project holders, and similarly it is now creating a network for alumni of the training schools because they could be scientists of the future, even if they do not have a grant just yet.

A particular concern with regard to networks fostered in GACD is their sustainability over time, in particular, of the programme groups.

6.4.1 Annual Scientific Meetings

The Annual Scientific Meetings are very well liked by almost all stakeholders we spoke to including funders, researchers involved in GACD activities and independent experts. They are viewed as a unique opportunity to have intercultural exchange, to hear about different approaches, common challenges and solutions.

The meeting is closed but is very interactive according to attendees. It has helped create an engaged and enthusiastic GACD community – 'a family'. This has fostered openness e.g. researchers are unafraid to discuss failures or unpublished preliminary results. It is the main GACD event for networking and has fostered interpersonal relationships and knowledge exchange across different country contexts and disease areas, which is cited by many of the interviewees as a rare occurrence outside of the GACD network.

The formal and informal discussions (e.g. over a drink or dinner) and workshops during the meetings are particularly valued by attendees, which they look forward to every year. The Meeting had to be held virtually in 2020 owing to the global COVID-19 pandemic, and a few of the attendees noted that networking was not as easy. The meetings provide an opportunity to make contact with potential new partners, senior experts and researchers in the field and have led to new partnerships and grant proposals. With GACD researchers based across the globe it is difficult to find a single time when researchers across all continents can interact. The Annual Scientific Meetings thus allow researchers from all across the world to meet at the same place and same time, and hear progress updates on all GACD projects and network-wide initiatives such as Programme and Working Groups.

The annual meetings also support networking between funders and researchers, which according to some interviewees (researchers and funders) is a unique aspect. They allow funders and investigators to know each other, and one funder mentioned that attending the meetings helps them to identify potential panel members and peer reviewers. The programme sub-committee meetings happen at the same time, which encourages members to attend the Annual Scientific Meetings as well.

6.4.2 *Programme groups*

GACD's efforts to convene project holders working in the same disease area to encourage cross-fertilisation is widely seen as valuable (as per all the 11 interviewees who commented on this topic). Some of the benefits are new opportunities and networks for collaboration with international partners, germination of new research ideas, papers co-authored with researchers across the world which is important for career development, and a tangible, practical mechanism (in the form of a network) that can facilitate and demonstrate impact. The programme groups provide a platform to share data, knowledge and learnings across the large number projects funded in one area, which may lead to additional outcomes and impacts over and above what the projects can achieve individually. Additionally, some of the programme groups are building their own common tools/repositories and collecting information across projects. For instance, the hypertension and diabetes groups have collated outcome metrics. These are slowly being made available not only to the groups themselves but also peers outside GACD.

There is some collaboration across programme groups e.g. between the diabetes and mental health groups, bringing together researchers and projects to get better outcomes.

Two academics noted that networking within the same disease area was probably easier as there would more familiarity and commonalities in research being conducted within the same area. On the other hand, one individual while recognising the usefulness of exchanging knowledge and outcomes within programme groups felt that collaborating outside these groups was "*better*", another interviewee concurred saying that focus on one disease area could "*create artificial silos*" which does not reflect the real-world situation where people have multiple chronic conditions.

One researcher also remarked that gender diversity among the programme chairs should be an important consideration for GACD.

6.4.3 *Working groups*

The Working Groups have similar benefits as the Programme Groups in terms of facilitating cross-fertilisation and knowledge exchange between the best researchers from different countries. The difference is that these are cross-cutting groups so create multidisciplinary networks across different research specialities, around common interests and research questions. There are about 10 Working Groups, which have been convened on cross-cutting topics such as multi-morbidity, indigenous populations, data standardisation etc. These are bottom-up efforts with set aims and objectives. This helps focus the work, keep people engaged and motivated, and provides a clear endpoint for the Group. Many of the Working Groups have produced publications (e.g. statement in Lancet Global Health and scoping review of outcome measures by the multi-morbidity group) and grant proposals.

Again stakeholders consulted in this review feel that the Working Groups add value, but a few individuals note that collaboration could be more difficult because of differences in fields and limited commonalities. According to one researcher, Working Groups provide a good non-hierarchical structure for networking and collaborating with international researchers at different stages in their careers, for contributing to some high-level research and methodology questions, for leadership building and publishing, which can be particularly valuable for early career researchers.

A variety of activities have been undertaken by the various Working Groups. The Multi-morbidity Working Group is particularly viewed as timely and of interest by the interviewed stakeholders. The Humanitarian Working Group has been working directly with humanitarian agencies (e.g.

UNHCR, U.N. Refugee Commission, Red Cross and Doctors Without Borders) on the delivery of hypertension and diabetes care during the COVID-19 pandemic. The project aims to inform care both during the pandemic and in future in situations which necessitate virtual delivery, e.g. conflicts or other disease outbreaks.

The Secretariat provides coordination and logistical support with some limited funding for things like article processing fees and database hosting. Most Working Group members however volunteer their time and are not paid by GACD. The work of the Working Groups is presented in the form of yearly progress updates to a wider audience at the Annual Scientific Meetings.

The Working Group model is seen as a very good example of international collaboration and GACD as a pioneer in these types of activities. Consequently, this model is now being replicated by other consortia or groups in implementation science according to one interviewee. We explored the characteristics of the Working Group Model through an in-depth case study on the Multi-morbidity Working Group, a summary of which is provided in the box below.

Case study: Added value of the Multi-morbidity Working Group

GACD Network meetings are unique in bringing together researchers and health-care professionals who specialise in different NCDs. The forum enables sharing of experiences and provides a 'safe space' to discuss challenges. At the 2017 GACD Network meeting, researchers with different specialisms identified their common interest in going beyond 'their' NCD and address multi-morbidity – the presence of two or more long-term health conditions and mental disorders – which is already affecting a large number of people in high-, middle- and low-income countries (by some estimates, around one third of the population), with figures set to rise further. This sparked the formation of the GACD Multi-morbidity Working Group, which has grown to 74 members from across disease areas, with around half of its members located in MICs. Since its establishment, the group has tackled a series of tasks:

- A joint statement and a policy brief to draw the attention of research funders and policy makers to the importance of multi-morbidity research
- Development of a set of core outcomes measures for multi-morbidity trials in LMICs, in consultation with LMIC stakeholders. This will enable research results from across studies to be combined, increasing the strength of the evidence and its potential for impact.
- A research prioritisation exercise, consulting with GACD Network members to assemble a 'top ten' list of urgent questions linked to international health targets such as the 2030 SDGs

The working group's efforts are galvanising the research community and preparing the ground for future multi-morbidity research. They have already addressed one of the GACD funders' main concerns – a lack of robust multi-morbidity outcome measures. As a result, the funders have agreed that the 2023 GACD call for proposals will fund 'implementation science research focussed on integrating interventions for optimising management and care for patients with multimorbidity in LMICs as well as vulnerable populations in HICs'.

6.4.4 *Networking opportunities outside GACD*

Networking opportunities outside GACD tend to be disease-based or implementation science-based e.g. Mental Health Innovation Network (MHIN), European Network for Mental Health

Service Evaluation (ENMESH), Tom Frieden Foundation (US),[173] National disease associations and implementation science societies e.g. UK Implementation Society. WHO and NIH also provide some relevant networking opportunities.

When asked to rate the opportunities outside of GACD to connect with researchers in implementation science in NCDs (Figure 55), many of the survey respondents felt that there are some relevant opportunities (40%) while a comparable number believed there are very few such opportunities (37%). While 15% knew of many opportunities, 8% were not aware of any. These results showcase the considerable role GACD has in establishing researcher networks for implementation science in NCDs.

6.5 Capacity strengthening

6.5.1 Capacity strengthening outcomes

16 of the interviewees agreed that GACD's networking and training activities have helped to build and strengthen implementation science capacity, especially in disadvantaged or resource-poor contexts. The number of Implementation Science Workshop participants has grown from 25 participants at the first event in Xi'an to over 60 participants in each of the last two years, with novel and innovative approaches for engaging with policymakers and funders.[174] The number of Training School participants has ranged from 62 participants (22 from Brazil, 40 from other countries) in Brazil in 2018 to 45 in the 2020 virtual school.[175]

Interviewees rated the training activities highly either based on their own experience and/or feedback from PhD students or colleagues. Nine individuals felt these activities also facilitated the pathway to impact, with another three interviewees pointing out that it is too early to judge the impacts on careers and the field.

The Training School was also rated very highly by participants in the ISS survey, where 69% of respondents (9 out of 13, Figure 69) indicated that GACD training activities allowed them to establish connections with other researchers, allowing them to expand their professional networks, publish joint papers, and exchange information and advice regularly.

The course content and secretariat and training faculty's efforts in delivering the training were greatly appreciated by several interviewees. In addition, building local capacity within LMICs and among more junior researchers is viewed as especially relevant because it supports development of the next generation of researchers and encourages new and innovative ideas in the field. While GACD is not unique in providing implementation science training, it is seen as a significant contributor to the expansion of implementation science and global implementation science capacity in the last decade, having introduced new people to the area – either early career researchers or researchers from other fields.

A number of the ISS survey respondents (Figure 72) reported becoming involved in new projects and others used the experience to submit a funding proposal, owing to their participation in the training schools and workshops and the knowhow gained. Two individuals reported that the skills gained helped them in their PhD research. The Training Schools and Workshops also

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[173] https://www.cdcfoundation.org/our-story

[174] https://www.gacd.org/research/implementation-science-capacity-building

[175] https://www.gacd.org/research/implementation-science-capacity-building/2020-gacd-implementation-science-training-school-virtual; https://www.gacd.org/research/implementation-science-capacity-building/2018-gacd-implementation-science-training-school-campinas-brazil

led to impacts on ways of working, with survey respondents predominantly using their new training in NCD-related research (88%, 21 of 24 in GACD survey; 69%, 9 of 13 in ISS survey; Figure 59, Figure 71). Some respondents (13%, 21 of 24 in GACD survey; 23%, 3 of 13 in ISS survey) also stated that the training influenced their work in areas other than NCDs and implementation science.

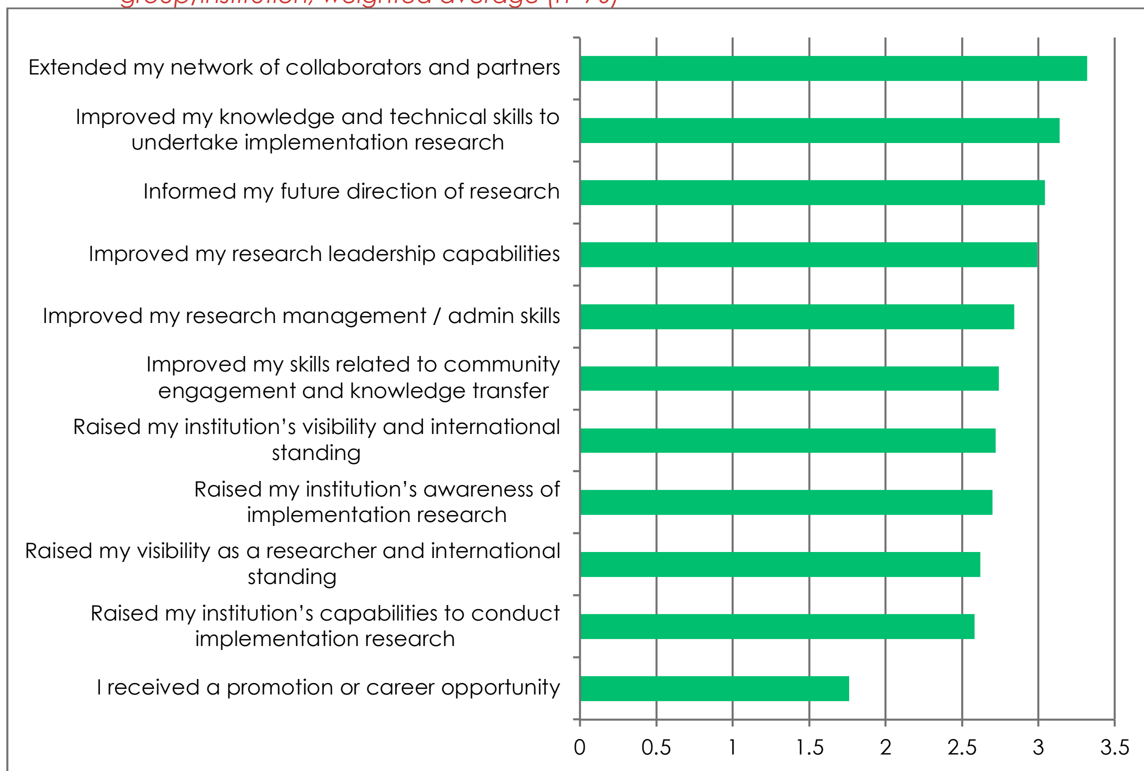
At least six stakeholders interviewed for this review felt that GACD has played a major role in increasing the awareness of implementation science globally. And four researchers credited the Implementation Science School with introducing them to implementation science, and further opening up opportunities to take up new research topics and to collaborate internationally. One researcher started working on eHealth, which has completely changed their career direction. Another researcher explained how he and likeminded co-participants in the Implementation Science School reviewed national guidelines from different countries and published a joint paper.

The Annual Scientific Meeting and the networking it fosters is also cited as a successful model for capacity building through peer support and exchange between researchers funded by different funders and bringing diverse perspectives with regard to different LMIC contexts and vulnerable populations in HICs. The programmes which bring together researchers in a particular disease area also contribute to capacity building in a similar way.

Capacity building occurs not only through GACD-sponsored networking and training events but also through the GACD projects themselves. The researchers involved, especially PhD students and other early career researchers, develop technical skills and gain experience that aids their career progression. A female researcher gave her own example explaining "*Looking back, without those three [GACD] studies, I would not have reached my career stage. Specifically one study … I was an early career [researcher] at that time, just back from maternity leave. So very, very lacking confidence and not knowing what to do. One of the PIs gave me the opportunity to kind of go ahead and do stuff and we still collaborate*". GACD projects also lead to capacity building and training of practitioners, policy makers and members of the community.

According to GACD survey responses (Figure 22), extension of professional networks (weighted average of 3.32, high scores equal larger impact) was the most important outcome of participating in GACD projects and activities. Furthermore, research experience and training within GACD has resulted in improved knowledge and technical skills to undertake implementation research (weighted average of 3.14), while a considerable number of respondents reported that their GACD participation led to improved research leadership capabilities (weighted average of 2.99). The spill-over effect on GACD project participants' institutions appears to be less evident (weighted averages between 2.58 and 2.72). Career development was least influenced according to the survey responses (weighted average of 1.76).

Figure 22 Extent to which participation in GACD projects and activities led to outcomes for research group/institution, weighted average (n=70)



Source: Technopolis analysis of GACD survey

6.5.2 *Capacity strengthening activities outside of GACD*

GACD contribution towards skills in NCD-implementation science is highlighted by survey responses regarding the availability of similar opportunities elsewhere. Only 6% of the respondents were aware of many options while most either knew some (44%) or very few (40%) relevant opportunities (Figure 61). Interestingly, 10% of respondents did not know of any other similar opportunities.

It was recommended in the interviews that GACD take a look at capacity building models in communicable diseases which have had great success, especially in building research capacity in sub-Saharan Africa, such as the U.S. President's Emergency Plan for AIDS Relief (PEPFAR). Capacity building opportunities are also more frequently available either in individual disease areas or for NCD research in general e.g. through the NCD Alliance.

In Japan, individual academic associations and the Japan International Cooperation Agency (JICA) provide capacity building opportunities. N-EQUITY, National Center Consortium in Implementation Science for Health Equity, established in 2019, in particular supports implementation science workshops and dissemination activities.

One GACD researcher had attended a two-day implementation science training at King's College London (UK) and was impressed with the course offered, the availability of different types of training – beginner's, advanced, data science – as well as the international faculty delivering this training.

6.5.3 *Value of GACD platforms and resources*

GACD offers four main platforms and resources:

- GACD Metadata Index
- GACD Process Evaluation Guidelines
- GACD Data Dictionary
- GACD Health Implementation Mapping Tool

Among the stakeholders interviewed, 14 were aware of at least some of the platforms and resources, and 3 had used one of the resources (2 Data Dictionary; 1 Health Mapping tool). Thirteen individuals were either not familiar with the aforementioned platforms and resources or had not used them even if they were aware of these resources. Even so, six interviewees agreed that the resources add value to GACD research. For example, common outcomes in the Data Dictionary allow people to align their outcomes with outcomes that have been used by others. The health implementation mapping tool helped one LMIC-based researcher to familiarise themselves with a new area, and has added another dimension to the work, which they would not have included otherwise. As one Working Group co-chair highlighted "*Implementation is a fairly new field ... So we actually have the opportunity to develop these kind of resources that would be valuable for the research field as a whole. And I think it definitely is, because subsequent projects that I work with, I tend to go back to some of these GACD tools and look at them first before we go on and look at others, because you know that projects have actually worked on this*".

The survey also explored whether respondents knew of or had used GACD platforms and resources and whether they thought they were valuable (based on weighted average where high score equals to higher knowledge and use or value, Figure 57). The Process Evaluation Guidelines were the most known/used resource (weighted average of 1.69) and the most valued resource (weighted average of 3.43). The GACD Metadata Index was the least known and used resource (weighted average of 1.33) and the Health Implementation Mapping Tool was the least valued resource (weighted average of 3). Five individuals commented that they were not aware of the resources or had found it difficult to access them. One individual suggested that the Metadata Index should be expanded to include other areas.

The GACD platforms and resources are not necessarily unique. In particular, two academics pointed out that Process Evaluation Guidelines are widely available, and perhaps GACD does not need to provide these. One individual while complementary about the usefulness of GACD resources emphasised the need to make them more visible to those who would benefit from them.

6.6 Policy and practice outcomes

Currently, outcomes in relation to policy and practice change are weaker due to the fact that most projects are ongoing or have completed recently, the length of time for such changes to occur and additional factors that such outcomes such as decision makers' priorities, political will and resource availability.

The majority of PIs who responded to the survey (77%, n=26; Figure 48) indicated that their projects have not yet resulted in policy or practice changes but they do anticipate such outcomes. Of the projects that have resulted in such changes, the outcomes occurred at the national level (National TB guidelines and strategic plans in Pakistan), and international level ("Results have been used in many countries and sub-national jurisdictions in the discussion of new legislation for tobacco control, including WHO reports").

While changes may not have occurred yet, several projects report discussions with decision makers about the implementation of a tested intervention (e.g. in Colombia and Malaysia,

HT02; Oyo State, Nigeria, HT15), or more broadly advisory roles in governments (e.g. in Tanzania, SU12; Mexico, DM10) or to actively lobby for adoption of the intervention or policy changes (e.g. on tobacco control).

One example of a direct outcome in the sense of adoption into practice is the adoption of WHO's Psychological First Aid training into professional training at the national level in Thailand and on the local level in the Philippines (project MH12). The SU15 project reported working with the Kenyan Ministry of Health and the World Bank to evaluate the (already ongoing) implementation of a primary integrated care project in two counties in Kenya, and support plans to scale up the model across the country. Also of note is the School-EduSalt intervention, which has been shown to effectively lower salt intake and blood pressure. As part of the SU14 project, it is being piloted in a population of 3.2 million people, and there are plans to include the intervention into the education curriculum in China. Similarly, the H10 project has influenced changes to the Food Act in Samoa and inclusion of salt reduction into national NCD / nutrition strategies in Fiji.

6.7 Impact

Ultimately, research and activities funded by GACD are expected to address the health needs of LMICs and vulnerable populations in HICs and lead to the impacts set out in the PLM: a reduction in risk factors for developing NCDs, improved management of patients living with NCDs, and a reduction in health inequalities and inequities both within and between countries (see section 4). These impacts are long term and reliant upon action being taken by policy makers and other users based on the outcomes highlighted in the PLM such as policy and practice change, further research and strengthened capacity of researchers and decision makers.

This section summarises the potential for impact resulting from the outcomes achieved to date, such as uptake of research evidence by policymakers, based on a set of in-depth case studies developed as part of this evaluation. It also highlights the enablers, challenges and barriers for achieving impact as well as opportunities for improvement.

6.7.1 Timeline to policy impact

Given this evaluation took place only 8 years since the first call for proposals, many projects would not be expected to have led to large-scale implementation or adoption at this point, let alone impacts such as reduced risk factors, reduced morbidity and mortality and greater health equity. However, since implementation science is much closer to uptake and adoption, some early examples of outcomes have been reported. The older programmes have had more time to generate policy and practice changes as opposed to recent programmes which are just coming out with initial results. With half of the 110 projects still ongoing and another 16 having just concluded in 2020 and potentially still publishing their results, there has not been enough time for large-scale adoption or implementation for the majority of GACD projects. In addition, the COVID-19 pandemic has shifted policymakers' and health professionals' priorities towards dealing with the immediate issues arising from the crisis, which is likely to delay uptake and impact of GACD research evidence.

6.7.2 Potential for future impact from GACD projects

As mentioned in the previous sections, population level impacts from GACD projects cannot yet be expected to have emerged given that many projects are still ongoing or completed only recently. However, the generation of research findings of relevance to LMICs, and interest and engagement from key decision makers in the resulting outputs and outcomes indicate a clear potential for large-scale implementation and future impact. The potential for future

impact from GACD projects is illustrated in eight in-depth case studies developed as part of this evaluation (see overview in Table 12 and brief summaries in the boxes below). The full-length GACD impact case studies are available as a stand-alone document accompanying this report.

We expect that projects which have contributed to policy or practice guideline changes nationally or internationally will have a 'high' likelihood of impact and those which are close to producing a similar outcome or with keen interest from decision makers will be 'moderately' likely to have impact. However, the majority of case studies highlight that follow-up or scale-up studies are required before the likelihood of downstream impact becomes clear.

Table 12 Overview of project impact case studies

Title (Grant number)	Years	Funder (Country)	Research locations	Stakeholder engagement	Capacity building	Policy/practice outcome	Further funding	Potential for future impact
A school-based education program to reduce salt intake in children and their families, School-EduSalt (HT04)	2012–15	MRC (UK)	China	In project: policy makers, teachers, parents and students Post-project dissemination: policy makers, health professionals and general population	Not known	**Not yet** Application-based education programme (AppSalt) built based on study findings	GACD scale-up study (SU14). NIHR funding for UK-China Unit 'Action on Salt China'	Depends on findings of scale-up study Clear pathway to impact established, incl. at national level
Cost effectiveness of salt reduction interventions in Pacific Islands (HT10)	2012–15	NHMRC (Australia)	Fiji Samoa	In project: food industry, government, NGOs, church groups, international organisations, and Pacific Island citizens. Post-project dissemination: disseminated through WHO Collaborating Centre on Population Salt Intake	Health staff, Ministry of Health (MoH) managers, and health volunteers. Junior researchers	**Yes** Food Act in Samoa amended. Salt reduction incorporated into national NCD or nutrition strategies in Fiji.	GACD scale-up study (SU18)	**High likelihood of impact.** Owing to policy and strategy change at national level
HOPE-4: Developing an innovative strategy for hypertension detection, treatment and control in two middle income countries (HT02)	2012–17	Canadian Institutes of Health Research, Canadian Stroke Network, Grand Challenges Canada, International Development Research Centre (Canada)	Colombia Malaysia	Not known	Not known	**Yes.** HOPE-4 curriculum has been adapted for WHO's HEARTS Technical Package policy document aimed at management of cardiovascular risk factors in primary care.	Not known	**High likelihood of impact.** WHO document expected to be taken up widely.
The Bangladesh D-Magic Trial. Diabetes Mellitus: Action Through Groups or Information for	2014–17	MRC (UK)	Bangladesh	In project: Community representatives incl. local policy makers & healthcare workers Post-project dissemination: MoH and Family Welfare, Bangladesh, and South	Healthcare workers and pharmacy employees. Junior researchers.	**Not yet.**	GACD scale-up study (SU16)	Depends on findings of scale-up study

Better Control? (DM13)				Asian Association for Regional Cooperation				
A people-centred approach through Self-Management and Reciprocal learning for the prevention and management of Type-2-Diabetes, SMART2D (DM07)	2015–19	European Commission	South Africa Sweden Uganda	In project: Policy makers, implementers, community representatives, diabetes associations Post-project dissemination: MoH, NGOs, WHO in Uganda; community in South Africa; Primary Care, Citizen's Offices and NGO stakeholders in Sweden	Community health workers, non-physician health care providers Junior researchers.	**Not yet.** Two policy briefs being prepared on request of MoH Uganda	Applied to Swedish Research Council for follow-up studies in Sweden and Uganda	Follow-up studies required
Tools and Practices to Reduce CVD and Complications in the Diabetic Population of Mexico (DM17)	2016–21	NIH (US), Conacyt (Mexico)	Mexico	In project: Patient support groups, Mexican government incl. MoH	Nurses and community health workers	**Not yet.**	Additional grants from NIH and CONACYT for wider piloting and scale-up	Depends on results of scale-up study, continued MoH support, capacity to deliver intervention
SISTAQUIT – a trial to implement culturally competent evidence-based smoking cessation for pregnant Aboriginal and Torres Strait Islander smokers (LD15)	2017–20	NHMRC (Australia)	Australia	In project: Healthcare professionals and mothers from Indigenous communities	Healthcare professionals	**Not yet.** Main findings still to be published.	Scale-up (iSISTAQUIT) funded by Australian Government Department of Health; GACD cancer call grant	Depends on findings of scale-up studies
Scale-up of Prevention and Management of Alcohol Use Disorders and Comorbid Depression in Latin America, SCALA (MH27)	2018–21	European Commission	Colombia Mexico Peru	In project: Community Advisory Boards incl. local policy makers & health care providers; PAHO and MoHs in three research countries Dissemination: to wider stakeholders via PAHO	Health care providers Junior researchers	**Not yet.** Study findings to feed into manual for WHO Europe. Plans to produce documents with guidance on implementation and scale-up of intervention	Not applicable	Moderate likelihood. Depends on political and economic factors, but positive interest built in MoHs and via PAHO

Source: Technopolis

- **High likelihood of impact**

HT10 case study: Cost effectiveness of salt reduction interventions in Pacific Islands

Approximately 40% of the 9.7 million Pacific Island citizens have been diagnosed with an NCD, mainly cardiovascular disease or diabetes, and/or have hypertension.[176] WHO has been supporting the development of salt reduction strategies in the Pacific Islands countries where an increased reliance on processed foods is likely contributing to the rise in the observed incidence and prevalence of NCDs.

The "Cost-effectiveness of salt reduction interventions in Pacific Islands" study was funded by the Australian National Health and Medical Research Council (NHMRC) through GACD hypertension programme (2012 to 2015; AUS$1.05m). The project aimed to accurately determine the baseline level of salt intake and evaluate the effectiveness and cost-effectiveness of salt reduction interventions to reduce salt intake in Pacific Islands countries. The study was implemented in Fiji and Samoa by researchers based in Australia and Fiji. The study team delivered the project in close collaboration with WHO and ministries of health in Fiji and Samoa.

The project has resulted in significant policy changes. The research team worked with the Government in Samoa to amend the Food Act, introducing labelling of salt content and mandatory limits for salt content. In Fiji salt reduction efforts were mainstreamed into government policies, including through voluntary salt targets and salt education as part of national NCD or nutrition strategies.

HT02 case study: Hypertension detection, treatment, and control in two middle income countries project (HOPE-4)

Hypertension is the leading cause of CVD worldwide,[177] and despite proven interventions, such as lifestyle changes and medication, it remains poorly controlled throughout the world. Therefore, simple scalable strategies are urgently needed to address the global disease burden.

The HOPE-4 study (2012-2017) was a randomised controlled trial funded by the Canadian Institutes of Health Research (CIHR), Canadian Stroke Network (CSN), Grand Challenges Canada (GCC), and International Development Research Centre (IDRC). It evaluated whether a community-based intervention package delivered by health workers (mostly non-physicians) could improve hypertension control and reduce overall CVD risk after one year. The study team spanned 4 countries – Canada, Colombia, the UK and Malaysia – with the primary research conducted in Colombia and Malaysia.

The HOPE-4 intervention substantially reduced cardiovascular risk and improved blood pressure and cholesterol levels as well as adherence to medication.[178] The intervention has also been successfully adapted and piloted in a high-income setting[179] – Canada – with promising results.

[176] Healthy Pacific Lifestyle Section Secretariat of the Pacific Community: NCD Statistics for the Pacific Islands Countries and Territories. 2010, Secretariat of the Pacific Community

[177] Schwalm JD, McCready T, Lopez-Jaramillo P, Yusoff K, Attaran A, Lamelas P, et al. A community-based comprehensive intervention to reduce cardiovascular risk in hypertension (HOPE 4): a cluster-randomised controlled trial. Lancet. 2019.

[178] Schwalm J. HOPE 4. In: HOPE 4: Heart Outcomes Prevention and Evaluation 4 Study. Paris: ESC Congress; 2019.

[179] Schwalm JD, McCready T, Lear SA, Lamelas P, Garis L, Musa H, et al. Exploring New Models for Cardiovascular Risk Reduction: The Heart Outcomes Prevention and Evaluation 4 (HOPE 4) Canada Pilot Study. CJC Open. 2021;

The results of HOPE-4 are also supporting implementation of a project using similar strategies in Spain, Colombia, Chile and the Dominican Republic. This suggests that the intervention could be similarly adapted for other settings. With that consideration, the HOPE-4 curriculum has been adapted for WHO's HEARTS Technical Package[180] policy document which offers a set of effective and practical interventions to help manage cardiovascular risk factors in primary care. This inclusion is likely to encourage uptake of the HOPE4 package internationally, potentially contributing to decreasing the burden of hypertension and CVD worldwide.

- **Moderate likelihood of impact**

MH27 case study: Scale-up of Prevention and Management of Alcohol Use Disorders and Comorbid Depression in Latin America (SCALA)

Funded by the European Commission (overall budget €2.6 million), the SCALA study aims to test the implementation of primary health care-based programmes, embedded in a community and municipal setting, for the measurement, management, and prevention of Alcohol Use Disorders and comorbid depression in Colombia, Mexico, and Peru.[181]

The SCALA project study team combines expertise from the Netherlands, Peru, Colombia, Germany, Mexico, Spain, and the UK. It was an equitable partnership and had close stakeholder engagement from the start, including from the ministries of health from all countries (local and national level), the Pan American Health Organisation (PAHO), and the community. The early engagement of local and national stakeholders via Community Advisory Boards was a major enabler as it created buy-in and interest from the start.

Findings so far demonstrate a clear impact of training.[182] In the absence of community support, centres whose providers received training measured the alcohol consumption of a nearly 10 times higher proportion of patients than centres whose providers had not received training. As the project draws to a close, the study team is looking at ensuring the sustainability of the implemented programmes. The Ministries of Health in Colombia, Mexico, and Peru are very interested in building on the study and scaling it up. The engagement with PAHO is expected to facilitate wider scale-up within and outside the three study countries.

The study team plans to produce a validated framework and strategy with guidance on implementation and scale-up as well as guidance on approaches for use in pandemics, including tele-medicine approaches.[183] This should be a key tool for more widespread adoption and implementation.

- **Impact dependant on findings of follow-up or scale-up studies**

HT04 case study: Reducing salt intake through a school-based education programme in China

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[180] WHO Hearts package: https://www.who.int/cardiovascular_diseases/hearts/Hearts_package.pdf

[181] Shield KD, Manthey J, Rylett M, Probst C, Wettlaufer A, Parry CDH, Rehm J. National, regional, and global burdens of disease from 2000 to 2016 attributable to alcohol use: a comparative risk assessment study. Lancet Public Health. 2020;5(1):e51-e61. https://doi.org/10.1016/S2468-2667(19)30231-2.

[182] Anderson P, Manthey J, Jané-Llopis E, *et al*. (2021) Impact of training and municipal support on primary health care-based measurement of alcohol consumption in three Latin American countries: five-month outcome results of the quasi-experimental randomized SCALA trial. Journal of general internal medicine, 1-9. doi.org/10.1007/s11606-020-06503-9.

[183] https://cordis.europa.eu/project/id/778048/reporting

The School-EduSalt (School-based Education Programme to Reduce Salt) study tested a novel approach to lowering salt intake, focussing on children in primary school education in China.[184] High salt intake is a major factor in heart disease and stroke; even a modest reduction in salt intake has been shown to lower blood pressure and reduce the risk of cardiovascular disease.[185] WHO has recommended reduced salt intake in food as one of the 'best buy' interventions to tackle the global crisis in non-communicable disease[186] and WHO Member States agreed on a voluntary global NCD target for a 30% relative reduction in salt intake by 2025.[187]

School-EduSalt tested if school health education lessons focussing on salt intake reduction over a 3.5-month period could reduce families' salt intake and lower blood pressure. The study was conducted in 28 primary schools in northern China by a team of researchers from the UK and China. It was funded from 2012 to 2015 by the UK MRC[188]).

The trial found that educating primary school children was successful in reducing salt intake by around 25%, in both children and their parents, accompanied by a significant decrease in the adults' blood pressure. The researchers estimated that this decrease could reduce the incidence of stroke by about 9% and ischaemic heart disease by about 5%, preventing around 153 000 deaths from stroke and 47 000 deaths from ischaemic heart disease a year in China.[189]

The researchers continued work on a salt intake reduction action plan for China, collaborating with national government organisations. The School-EduSalt education package was expanded to include an application-based programme (AppSalt)[190] as part of the UK-China Collaboration Unit Action on Salt China (2017-2021), funded by the UK NIHR.[191] While the full analysis is still under way, preliminary results are encouraging.[192] The team then secured further funding through the GACD Scale-up call (2019-2023; £2.5m/US$3.16m, UK MRC and NIHR[193]). Currently in its early stages, the project will test whether the educational programme can be successfully delivered across multiple settings in China, involving at least 100 schools and covering a population of 3.2m (1.1m children and 2.1m adults). If successful, the intervention will be rolled out nationwide. School-EduSalt is also informing efforts to reduce salt intake

[184] He F J, Wu Y, Feng X et al. School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial BMJ 2015; 350:h770

[185] He FJ, Li J, MacGregor GA. Effect of longer-term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. BMJ 2013; 346:f1325

[186] WHO. From Burden to "Best Buys": Reducing the Economic Impact of Non-Communicable Diseases in Low- and Middle-Income Countries. 2011. Available via https://www.who.int/nmh/publications/best_buys_summary.pdf. Accessed 7 June 2021

[187] WHO. Fact Sheet Salt Reduction. Available via https://www.who.int/news-room/fact-sheets/detail/salt-reduction. Accessed on 23 June 2021.

[188] Gateway to Research, MRC Research Grant: A school-based education programme to reduce salt intake in children and their families. Available via https://gtr.ukri.org/projects?ref=MR%2FJ015903%2F1#/tabOverview. Accessed on 8 June 2021.

[189] He F J, Wu Y, Feng X et al. School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial BMJ 2015; 350:h770

[190] He FJ, Zhang P, Luo R, et al. An Application- based programme to reinforce and maintain lower salt intake (AppSalt) in schoolchildren and their families in China. BMJ Open 2019;9:e027793. doi:10.1136/ bmjopen-2018-027793

[191] NIHR Award NIHR Global Health Research Unit Action on Salt China (ASC), Queen Mary University of London. Available via https://fundingawards.nihr.ac.uk/award/16/136/77. Accessed 8 June 2021

[192] Prof Fengjun He. Personal communication, 23 June 2021

[193] Gateway to Research, MRC Research Grant: School-based education programme to reduce salt: Scaling-up in China (EduSaltS). Available via https://gtr.ukri.org/projects?ref=MR%2FT024399%2F1. Accessed 8 June 2021

elsewhere. Modelled on the EduSalt trial, a research team is carrying out a salt reduction study in Malawi, the 'NoToNa' study, funded by the UK MRC.[194]

DM17 case study: Tools and Practices to Reduce CVD and Complications in the Diabetic Population of Mexico

The "Tools and Practices to Reduce CVD and Complications in the Diabetic Population of Mexico" study sought to evaluate the impact of Meta Salud Diabetes, a behavioural intervention aiming to reduce clinical risk factors for developing CVD among diabetic populations. The intervention is based on behavioural change theories working to increase understanding of the disease and empower patients to manage their condition. The study was funded by the US NIH as part of the second GACD call for proposals focussed on diabetes.

As part of the project implementation, the team (based in the US and Mexico) worked closely with regional healthcare centres in the Mexican state of Sonora. Following the 13-week period during which the Meta Salud Diabetes intervention was introduced to patient groups, the project team found that the intervention reduced the risk of cardiovascular disease and led to behavioural changes: study participants consumed fewer for sugary drinks and more vegetables.

Based on the successful deployment of MSD, the research team secured additional funding from the US NIH and Mexico's CONACYT to continue piloting the MSD intervention in other areas in Mexico, the USA and Benin, including scale-up activities in the state of Sonora.

LD15 case study: Supporting Indigenous Smokers To Assist Quitting (SISTAQUIT)

Smoking remains the most common preventable cause of chronic diseases[195] and premature mortality. [196] Smoking during pregnancy increases the risk of NCDs, such as obesity, hypertension, and some respiratory problems in children's early adulthood. Thus, pregnancy offers an important window of opportunity to prevent NCDs for Indigenous mothers and their babies. Globally, 53% of women who smoke daily continue to smoke during pregnancy.[197] Smoking prevalence among Indigenous pregnant women is four times the rate in non-Indigenous women.

The "Supporting Indigenous Smokers To Assist Quitting (SISTAQUIT)" grant was funded by the Australian NHMRC (AUS $1.8 million) from 2017 to 2020. The research team was also based in Australia and included both Indigenous and non-Indigenous investigators and research staff. The study involved a randomised control trial in Aboriginal Community Controlled Health Services in Australia or other Aboriginal Medical Services. SISTAQUIT is the first national trial

[194] Gateway to Research: NoToNa: Tackling cardiovascular risk in the adolescent life-course through a schools' salt-reduction intervention in sub-Saharan Africa. MR/R022186/1. Available via https://gtr.ukri.org/project/63E397B2-5B17-4D2C-AC1F-0A13E39FB683#/tabOverview. Accessed 23 June 2021.

[195] GBD 2016 Risk Factors Collaborators, Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390(10100):1345-422.

[196] GBD 2015 Tobacco Collaborators, Smoking prevalence and attributable disease burden in 195 countries and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015. Lancet. 2017;389(10082):1885-906.

[197] Lange S, et al. National, regional, and global prevalence of smoking during pregnancy in the general population: a systematic review and meta-analysis. Lancet Glob Health 2018;6:e769–76.

providing smoking cessation care for pregnant indigenous women and following the women and their baby postpartum.

One of the key outcomes of the project is its contribution to improved capacity of healthcare professionals to deliver effective smoking cessation care to patients. The SISTAQUIT team has received interest from universities to integrate the training into midwifery undergraduate training courses. The study team has leveraged further funding from the Australian Government Department of Health for an implementation phase called iSISTAQUIT to further scale the intervention in Australia.

DM13 case study: The Bangladesh D-Magic Trial. Diabetes Mellitus: Action Through Groups or Information for Better Control

The Bangladesh D-Magic Trial project evaluated two interventions – one mHealth and one participatory learning and action-based – to improve the detection, management and prevention of diabetes in rural communities in Bangladesh. Owing to the high burden of diabetes in Bangladesh, effective strategies to prevent and control diabetes are urgently needed, especially in rural areas.[198]

The study was funded by the UK MRC from 2014 to 2017 and involved researchers from University College London and the Diabetic Association of Bangladesh.

While both interventions were able to increase awareness of diabetes, only participatory learning and action was effective in reducing intermediate hyperglycaemia and type 2 diabetes cases among the rural population.[199] Combined, the interventions resulted in a reduction of 20% for diabetes and intermediate hyperglycaemia prevalence among the participants.[200]

The team has received a scale-up grant through GACD to see how stakeholder involvement and subsequent uptake of the participatory learning and action intervention can be improved. It is estimated that scale-up of the approach could reach up to 240,000 people in rural Bangladesh.[201]

DM07 case study: Self-Management and Reciprocal learning for the prevention and management of Type-2-Diabetes (SMART2D)

LMICs are disproportionately affected by diabetes, with around 80% of the adult diabetic population living in these countries[202]. It also represents a major disease burden for socioeconomically disadvantaged people in HICs. The SMART2D grant, funded by the European Commission, aimed to implement self-management support for type 2 diabetes

[198] Fottrell E, Ahmed N, Shaha SK, et al., Diabetes knowledge and care practices among adults in rural Bangladesh: a cross-sectional survey. BMJ Global Health 2018;3:e000891

[199] Sathish T. Diabetes prevention and lifestyle intervention in resource-limited settings. 2019. Available at: https://www.thelancet.com/journals/landia/article/PIIS2213-8587(19)30027-0/fulltext

[200] Morrison et al. Participatory learning and action to address type 2 diabetes in rural Bangladesh: a qualitative process evaluation. 2019. Available at: https://bmcendocrdisord.biomedcentral.com/articles/10.1186/s12902-019-0447-3

[201] Project report from GACD annual scientific meeting: 2020 ASM Projects updates. 2020

[202] Flood D, Hane J, Dunn M, Brown SJ, Wagenaar BH, Rogers EA, et al. Health system interventions for adults with type 2 diabetes in low- And middle-income countries: A systematic review and meta-analysis. PLoS Medicine. 2020.

prevention and management in three different settings (Uganda, South Africa, and Sweden). The project involved researchers from Sweden, Uganda, South Africa, Finland and Belgium.

The intervention involved strategies including task-shifting to non-physician healthcare providers and community health workers, and expanding care networks through community-based support groups to build capacity for prevention and management. The intervention involved was adapted according to the specific needs and context of each setting. Stakeholders, including policy makers, implementers, representatives of the community, and diabetes associations, were engaged in the project from the outset.

Addition of a community support component was beneficial for people with pre-diabetes in Uganda rather than for those who already had the disease. The feasibility trial in Sweden was found to improve reach among hard-to-reach populations through community-based screening.

Project findings have been disseminated to policy, practice and community stakeholders in Sweden, Uganda and South Africa, and two policy briefs are being drafted. However, future scale-up of the SMART2D intervention would require further studies including a full implementation trial. Two applications are currently pending with Swedish Research Council for follow-up studies in Uganda and Sweden.

6.7.3 *Enablers of impact from GACD research*

Experience within GACD projects mirrors that described in literature (see Section 3.3) when it comes to factors or mechanisms that enable outcomes, particularly policy or practice outcomes, that have the potential to lead to impacts in the long term. For instance, GACD projects often include the following to facilitate outcomes (and potential impacts) (see Figure 16, Table 12):

- Active involvement of local stakeholders in the project including policy makers, health care providers and workers as well as the local community
- Close involvement of National or regional policy makers e.g. from Ministries of Health or WHO in the project or dissemination of research findings to these actors at the end of a project
- Capacity strengthening (through training) of end users e.g. those delivering an intervention such as community health workers, doctors and nurses
- Intervention tested in multiple country settings to understand contextual elements of implementation and transferability

These approaches have met with some success in GACD projects. For example, the *Cost effectiveness of salt reduction interventions in Pacific Islands* study (HT10) closely involved WHO and Ministries of Health in Fiji and Samoa, and its findings have now informed national policies in both countries. The HOPE-4 (HT02) study successfully piloted a community-based intervention package to improve hypertension control in Canada after it had shown positive results in Colombia and Malaysia. This suggests that the intervention could work in both HIC and LMIC settings, which will likely encourage uptake of the HOPE4 package in more countries worldwide, potentially leading to reduced burden of hypertension and CVD.

The types of stakeholders collaborating in GACD projects according to annual monitoring information include policy bodies (e.g. China Center for Disease Control and Prevention (project SU20), Chinese Centre for Health Education (SU14), Vietnam Department of Tax Policy and Ministry of Finance (LD07)) or non-governmental organisations (e.g. WHO (MH26)). Civil society organisations (e.g. the Diabetic Association of Bangladesh (SU16)) are mentioned by

the project teams as important facilitators to reach target communities or as actors that use the produced evidence to advocate for change. Such activities can be enabled by having articulated stakeholder engagement and pathway to impact plans for a project. 80% (n=25) of survey respondents who had a stakeholder engagement plan indicated that the plan was useful or very useful for their project. Similarly, among those who had a pathway to impact plan, 81% (n=16) of respondents considered the plan useful or very useful for achieving the impacts.

Interviewees noted the importance of establishing relationships with policy makers as these relationships can translate into gateways to achieve greater impacts. This might especially be true in LMIC environments where successful policy impacts can depend as much on the research results as it an on the personal relationship with local policy makers that create pathways to introduce these results directly to interested stakeholders. One interviewee explained "If they can establish a buy-in with LMIC ministries of health and have at least some sort of surrogate with policy makers then the chances of success are much greater. I think the researchers need to be strategic if they want to achieve that as a policy change and practice change as the outcome."

A different pathway for enabling policy impacts according to interviewees is presenting the research results to or aligning the research to policy maker needs (for example Directorate Generals working under the EU) to encourage uptake into policy or practice guidelines. Such approaches can have a considerable multiplying effect if the relevant documents are being produced under the aegis of an international organisation which can promote uptake in many different countries.

6.7.4 Challenges/barriers to impact for GACD funded research

While many GACD projects foster adoption of research to specific local or national contexts, this has also been discussed as a potential barrier to greater impacts, because of limited transferability and generalisability of findings. One independent expert explained this point: "*And one of the real challenges which I think remains a challenge not just for GACD, but most global health researchers, you need to understand what the generalisability is and isn't. So if you do research in Malawi, can you translate that to Zambia which isn't very far away, never mind Morocco or a poor country in Latin America or Asia."*

Lack of monitoring for policy level impacts from GACD projects was cited as another barrier. It is claimed that by not having monitoring in place, GACD de-emphasises policy impacts (or any other particular impacts) that it wants to achieve and so there is no incentive for researchers to pursue such impacts. In fact, some interviewees expressed surprise about policy impact questions, noting that GACD itself does not emphasise this as a particular priority (or at least in the interviewees' view this is not prioritised by GACD).

While it was noted that GACD projects have to receive letters of support from policy makers where the projects take place, there is no formalised tracking of whether the policy makers truly engage with the project. In other words, while GACD requires that policy makers "give their blessing" for the projects to take place, the researchers are not mandated to continue that relationship. The lack of meaningful engagement will lead to research and findings that may not be relevant or useful for policy makers.

It is acknowledged that the GACD Secretariat and researchers have put a lot of effort into developing a variety of useful tools and resources. However, without timely updates it will be difficult to maintain their relevance and usefulness, which would in turn affect the impact. This presents a challenge for GACD.

Interviewees also pointed to external factors that pose a risk to research impact. The main challenge highlighted is the ongoing COVID-19 crisis, which is shifting governments' priorities away from other issues including addressing NCDs. This may lead to funds being redistributed to 'more urgent' activities, especially in LMICs, such as food programmes and reducing political tensions. One interviewee thought it likely that the pandemic will affect GACD membership. At the same time, it was noted by a few interviewees that the exacerbating effect of NCDs on COVID-19 outcomes may emphasise the need to address chronic disease in the long run. Two funders from HICs also noted that the COVID-19 crisis had sharpened policymakers' focus on implementation science, e.g. through encountering the challenge of implementing population-wide vaccine roll outs.

6.7.5 Opportunities for enhancing impact of implementation science research

Some interviewees feel that GACD, particularly with its focus on implementation science, NCDs and vulnerable populations (in LMICs and HICs), can complement other international initiatives and create synergies that result in added impact. WHO came up several times in interviews as a potential collaborator, particularly in light of the WHO Best Buy interventions that target LMICs with suggested interventions for NCD prevention, which would be an ideal fit for GACD activities. Similar synergistic approaches were suggested for selection of topics for GACD calls, where topics could be aligned with major global policy concerns.

As discussed earlier, working groups are valued for connecting researchers around cross-cutting issues and enabling them to effectively compare research and results, finding commonalities and transferability in the research designs and findings. These structures could be leveraged to draft documents targeting policy makers and other research users, for example, policy recommendations, implementation guides or briefing papers.

It was suggested that GACD could do more to share best practice examples. Knowing what approaches have worked or not worked in the past to achieve the desired impacts could guide subsequent researchers. Interviewees advocated for case studies that explore the types of impacts GACD want to achieve, tailored towards researchers and supporting future research projects.

Several interviewees suggested that GACD could support engagement with policy makers and other research users. It was noted that GACD events are tailored towards researcher interest and hence engagement activities and events should be structured around policy makers and practitioners needs and interests.

Overall, interviewees pointed to a need for increased communication and stakeholder engagement, especially at this point in GACD when research findings have emerged that can be shared with policy makers and practitioners to achieve impact. Four interviewees felt that GACD has little visibility beyond its members. This was seen to limit its influence, and described as a missed opportunity given its membership, including some of the top research funders globally. Suggestions included targeted engagement with partners and policy makers, such as the United Nations, World Health Assembly and African Union, as well as communication activities such as newsletters and webinars tailored to different stakeholders. This would need to be supported through syntheses of research findings across GACD projects and the preparation of tailored material such as policy briefs. There was a recognition that the current secretariat is not resourced to provide these functions on top of its current responsibilities.

A working group chair proposed having a repository of training materials (aimed at health workers, staff, etc.) created in GACD projects, which would be very useful for a wider audience.

A few interviewees commented on potential improvements to the capacity building activities. One independent expert felt that GACD had the potential to do more with the networks, platform and enthusiasm it had developed. They felt that there is perhaps room to run the training more frequently, create advanced level courses, or develop specialist courses in specific areas of implementation science. The Secretariat is already looking into the possibility of developing advanced masterclasses, and the e-Hub which is a recent development has the potential to be further developed.

Another suggestion was that GACD should explore the possibility of funding fellowship-type grants for early- and mid-career researchers because the former often find it difficult to break into the field and lack of mid-career funding often results in trained researchers leaving the field.

6.8 GACD activity management and evaluation

6.8.1 Added value of joint working

GACD members identified several ways in which undertaking activities as an alliance of funders adds value.

Interviewees from across groups, and especially alliance members (7 of 9), most commonly stressed that GACD enables funders to agree on a common target (a health challenge) and research approach (implementation science) on which to focus substantive investment. This adds value at both the funder and researcher levels:

- At the *funder level*, the alliance was generally acknowledged as an effective platform for drawing agencies' attention to implementation science and NCDs. As one interviewee commented: "It [GACD] has played a symbolic role because all these funders have got together and said: This is important." Coming together as an alliance and engaging in discussions has enhanced funders' awareness of implementation science, a research field few organisations were familiar with. As a result, GACD was seen to have increased individual members' funding activity in implementation science. As one funder commented: "Prior to the establishment of GACD, we weren't funding implementation science research proposals. […] My impression is that most funders wouldn't have funded research in this space without GACD." Aligning investments in implementation science across different funders was also seen to result in a higher potential for impact.
- At the *researcher level*, the alliance was described as adding value through funding a cohort of projects that focus on tackling a single health challenge. This enables cross-fertilisation and learning, supported by GACD Network activities, and thereby enhances the pace of learning and progress as well as the potential for impact. As one interviewee explained: "Before GACD, each of these funders had entirely their own portfolio of grants. […] There is strength in doing things together, in having a larger network that's working on the same problem, with the hope that we can find better solutions quicker. And it's for that reason that GACD provides value." In addition, working as an alliance can enhance the quality of research projects: One funder described that feedback from the joint international review panel had helped to improve project applications from researchers in their country.

The GACD mechanism was also described as adding value by allowing funders to *share knowledge and learning* about implementation science, as well as how to fund implementation research. A few agencies were considered more advanced in this field than others. As one interviewee commented: "I don't think we had any experience of funding implementation science, frankly, prior to GACD, but other funders do. We've learnt a lot from

them." This learning cascades down to the review committee and research community. One funding committee member explained: “I have to be honest: I learned about implementation science from colleagues in GACD and on GACD panels more than I did from any number of courses and programmes. Because GACD has a rigorous approach to study design and implementation. I think this has a significant ripple or cascading effect through its calls.”

GACD was acknowledged as successful in developing a model for coordination between research funders and mechanisms for joint activity. In particular, the establishment of a joint review panel and review process was highlighted as a major achievement. Joint review ensures that proposals are assessed in a consistent manner across the agencies, and that funded projects are of high quality. This common process also delivers efficiencies to GACD members, obviating the need for coordination of individual panels. As a review committee member commented: “Putting all these funders together, effectively making an amalgam of their processes, worked amazingly well. I thought it was going to be a nightmare, but it wasn't.” Three interviewees emphasised that the experience had allowed funders to exchange best practise in relation to peer review more broadly. While the GACD joint review process has already facilitated the delivery of GACD calls and is expected to continue doing so in the future, panel members highlighted a few challenges associated, including a high turnover of panellists and the high workload of the committee chair (which could be addressed through appointment of a co-chair).

6.8.2 Challenges faced by funders

A number of challenges faced by GACD as an alliance of funders were also highlighted:

Interviewees described that calls can be relatively broad in scope as they need to accommodate the various priorities of participating agencies. This can reduce opportunities for cross-fertilisation and synergies between projects and limit the potential impact.

In addition, funders set different eligibility criteria and funding requirements. For example, some funders can only support research of relevance to their indigenous populations, others can only fund research staff but not equipment or infrastructure at the LMIC location, yet others require co-funding from another agency. This has resulted in a complex ‘patchwork’ of funding pathways that can be difficult for researchers to navigate. While interviewees from funding agencies acknowledged these issues, they pointed out that the flexibility of the GACD model was essential to allow members to participate: A ‘common pot’ approach, where funders pool budgets, would eliminate this patchwork, but this was not considered a realistic option at this point in time as agencies are obligated to follow national processes. As one funder commented: “Fundamentally, the [GACD] model is not perfect - but it cannot be perfect and also function. It's a balance of perfect and pragmatic. I'm comfortable with that personally. [...] You need to live with the non-perfect for the sake of the benefits."

Interestingly, none of the representatives from funding agencies pointed to a role for GACD in *funding* international research collaborations to date – the focus was on coordination of targeted investment between funders and the opportunity for researchers from different projects to learn from each other, working ‘in parallel’. Researchers confirmed that the alliance was not (yet) set up in a way that maximises opportunities for funding international teams. Three researchers provided examples of where agencies’ different funding processes and requirements had hampered applications involving multi-national teams, and in at least one case, this led to a study being pared back to a single country. Going forward, two funders commented that they would like to expand opportunities for co-funding to enable support for larger multi-national consortia, building on researcher networks GACD helped to set up through its earlier calls.

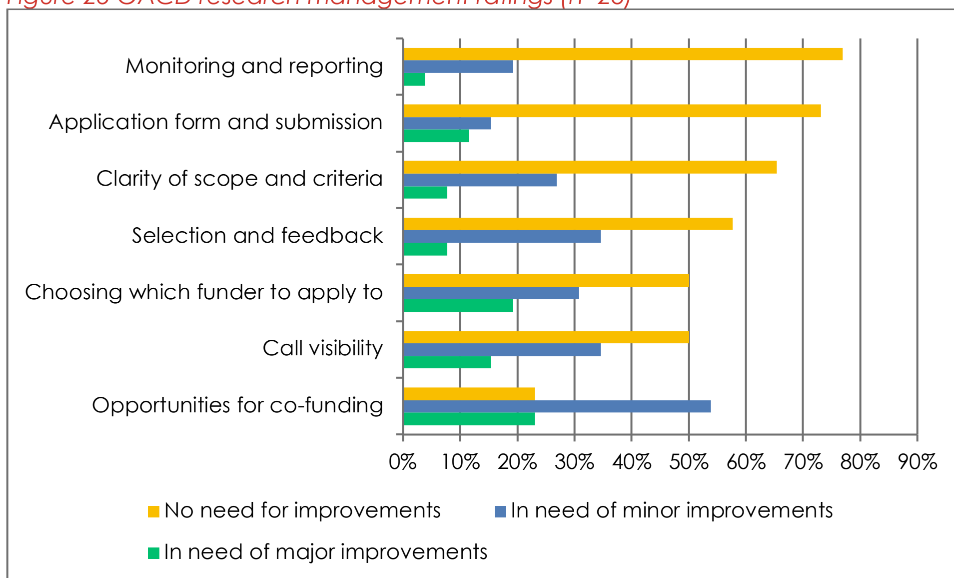
Interviewees were also concerned about the amount of research funding provided by GACD and the sustainability of this support. This included external challenges (e.g. shifting priorities at the GACD funding agencies due to COVID-19; a change in their country's government) as well as internal issues (e.g. single calls in specific disease areas without opportunities for follow up funding).

To secure and increase the overall budget of GACD, three interviewees suggested expanding GACD's membership and/or partnering with other types of organisations, such as the private and charitable sectors: "In order to get to the next level and have an impact on health, you need to put in more ingredients and grow the alliance and its impact." (3 interviewees). However, others felt that expanding the GACD membership would require the alliance's processes to become more established and efficient. Two funders would like to explore opportunities for joint calls involving a smaller number of GACD members, thereby increasing the funding envelope. Co-funding arrangements could build on the groundwork laid by GACD in developing agreements and joint processes between the funders, and support international research consortia that came together as a result of GACD Networking activities.

GACD members differed in their views on the time commitment required for GACD processes: Of the four funders who specifically commented on this aspect (all members of the programme subcommittee), two considered the time required was about right, while the other two felt it was 'quite a lot' due to the many meetings and associated preparation time – but did not put forward suggestions for how to address this challenge. All interviewees agreed that the secretariat provides helpful material and acknowledged that amount of work involved.

6.8.3 *Call design and management*

Figure 23 GACD research management ratings (n=26)



Source: Technopolis analysis of GACD survey

Out of 27 respondents who commented on the GACD call design and requirements in the project team survey, 22 (81%) had no negative comments. The majority of respondents also felt that monitoring and reporting (77%) and application form and submission (73%) do not need further improvements (Figure 23). Opportunities for co-funding were in most need of change, with most respondents (77%) highlighting need for improvements (either major or minor). Call

visibility and selection and feedback also seem in need of some work with respondents demanding minor improvements (35% each).

Views on the topics and scope of past calls were mixed: One interviewee strongly supported focussing on specific policy questions, directing a set of projects to provide the answer in different contexts and countries, thus building a sufficient evidence base for policy change. The interviewee also explained that clearly defined questions would help LMIC researchers to participate: "Short, sharp, specific questions which are related to programmatic change and policy change are tangible to researchers from LMICs and lets them submit proposals. Questions such as: 'Does tobacco taxation work? Do car-free days work?'." On the other hand, another interviewee would prefer calls to be more open, enabling more researchers to apply. By including applicants from previous rounds, this would also support the sustainability of research projects. "So that if you are working in a particular area, you're not waiting ten years until there might be a call that works for you."

Further improvement is ongoing: The secretariat continues to finetune the call text outlining the scope of implementation science to provide an appropriate steer to potential applicants. This includes an analysis of reviewer feedback to see whether unsuccessful applications show common issues that could be clarified up front. The secretariat also provides applicants with links to implementation science resources and training.

Several interviewees, especially researchers, explained that GACD's approach of funding a single call in each area prevents further development of project findings – and thus limits the level of impact achieved. As one researcher explained: "Would you rather find new brilliant and exciting ideas for every call? Then you abandon the exciting ideas from previous investments which potentially could have ended up with impact on the ground. Maybe these old projects are nothing as exciting as the new ideas - but you would have ended up with impact [if they had been funded]." Another (half-jokingly) commented: "I look – there are no calls in my area in the next three years. I think I'll have to retire." Two funders also highlighted the need for more frequent calls to build momentum in the research community. A researcher suggested to build long-term sustainability into funding, e.g. by offering GACD-funded researchers further grant opportunities covering sequential phases, from proof-of-concept to scale-up.

On the other hand, interviewees have also noted that the GACD selection process for disease areas can feel ad hoc, raising questions whether GACD funding is really directed at the most relevant needs. To address this concern, interviewees from across stakeholder groups welcomed the convening of an external advisory group to identify potential call topics. As one funder commented: "The current CEO initiated a sensible idea: to draw on international experts in NCDs to identify gaps that GACD should contribute to. It helped define our topics. I am comfortable now about the rationality of our decisions." In turn, researchers were also positive about a timeline of call topics for the next years, which allows them to properly consider ideas and prepare. One researcher specifically commended the cross-cutting nature of the planned calls, which breaks down silos and promotes interdisciplinarity.

Several interviewees emphasised that they would like to continue drawing on external experts and embed such advisory groups in GACD's processes. To increase the potential for impact of GACD research, three interviewees also recommended linking GACD funding calls more clearly to global policy targets, e.g. WHO and SDGs. Two interviewees suggested bringing in perspectives from different LMICs through regional consultations. A stronger link to policy would then allow targeted engagement with key policy stakeholders – and raise the visibility of GACD more generally.

In the past, applications to GACD funding calls had to be submitted to the individual funder, using the established application form. GACD instituted a common submission portal for the most recent call that includes many (but not all) of its members and uses a common application form. Review panel members were positive about this change as it has enabled them to assess proposals in a more consistent manner. One researcher commented however that the portal had caused confusion, as they found information on individual funders' websites to be inconsistent with information provided by GACD.

Two interviewees[203] with a strong background of working in LMICs considered project application forms too complicated and extensive. This represents a substantial barrier for LMIC researchers, most of whom do not have access to the necessary resources and administrative support. To provide opportunities for participation, three interviewees suggested a funding stream of much smaller awards for LMIC-based researchers, using a very simple application form. Two researchers also felt that LMIC researchers should have the ability to apply in their own language. Another suggestion was providing funding for essential research infrastructure at LMIC institutions, such as databases, which would enhance LMIC research participation over the longer term.

6.8.4 Quality of the received proposals

GACD's activities have led to new or strengthened relationships at several levels, which enhances the relevance and quality of the research:

- At the funder level, alliance members explained that they had formed close working relationships with representatives from other agencies. Two interviewees from GACD members highlighted that the alliance brings together funders from HICs and LMICs, with vastly different budgets, to "sit as equals around the table". This was seen to benefit research by combining perspectives of different countries, including LMICs, and thus ensuring that the research is of relevance to LMICs. One funder from a HIC commented that they would like to see more funding agencies from LMICs to join GACD to expand this even further. In addition, strengthened funder-to-funder relationships can support communication and closer working more broadly. One funder described how being able to access contacts made through GACD had facilitated discussions on other (non-GACD) co-funding opportunities. The joint review process is also seen to have built trust between individual GACD members - and to potentially provide a mechanism for other co-funding efforts (beyond GACD). A representative from a major funding agency commented: "I think there's a recognition that this is a way to go in the future, a common vision and a common process. […] We're really trying to build a tradition of excellence in research and networking collaboration and of the tremendous synergy that comes from an international consortium."
- Five researchers highlighted that GACD has been exceptional in enabling direct communication between the research community and funders, especially during the annual network meeting. These conversations have informed and enhanced research projects. As one researcher commented: "[The conversations] gave us an understanding of where the funder is coming from and what they're looking for in their projects, and how they want to see the delivery. It's been a real eye opener.". Another explained: "I think it's the only funding initiative where you have funders and researchers sitting in the same room. [Researchers] can really look at the research from a funder's perspective, and it also gives

[203] These individuals were referring to templates of individual funders and may not be aware of the recently used joint application form.

the researchers a chance to communicate their points of view. That enhances collaboration between the two parties and makes it a lot easier."

6.8.5 Monitoring

Current reporting requirements from GACD – an annual report of current project status, publications and challenges encountered – were described as 'low burden' or 'not cumbersome' by most interviewees. There was broad agreement that going forward, GACD needed to capture outcomes and impacts beyond the duration of the research project. This was considered particularly important (and relevant) as implementation science is "the closest to real-world impact you can get". Funders can hence expect a higher level of impacts to emerge from their GACD investments compared to other funding streams, providing an opportunity to showcase the agencies' achievements. As one funder stated: "Follow up after the project is essential. Funders need to understand what research has achieved and how implementation science is developing, what benefits come from that. Researchers need to be able to learn from the others. We need this information, put together in a kind of catalogue."

Projects also need to report following the processes of the individual funders. Six interviewees highlighted that they would like to see a more standardised approach to monitoring across projects, collected centrally by the GACD secretariat through a standard reporting template. This includes not only monitoring of outputs outcomes and impacts, but also a better overview of parameters of the funded projects, such as geographic location, the diversity of regions engaged with and gender balance. The resulting synthesis can then be communicated to GACD members as well as external stakeholder to raise the alliance's visibility. As one interviewee explained: "Gathering core standardised metrics across the projects can be really, really valuable for communicating results to funders and to the scientific community." The secretariat is currently setting up such a process and is developing a form for annual project reports to standardise reporting across all projects. The intention is to combine indicators from all funders as much as possible, and include GACD-specific indicators where appropriate, so that researchers can copy and paste sections between their funder's and the GACD reporting form (thus minimising the reporting burden).

Specific monitoring indicators put forward by interviewees include 'traditional' research outputs (e.g. number of projects completed on time, publications, number of individuals attending a training course), as well as non-academic communications (newspaper articles, radio/TV features), new collaborations or networks formed, the number of stakeholders involved in a project (as well as the nature of involvement), and instances of influence on policy and practice (e.g. the level of implementation and reimbursement). Focusing on indicators for capacity building, one interviewee suggested capturing 'researcher number per 100k population' for NCDs; two others recommended collecting information on the number of early career researchers involved in project delivery.

Two interviewees suggested GACD take the approach of providing a Theory of Change for implementation research in NCDs as part of the call text. Researchers can then take account of the expected outputs, outcomes and impacts when designing their studies and monitoring activities. One of the interviewees added that training on measuring impact and model frameworks used at projects levels would be helpful in supporting this effort. In addition, small grants could be made available to allow collection of outcomes and impact metrics beyond the duration of the GACD project.

Other suggestions included qualitative measures, such as demonstrating impact in case studies or through a 'Most Significant Change' approach. The latter collects and analyses stories from

PIs and research team members on what they feel the research has added, allowing capture of unexpected outcomes and learning.

6.8.6 The GACD secretariat

Nearly all interviewees held a positive view of the work of the GACD secretariat. Management processes were seen to have improved considerably over the past few years and are now considered efficient. As one funder commented: "I think GACD management is running well now. […] I don't have any concerns about efficiency at the moment." Especially the process of prioritising and agreeing topics for the next three years, drawing on input from an ad hoc advisory group, was commended: "We've now got our next three call priorities drawing upon expert advice. And with that, a framework and a focus for the programme subcommittee and the secretariat in terms of what we're going to deliver over the next few years. I'm really happy with the process and the outcome." Two GACD members also highlighted the challenging task of liaison between funders and coordinating meetings (and accompanying materials). As one funder said: "I think [the secretariat] is doing a wonderful job in keeping 'the lions' all tamed and working together. That's an important challenge. The strength of the whole activity is in the partnership."

Interviewees raised few concerns about the secretariat. Three interviewees were concerned that its location - in the UK – gives it a HIC perspective. Moving the secretariat to LMICs would bring it "closer to the action". Another three interviewees were concerned that the secretariat was not sufficiently resourced to take on an additional activities they see as crucial to achieve impact: stakeholder engagement and increasing the visibility of GACD.

6.9 Value for Money

- **Efficiencies achieved through joint working**

Joint mechanisms supported within GACD such as the joint secretariat, joint development of the funding calls, joint review panel and common submission portal for those funders who are able to participate avoids duplication of effort, allows sharing of common tasks and leverages funders' collective expertise and networks, creating economies and reducing the burden on individual funders, thus providing value for money for funders.

- **Value for money of GACD activities**

The implementation science e-Hub is a very valuable platform for training and dissemination. It is paid for from secretariat contributions (not requiring additional funds) and thus presents value for money for funders according to one funder member we interviewed.

GACD projects also contribute evidence on aspects such as costs of implementation, cost savings and/or enhanced efficiency, effectiveness or equity which can translate into potential value for money for health systems when GACD findings are implemented on a large-scale. For example, the School-EduSalt intervention programme is low cost and highly effective for reducing salt intake and thus represents potential economic benefits in terms of improved population health and reduced NCD burden.

GACD could also be seen to offer value for money in terms of equity. With its focus on LMIC and vulnerable HIC populations, the research results are likely to promote health equity among disadvantaged communities. Furthermore, the research itself involves a good proportion of women researchers (41% of authors) and GACD activities are strengthening implementation research capacity locally in LMICs, where it is sorely needed.

7 Conclusions and recommendations

7.1 Conclusions

- *GACD has an important role in the global funding landscape*

GACD is an alliance of research funders that coordinates funding of implementation science projects addressing NCDs in LMICs and vulnerable populations in HICs. The GACD model tries to accommodate the priorities and requirements of each funder and fosters consensus among members on which research areas they should fund, through joint calls. There are no direct comparators to GACD, and the alliance plays an important role in the funding landscape by providing a focal point for implementation science research in NCDs, raising awareness and knowledge of this type of research globally among stakeholders, including funders and researchers, and offering networking and capacity building opportunities.

- *GACD has established a well-functioning model for collaboration between funders*

The alliance has established a model for coordination among the many funders through joint processes (e.g. joint review panel). This has led to efficiencies and improved consistency of proposal assessment across the agencies. It has also allowed funders to learn from each other about implementation science and NCD research as well as funding processes.

Funders are overall positive about the GACD as an alliance. The secretariat was recognised for bringing focus and clarity to the discussions and provides valuable support. Involving an External Advisory Group to inform call topic selection has been welcomed and has re-assured members that they are supporting relevant topics. Joint funding processes developed for GACD calls – and trust in the relationships – are now in place. This can benefit future co-funding activities between GACD members.

GACD's flexibility in accommodating the different funding requirements of individual GACD members has enabled broad participation in calls. However, the diversity of members also poses challenges, such as defining an appropriate scope for calls and monitoring research outcomes across the portfolio.

- *GACD members fund high-quality NCD-implementation science projects of relevance to needs of LMICs and vulnerable populations in HICs*

Interviewees noted that the quality and relevance of GACD proposals and projects have increased over time, partly owing to increased awareness of implementation science and increased research capacity. This has led to research findings and resources that are relevant for needs in the specified LMIC and HIC vulnerable population contexts and which have the potential to contribute to decreasing the burden of NCDs.

Bibliometric analysis of GACD-funded publications indicates that GACD has managed to increase the share of LMIC authorship compared to publications by comparator funders (i.e., selected GACD members' non-GACD outputs or non-GACD members). Citation-based scientific outcomes of GACD-funded publications published between 2014-2019 (Table 8) are of a similar level to those of comparator funders and significantly higher than the overall world level for selected chronic diseases (hypertension, diabetes and lung diseases).

- *GACD projects and activities are fostering collaborations across countries, disciplines and sectors*

Of the 300 unique GACD publications included in the bibliometric analysis, 81% involve authors from at least 2 countries. HIC-LMIC collaborations are particularly supported: 60% of the 300

publications have both HIC and LMIC authors. 41% of authors on GACD publications are women.

GACD also fosters collaborations across disciplines and sectors. The disciplinary diversity of authors is higher for GACD-funded papers than comparators. GACD-funded publications also have more diverse authorship in terms of non-academic categories than comparators, i.e. a higher share of authors is affiliated with government or research institutes.

Interviews indicate that the GACD is fostering truly international networks and collaboration through the Programme Groups (projects in the same disease area), cross-cutting Working Groups and Annual Scientific Meetings. For example, the Annual Scientific Meetings have forged close links between researchers and funders from different countries, working in different areas and at different career stages, which has created an engaged and enthusiastic GACD community. Programme groups and Working Groups have led to new global collaboration networks; sharing of data, knowledge and experiences; new research proposals and projects; and high-profile papers often of general value to the field.

- *GACD networking and training activities are building capacity in NCD-implementation science research*

GACD's networking and training activities have helped to build and strengthen implementation science capacity. The Implementation Science School and Workshops are valued very highly by participants, senior experts in the field and funders. GACD is seen as a significant contributor to the expansion of implementation science and global implementation science capacity in the last decade, having attracted new entrants to the area – either early career researchers or researchers from other fields. The training has had an impact on trainees' skills, ways of working and research careers.

- *Engagement with policy makers and other research users is a key enabler of impact*

Involvement of policy makers, practitioners or other stakeholders in projects, either as collaborators or consultants, is the key mechanism for facilitating impact in GACD projects, as it encourages buy-in from the intended research users. Formal stakeholder engagement plans and pathways to impact are useful for enabling stakeholder involvement in projects and uptake of project findings. Engagement with international organisations such as WHO, European Commission and African Union in particular is a route to facilitating impact beyond the research site(s).

- *GACD projects have the potential to achieve policy impacts in the future*

With around half of GACD-funded projects still on-going, and many that completed only recently, most projects have not (yet) led to large-scale implementation or adoption to date, even though some projects have led to changes in policy and guidance. In addition, the COVID-19 pandemic required policy makers to shift their priority to address the most urgent needs at hand. Avenues for uptake of GACD research evidence are however in place: Many projects have collaborated with or consulted policy makers and other stakeholders during the lifetime of the project, and have mechanisms in place for dissemination and communication of findings to the relevant users. Hence, most principal investigators who responded to our survey expect their projects to lead to policy/practice outcomes and subsequent impact on health, such as reduced risk factors, reduced morbidity and mortality, and greater health equity.

- *Low visibility and inconsistent monitoring of GACD*

There is a need to capture outcomes and impact (with projects finishing), synthesise findings, and communicate those to key stakeholders to facilitate scale-up, implementation and

impact. However, the portfolio and monitoring information currently available is inconsistent and often inadequate, hampering efforts to enhance GACD's visibility and hence influence outside its immediate network, and to maximise learning about key success factors to support future research.

7.2 Recommendations

1. **Explore options for additional partnerships and co-funding involving smaller groups of GACD members**

GACD members invest in NCD implementation science through annual calls with an agreed scope. While joint efforts, e.g. the joint review panel and common submission portal, are establishing ways of working as well as trust between alliance members to collaborate in the long term, there is potential to explore additional partnership models in the medium term – potentially involving subsets of the GACD funders. This would provide a number of opportunities:

- Simplified and agile mechanisms for co-funding partnerships, enabling greater support for international consortia. This has the potential to enhance impact, as research can span across countries/contexts that may not be being addressed in the current ('more individual') funding model or that may not usually collaborate
- Clusters of like-minded funders may be able to agree on a different scope (e.g. fellowship funding for capacity building in LMICs, specific research question, intervention development etc.) to support activities that complement the annual calls and other current GACD activities. A few well-targeted projects could provide a strong evidence base which could then be taken up into policy and practice, or help create critical mass in some countries for further research
- Smaller funders may find it easier to participate in and support smaller, more targeted partnerships and activities that do not involve funding a large research project

RECOMMENDATION: GACD should explore options for additional partnerships and co-funding involving smaller clusters of GACD members to complement existing GACD activities. These partnerships could be stand-alone initiatives rather than remaining under the GACD umbrella. However, linking with the wider GACD Network would result in added benefit for the alliance (e.g. learning across projects) and efficiencies (e.g. use of GACD processes). The role (and resourcing) of the GACD secretariat in supporting these discussions and any subsequent arrangements would need to be considered.

2. **Improve collection, sharing and synthesis of portfolio and monitoring information**

GACD does not currently have a process for synthesising an overview of its funded portfolio (e.g. geographic location of research team members, gender of PI/team members) and of any outputs/outcomes and learning arising from the research. Project details and monitoring information are often held by the funder of each project; however, this is not always accessible to GACD. GACD monitoring currently comprises a light-touch annual report.

The information and insights from across the portfolio should be used to inform GACD strategy on an ongoing basis, to assist other researchers in delivering their projects, and to showcase GACD to external stakeholders. Moreover, at this point, several GACD research projects have completed, and outcomes and impacts are starting to accrue. Outcomes and impacts only unfold beyond the lifetime of the grant and need to be captured in order to demonstrate to funders that their investment is bringing benefits.

RECOMMENDATION: GACD should create systems and/or mechanisms to collect the relevant portfolio and output/outcome/impact information from grantees and/or funders and to synthesise this information.

Researchers could be asked to fill in a template at the start of their project, capturing relevant project information. Information on progress and outputs/outcomes could be captured through a regular monitoring process. These data could then be synthesised, either by the GACD secretariat or outsources, to derive key insights on the relevant aspects of funded projects and identify enablers and barriers.

We understand the GACD secretariat is currently working on a standardised reporting system that gathers key data while minimising burden on the researchers. The Theory of Change set out in this evaluation report could serve as a framework and be provided to researchers within the research call so that projects are designed to capture relevant indicators. Consideration should be given to how researchers can be incentivised to provide outcomes and impact updates after grant funding has ceased; this could involve conditional membership in the GACD Alumni Network or provision of 'reporting grants'.

3. **Enhance stakeholder engagement**

While research projects link with stakeholders and are expected to disseminate their findings, GACD activities (outside projects) have limited involvement of stakeholders. This limits the level of influence, e.g. on strategies of non-GACD funders or considerations of policy makers – a missed opportunity given the alliance's strong funder and researcher networks. In addition, GACD could engage with other types of organisations active in health research and delivery, such as industry, NGOs or foundations, and healthcare providers. At a minimum, this would help to inform GACD-funded research projects, and could potentially lead to new collaborations and partnerships in the long term, at the research project level and GACD level. It could also help inform selection of call topics; enable uptake of outputs from GACD projects, programme groups and working groups; and facilitate the pathway to impact.

RECOMMENDATION: GACD should explore ways to enhance engagement of stakeholders with the alliance. Current GACD networking and capacity building activities are researcher-focussed. While existing activities could be opened up and advertised to stakeholders, they may not meet the stakeholders' needs and time pressures. Thus, GACD may need to develop tailored events and resources. For instance, stakeholder-relevant training material, self-learning courses or implementation guides, etc. could be provided via the e-Hub. There is also an opportunity to target specific organisations regionally or internationally such as WHO, PAHO, and the African Union.

4. **Increase visibility of GACD and what it has to offer**

GACD's visibility beyond the alliance members is low. This limits its potential to engage more widely with other funders, researchers and stakeholders as described above. Even among members and grantees there is little awareness of all the resources on offer e.g. the Metadata Index and Data Dictionary. Therefore, there is a need to improve GACD's communication activities.

Communications could be supported by a clear demonstration of GACD's reach and achievements, e.g. drawing on the portfolio and outputs/outcomes/impact syntheses described in Recommendation 2.

RECOMMENDATION: GACD should enhance its external communications and improve access to relevant tools and resources by improving their visibility to potential users. This could be done by including project case studies and similar information on the GACD website and improving

navigation within to make the relevant content easily available to the audience. GACD could also include some of this content in a regular newsletter.

To build brand recognition, especially among the most important audiences, the first step in our view would be to deliver the GACD Communications Strategy 2020 – 2024, which has similar goals to our recommendation and identifies activities to progress towards those goals.

5. **Ensure sustainability of GACD networks as the community grows**

The GACD network has expanded with each call and training course. While an alumni network is being considered, there is currently no strategy for accommodating the increasing number of members, research programmes and working groups. As highlighted in this report, these activities have nurtured communities of researchers and led to a variety of scientific, collaboration and capacity building outputs and outcomes. However, as GACD grows, there is a danger of the network becoming unsustainable or developing discrete silos.

RECOMMENDATION: GACD has done a very commendable job so far in helping to create and sustain multiple separate and overlapping networks. These are open rather than closed networks with individuals often participating in more than one. Learnings from this experience should be leveraged for ensuring future sustainability and manageability of the networks.

Alumni network/s not only of previous project participants but also of trainees would be a valuable initial step. If Recommendation 3 is implemented, a new network of stakeholders may also emerge. To gain the most benefit from these networks, GACD could look into mechanisms to foster cross-communication or opportunities for collaboration (as relevant) between the different networks. The wider role of GACD and the support it should or should not provide is also a matter for consideration.

Appendix A Methodology of the bibliometric analysis

A.1. General data preparation

Bibliometric database

The Scopus database was used which provides comprehensive coverage of the scholarly literature by indexing more than 43 million publications, published in some 50,000 peer-reviewed journals and conference proceedings since 1996. Scopus also provides the names and affiliations of all authors appearing in peer-reviewed publications, making it possible to identify publications produced by individual researchers and the institutions with which they are affiliated.

The document types included in the Scopus analysis are articles, reviews, short surveys and conference proceedings. Unless stated otherwise, the tables and figures deriving from Scopus data include all the aforementioned document types. The version of the production database proposed for this project has complete coverage of articles published up until 2019.

Analytical period

The main analytical period used in the analysis was 2014–2019. This period was selected given that the first GACD-funded projects began work in 2012, allowing a two-year gap for the first publications produced by these projects to be officially published by scientific journals.

Disease-based thematic data sets

GACD has focussed on research on diabetes, hypertension, lung diseases, and –more recently– mental health (selected chronic disease areas or SCD). Keyword-based queries of publication abstracts, keywords and titles were conducted to isolate these thematically relevant records within the Scopus database. These thematic filters could then be deployed to other publication sets of interest, including GACD publications, publications by other funders used in the comparison, or by groups of countries. The mental health thematic area was associated with less than 30 GACD publications and limited time to accrue citation statistics, and therefore removed from the final thematic filter employed in the computation of the bibliometric indicators.

Implementation science-based thematic data set

Given the focus of the GACD on IS, an additional thematic data set was assembled to capture this aspect. This dataset could be added as a second order filter to complement the disease-oriented filters presented above.

Keyword-based queries were used to isolate relevant publications both in the global publication archive and in the GACD publications set. However, the exact definition of implementation science is challenging and, to differentiate the field from other closely-related research specialities, a rather narrow definition of the field was used. Consequently, this thematic data set may underestimate the true extent of IS-relevant publications. Therefore IS subset of GACD publications should be interpreted as proportions in relation to comparator funders, rather than in absolute terms.

Comparison data set

Comparative analysis of overall or average bibliometric data can be conducted against all publications included globally in a thematic dataset (i.e. the **world level**). World level scores include publications originating in a variety of institutions, funded through a variety of mechanisms, and from all countries. Therefore publications supported by funding programs

managed by either inter-governmental, international, or HIC funders tend to score above the world level.

Comparison of GACD-funded publications was also conducted against **non-GACD publications by selected GACD funders**. These funders were European Commission, National Institutes of Health (US), and the UK Medical Research Council. These publications were selected to mirror the thematic focus of GACD publications using classifications made available in the relevant online repositories. These were OpenAire (for European Commission publications), NIH RePORTER (for the National Institutes of Health), and Gateway to Research (for MRC publications).

An additional comparison group was constructed to benchmark GACD publications. This was assembled from **non-GACD funders**: Deutsche Forschungsgemeinschaft; National Research Foundation of Korea; and the Wellcome Trust publications. Publications from these funders were identified by querying Scopus records containing the acknowledgement section of publications, and further delineating those publications belonging to the thematic data sets described above

Identification of GACD publications

Publications authored by GACD-funded researchers were identified by starting from an initial list of project-level descriptions provided by GACD secretariat (i.e. award numbers and funding agencies). Online award databases including Gateway to Research, OpenAire and NIH RePORTER were queried to retrieve lists of publications produced by these projects. Scopus records of acknowledgement sections in scientific publications were also parsed to identify relevant mentions.

Note that the intersection of the GACD publications identified through funding award databases and in Scopus acknowledgement records do not fully match the SCD thematic dataset. This may be due to the fact that GACD funding leads further publications not directly linked to the original disease topic of interest (e.g. interdisciplinary collaborations) or imperfect delineation of the disease-oriented thematic publication sets.

Identification of publications from HICs and LMICs

Authors of a publication affiliated with institutions located in HIC, as defined by the World Bank, were linked to HICs, while those with affiliations located in LMICs, were linked to LMICs. Co-publications with authors falling in both HIC and LMIC categories were included in each breakdown. Moreover, we distinguish whether the first author, last author or the corresponding author of a publication is affiliated with an institution located in an LMIC.

A.2. Indicators

Publication volume counts

This indicator shows the number of publications for a given entity, calculated using a method called full counting. Using this method, each country, economic sector, or research organisation that has a researcher on the list of authors for a given paper gets a full count (1 publication) for that paper. For example, if a paper is authored by two researchers with addresses in the United Kingdom, one from Spain, and one from the United States, the paper will be counted once for the United Kingdom, once for Spain, and once for the United States.

Periodic variations in publication volume

Variations in publication volume over time can be captured and relativized by the computation of compound annual growth rates (CAGR). The CAGR measures the rate at

which a given entity's production changed over a number of years, taking compounding effects into account. For instance, if an entity's output increases by 6% every year, then after 12 years of compounded growth (also known as exponential growth) its output total will double. Because the CAGR is a single number that does not communicate information on the yearly fluctuations within a trend, output trend data for each entity can also be included as a bar graph in the results tables.

Specialization Index

The specialization index (SI) indicates how much output an entity produces in an area of research, adjusted for the entity's overall number of papers and relativised to the global average. For instance, if 20% of a given country's publications are in physics, but at the global level only 15% of papers are in physics, then the country is said to be specialized in physics, producing proportionately more output in that field than is normally the case elsewhere around the world.

The SI reference value is 1 (i.e., the world level is always equal to 1); accordingly, an SI above 1 shows that an entity produces proportionately more papers than the average in a given area, an SI below 1 shows that an entity produces proportionately fewer papers than the average in that area, and an SI near 1 shows that an entity produces close to the average proportion of papers in that area.

Field-Weighted CiteScore

The CiteScore is calculated at the journal level as the total number of times peer-reviewed papers published in the journal in years X-1 and X-2 were cited in year X, divided by the total number of peer-reviewed papers appearing in the journal in years X-1 and X-2. As a result, using the CiteScore to evaluate individual research publications (or the entities producing them) is equating the quality of research with the quality of the journal in which they are published.

In brief, the CiteScores of papers are calculated by ascribing to them the CiteScore of the journal in which they are published, for the year in which they are published. Subsequently, to account for different citation patterns across fields and subfields of science, each paper's CiteScore is divided by the average CiteScore of the papers published in the same year in its subfield to obtain a relative CiteScore. The final indicator computation of a given entity is the average of its relative CiteScores.

Average of relative citations

The average of relative citations (ARC) is the average of the relative citation scores of all the articles published by a given entity. The ARC is normalised to 1, meaning that an ARC above 1 indicates that the entity's articles have higher-than-average impact, an ARC below 1 means that the entity's articles have lower-than-average impact, and an ARC near 1 means that the publications have near-average impact.

Because RC scores are known to be skewed in their distribution—with a small number of papers receiving a large share of the total citations—the ARC offers a useful snapshot of overall performance but can hide important underlying nuance. For this reason, we complement the ARC with the highly cited papers measure, see below.

Highly cited publications

Highly cited papers (HCP) are publications that have received RC scores among the highest in their respective field. This indicator is frequently used to examine research excellence, measuring how many high-impact articles are produced by a given research entity, relative to

their expected contribution to world-leading research. For the present study, contributions to the top 10% of publications will be measured.

The HCP measure is normalised to 1, meaning that an entity with an HCP over 1 contributes more than its expected number of highly cited papers, an entity with an HCP below 1 contributes fewer than its expected number of highly cited papers, and an entity with an HCP near 1 contributes close to its expected number of highly cited papers.

Citation Distribution Chart (CDC) and Citation Distribution Index (CDI)

The CDC is a tool that facilitates a simple but nuanced visual inspection of an entity's research impact relative to worldwide performance. To prepare these charts, all publications are divided in a given research area into 10 groups of equal size, or deciles, based on their RC scores. The 1st decile contains the 10% of publications with the lowest RC scores; the 10th decile contains the 10% of publications with the highest RC scores.

For a given research entity, it is expected that the RC scores of its publications will follow the global distribution, with an equal number of publications falling in each of the deciles. The CDC for a given entity compares that entity's scientific impact to the global level by showing how its performance compares to the world level in each of the deciles.

Ideally, one would hope to be over-represented in the highest deciles, where the most impactful publications are found; similarly, one would hope to be under-represented in the lowest deciles, where the least impactful publications are found. Thus, strong research performance is shown by long red bars on the left of the CDC and long green bars on the right of the graph.

The content of the CDC can also be summarised numerically using the CDI. For each decile, the performance of a given research organisation is compared to the global average, and this ratio is then multiplied by the weight corresponding to that decile (negative weight for deciles 1 through 5, positive for 6 through 10). Once a score has been produced in this fashion for each decile, they are summed to calculate the CDI for the research organisation. Thus, having a higher-than-expected number of publications in the 1st decile (i.e., the lowest-impact decile) will reduce the CDI more than having a higher-than-expected number of publications in the 2nd decile. The CDI ranges from -50 (worst-case scenario) to 50 (best-case scenario), with 0 representing parity with the world level.

International collaboration rate (ICR)

An international co-publication is defined as a publication that was co-authored by individuals from at least two countries. The ICR of an entity is simply a measure of how many of its articles are co-published with international partners as a proportion of the given entity's total output. The ICR is obtained by dividing the number of international co-publications of an entity by its total number of publications (both national and international).

Disciplinary diversity in publication authorship (DDA)

The index of DDA relies on a journal-based classification of science. It reflects the diversity of prior disciplinary background of a paper's co-authors. It increases for authors from different subfields, particularly where these subfields are not frequently connected in Scopus. Note that a single-author publication, no matter the diversity of the author's background, will receive a

minimum score, since the indicator is intended to capture diversity across different authors. It is normalized by the paper's subfield and year to avoid coverage biases.[204] (Campbell et al., 2015)

Disciplinary diversity in publication references (DDR)

Examining the material that is cited in a paper offers a reflection of the thematic content that is being integrated in the underlying research. Accordingly, the integration of material drawn from across disciplinary boundaries is assessed through citation behaviours, leading to an index of disciplinary DDR. The indicator considers (a) the number of different subfields that are being cited, (b) the distribution of those citations across the cited subfields, and (c) the proximity of those subfields to one another. The index is normalized by the paper's subfield and year to avoid coverage biases, with a world level in a given subfield and year set at 1.0.

Share of authorships held by woman authors

The share of authorships (with authorships defined as publication-author pairs, i.e. two publications with three and five authors leads to eight authorships in total) in a publication set likely held by a woman author, as identified by the name recognition software NamSor. Moreover, we distinguish whether the first author, last author or the corresponding author of a publication is likely to be a woman.

Share of authors by career stage

The share of authorships in a publication set that was held by a researcher in a specific career stage: graduate student (latest publication is one to five years older than the earliest publication); early-stage researcher (latest publication is five to 10 years older than the earliest publication); or established researcher (latest publication is 10 or more years older than the earliest publication).

Network indicators – betweenness centrality

Network-level analyses require a delineation of actors (nodes – researchers here) and types of connections between them (edges – joint authorship of publications here, also called co-publication activity). With nodes and edges defined, numerous social network analysis tools can be applied to discover the dynamics of the system.

Betweenness centrality measures how often a given node in a network lies along the shortest paths between two other nodes that are not directly connected to one another. For example, this indicator would highlight entities who play an important "brokering" role, acting as a connecting link between entities who do not co-publish with one another or cite one another's work directly. Nodes with a high betweenness centrality score are the bridges that connect relatively isolated islands of research communities within the overall topography. These entities play an important role in the interconnection of subgroups within the network as a whole; betweenness centrality highlights entities who may be providing an important routing service within the community. The weighted version of this indicator also takes into account the extent of the link between nodes.

Qualification of findings with stability intervals

It is important to measure the degree of uncertainty that are associated with the bibliometric indicators using stability intervals. Stability intervals provide a range within which a computed

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[204] Campbell D, Deschamps P, Côté G et al (2015) Application of an "interdisciplinarity" metric at the paper level and its use in a comparative analysis of the most publishing ERA and non-ERA universities. In: 20th International Conference on Science and Technology Indicators

score could likely fluctuate in response to a change in the underlying set of publications that was used to compute it. Stability intervals are built by randomly resampling, with replacement, a group's papers to produce many resamples (e.g., N = 1000) of equal size to the group's number of papers. The various indicators to be produced are then computed for each resample to produce an empirical distribution of the scores. This enables the computation of a 95% stability interval—that is, the interval containing 95% of the resamples' scores. It can be assumed that if the 95% intervals of the groups being compared do not overlap, then the observed difference is likely to remain visible should the underlying data be altered. Because they are built empirically, stability intervals do not rely on the assumptions that the study samples are random and follow a specific distribution. However, they assume that the observed data are representative of the larger populations to which they belong.

Note on citation metrics as impact

All indicators of scientific impact used here are based on citations. An important assumption underlying such analyses is that citations are a good proxy for contributions to scientific knowledge. While it is true that citations are generally used to communicate the positive influence of one piece of research on another, citations are also sometimes used for other reasons. For example, one article may be contradicting another; the author would in that case use a citation to highlight the article being contradicted. Additionally, an article may cite many others, with some material constituting general background information and other material constituting the principal foundation on which the new piece of knowledge is built. These varying citation behaviours are all treated equally in analyses of scientific impact, which are blind to the differences between them.

Scientific impact assessed on the basis of citations would therefore be better interpreted as contributions to and visibility within scientific discourse; it would not, for example, highlight a paper that is of good quality but rather a paper that may get much visibility or recognition within the research community. In light of these considerations, the interpretation of scientific impact analyses should proceed with due caution.

Counting citations can be used as a proxy for measuring contributions to subsequent knowledge generation; however, because citation practices vary between the disciplines and sub-disciplines of science, simple counting would create unwanted biases in the results. To correct these potential distortions, individual publications are evaluated relative to the average citation rate for publications in the same subfield and published in the same year.

For all citation-based measures, a certain amount of time must be allowed for the published work to influence subsequent research and accrue citations. A recent analysis conducted at Science-Metrix shows that only a small number of subfields reach citation peak within two years; that is to say, citation attention for papers is still continuing to increase even several years after publication, and therefore a measurement taken too early risks not effectively reflecting the total attention that a body of work will receive. For this reason, we did not compute impact statistics for papers published in 2017 or later, as they have not had sufficient time for citations to accrue.

Appendix B Additional bibliometric findings

Table 13 shows GACD publication output, as well as overall publication output in selected LMIC countries where GACD Associate Members are located.

Table 13 Publication output by selected countries

Country	Papers					
	SCD	DM	HT	LD	SCD-IS	GACD
Argentina	2,427	800	958	891	76	16
Brazil	14,575	5,592	5,805	4,726	364	14
China	90,754	29,901	20,868	45,394	1,217	43
India	25,281	10,013	5,577	11,678	471	45
Mexico	4,963	2,406	1,541	1,624	123	16
South Africa	6,086	1,450	1,475	3,671	316	41
Other LMICs[1]	67,011	28,287	21,575	24,012	1,673	145

[1] All LMICs not listed above. Source: Produced by Science-Metrix using Scopus (Elsevier) data.

The following tables (Table 14 - Table 16) give a breakdown of Table 7 by disease areas:

Table 14 Publication output for diabetes

	Papers	2014-2019 Trend	2014-2019 CAGR	Ratio to world
	Number of papers			
GACD - Diabetes	128		71.9%	0.1%
Diabetes	91		62.5%	0.0%
Diabetes-IS	30		N/C	0.5%
World Level				
Diabetes	191,542		4.8%	N/A
Diabetes-IS	5,847		9.4%	N/A
HICs				
Diabetes	131,566		2.5%	68.7%
Diabetes-IS	4,886		7.6%	83.6%
LMICs				
Diabetes	77,687		10.7%	40.6%
Diabetes-IS	1,565		22.4%	26.8%
3 GACD members (based on funders lists of publications)				
Diabetes	23,558		-1.3%	12.3%
Diabetes-IS	945		2.8%	16.2%
3 non-GACD members (based on Scopus Acknowledgements)				
Diabetes	3,363	N/C	22.5%	1.8%
Diabetes-IS	51	N/C	N/C	0.9%
	Share of IS papers (within NCD papers)			
GACD	33%		N/C	10.8
World Level	3%		4.4%	1.0
HICs	4%		4.9%	1.2
LICs	2%		10.6%	0.7
3 GACD members (based on funders lists of publications)	4%		4.2%	1.3
3 non-GACD members (based on Scopus Acknowledgements)	2%	N/C	N/C	0.5

Source: Produced by Science-Metrix using Scopus (Elsevier) data.

Table 15 Publication output for hypertension

	2014-2019			
	Papers	Trend	CAGR	Ratio to world
	Number of papers			
GACD - *Hypertension*	176		10.8%	0.1%
Hypertension	133		7.3%	0.1%
Hypertension-IS	57		-1.7%	1.4%
World Level				
Hypertension	145,720		3.4%	N/A
Hypertension-IS	4,159		8.1%	N/A
HICs				
Hypertension	102,738		2.3%	70.5%
Hypertension-IS	3,403		6.7%	81.8%
LMICs				
Hypertension	56,922		7.8%	39.1%
Hypertension-IS	1,392		18.5%	33.5%
3 GACD members (based on funders lists of publications)				
Hypertension	17,656		-0.2%	12.1%
Hypertension-IS	614		2.7%	14.8%
3 non-GACD members (based on Scopus Acknowledgements)				
Hypertension	2,039	N/C	26.1%	1.4%
Hypertension-IS	40	N/C	N/C	1.0%
	Share of IS papers (within NCD papers)			
GACD	43%		-8.4%	15.0
World Level	3%		4.6%	1.0
HICs	3%		4.3%	1.2
LICs	2%		10.0%	0.9
3 GACD members (based on funders lists of publications)	3%		2.9%	1.2
3 non-GACD members (based on Scopus Acknowledgements)	2%	N/C	N/C	0.7

Source: Produced by Science-Metrix using Scopus (Elsevier) data.

Table 16 Publication output for lung diseases

	2014-2019			
	Papers	Trend	CAGR	Ratio to world
	Number of papers			
GACD - *Lung Diseases*	145		N/C	0.1%
Lung Diseases	101		N/C	0.0%
Lung Diseases-IS	23		N/C	0.4%
World Level				
Lung Diseases	206,905		5.3%	N/A
Lung Diseases-IS	5,416		9.8%	N/A
HICs				
Lung Diseases	139,254		3.3%	67.3%
Lung Diseases-IS	4,618		8.4%	85.3%
LMICs				
Lung Diseases	90,690		9.8%	43.8%
Lung Diseases-IS	1,603		17.3%	29.6%
3 GACD members (based on funders lists of publications)				
Lung Diseases	26,629		-1.1%	12.9%
Lung Diseases-IS	968		1.8%	17.9%
3 non-GACD members (based on Scopus Acknowledgements)				
Lung Diseases	3,489	N/C	23.1%	1.7%
Lung Diseases-IS	63	N/C	38.0%	1.2%
	Share of IS papers (within NCD papers)			
GACD	23%		N/C	8.7
World Level	3%		4.3%	1.0
HICs	3%		4.9%	1.3
LICs	2%		6.8%	0.7
3 GACD members (based on funders lists of publications)	4%		2.9%	1.4
3 non-GACD members (based on Scopus Acknowledgements)	2%	N/C	12.1%	0.7

Source: Produced by Science-Metrix using Scopus (Elsevier) data.

The following tables (Table 17 - Table 19) give a breakdown of scientific impact by disease area:

Table 17 Scientific impact of GACD and comparators in diabetes (2014-2019)

	Papers	FWCS	ARC	$HCP_{10\%}$	CDI	CDC
Diabetes						
GACD	91	1.62	2.99	3.13	23.3	
World level	191,542	1.03	1.18	1.26	4.6	
HICs	131,566	1.18	1.37	1.50	8.5	
LMICs	77,687	0.84	0.95	0.90	-0.8	
3 GACD members (non-GACD output)	23,558	1.58	2.10	2.51	21.1	
3 non-GACD members	3,363	1.58	2.03	2.22	17.8	
Diabetes-IS						
GACD	30	1.18	N/C	N/C	N/C	N/C
World level	5,847	1.15	1.41	1.46	7.9	
HICs	4,886	1.22	1.50	1.55	9.1	
LMICs	1,565	1.00	1.22	1.46	6.2	
3 GACD members (non-GACD output)	945	1.58	2.28	2.39	19.6	
3 non-GACD members	51	1.36	N/C	N/C	N/C	N/C

Abbreviations: Number of papers, field weighted CiteScore (FWCS), average of relative citations (ARC), highly cited publications (HCP) (10%), citation distribution index (CDI) and chart (CDC). Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

Table 18 Scientific impact of GACD and comparators in hypertension (2014-2019)

	Papers	FWCS	ARC	$HCP_{10\%}$	CDI	CDC
Hypertension						
GACD	133	1.69	2.30	1.48	14.9	
World level	145,720	1.06	1.14	1.12	3.5	
HICs	102,738	1.23	1.36	1.41	8.7	
LMICs	56,922	0.83	0.87	0.70	-4.1	
3 GACD members (non-GACD output)	17,656	1.69	2.16	2.46	22.4	
3 non-GACD members	2,039	1.71	2.03	2.25	18.9	
Hypertension-IS						
GACD	57	1.49	1.84	2.42	25.9	
World level	4,159	1.26	1.61	1.59	9.7	
HICs	3,403	1.36	1.78	1.74	12.4	
LMICs	1,392	1.13	1.17	1.43	4.8	
3 GACD members (non-GACD output)	614	1.71	3.25	2.66	23.4	
3 non-GACD members	40	1.64	N/C	N/C	N/C	N/C

Abbreviations: Number of papers, field weighted CiteScore (FWCS), average of relative citations (ARC), highly cited publications (HCP) (10%), citation distribution index (CDI) and chart (CDC). Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

Table 19 Scientific impact of GACD and comparators in lung diseases (2014-2019)

	Papers	FWCS	ARC	$HCP_{10\%}$	CDI	CDC
Lung Diseases						
GACD	101	1.53				
World level	206,905	1.04	1.20	1.22	3.3	
HICs	139,254	1.19	1.43	1.46	7.9	
LMICs	90,690	0.88	1.04	0.95	-1.9	
3 GACD members (non-GACD output)	26,629	1.62	2.29	2.55	22.0	
3 non-GACD members	3,489	1.60	2.05	1.97	17.6	
Lung Diseases-IS						
GACD	23					
World level	5,416	1.24	1.61	1.62	9.2	
HICs	4,618	1.32	1.77	1.81	11.8	
LMICs	1,603	1.15	1.75	1.17	1.8	
3 GACD members (non-GACD output)	968	1.56	2.08	2.46	21.5	
3 non-GACD members	63	2.55				

Abbreviations: Number of papers, field weighted CiteScore (FWCS), average of relative citations (ARC), highly cited publications (HCP) (10%), citation distribution index (CDI) and chart (CDC). Source: Prepared by Science-Metrix using Scopus (Elsevier) data.

Table 20 Share of papers by sector (2014-2019)

Group	Papers	Academic	Medical	Government	Private	Research Institute	Other
GACD SCD papers	300	98%	43%	22%	11%	30%	26%
3 GACD members (non-GACD output) SCD papers	300	95%	45%	12%	6%	32%	4%

Source: Produced by Science-Metrix using Scopus (Elsevier) data. Note that comparator SCD papers were randomly selected from the datasets to match GACD SCD papers to make the semi-automated process of sectorial categorisation more efficient. The groups Government, Research Institute and Other are associated with a higher level of uncertainty, given the challenges to code unambiguously those sectors.

Appendix C GACD survey analysis

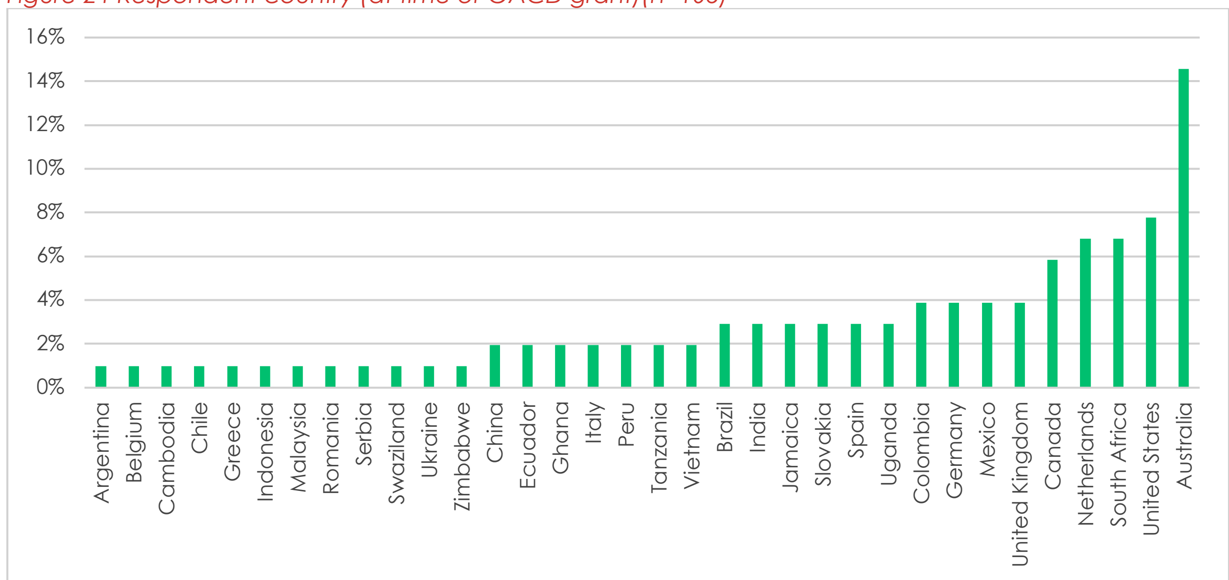
Overall 103 GACD project team members answered the survey. Of the 113 GACD projects, 45 were covered in the survey even though 30 respondents were unable to identify their project. One to four responses (average 1.6) were collected per project (discounting projects with no responses). Two-thirds (66%) of the respondents identified as female.

C.1. Respondent background

- **Respondent country**

Of the 103 respondents who took part in the survey, the highest number were from Australia (15%). This was followed by the USA (8%), the Netherlands and South Africa (each 7%) and Canada (6%).

Figure 24 Respondent country (at time of GACD grant)(n=103)

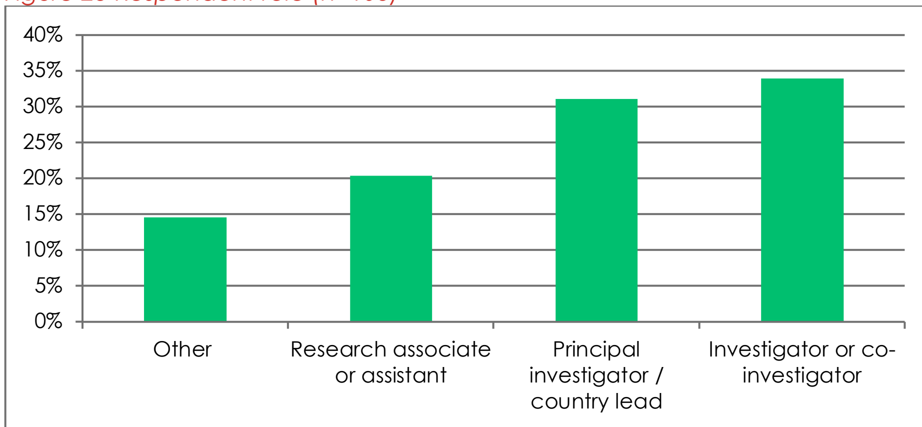


Source: Technopolis analysis of GACD survey

- **Respondent background**

The respondents were fairly evenly distributed in their project roles with investigators or co-investigators (34%) just ahead of principal investigators/country lead (31%) while research associates or assistants represented roughly a fifth of the respondents (20%). The responses of those who chose "other" can be aggregated into the following groups: project management (8%), PhD students/students (4%) and programme management (3%).

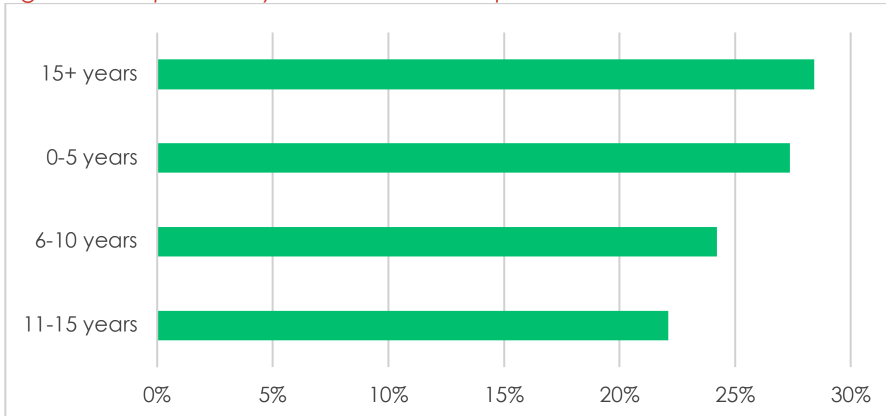
Figure 25 Respondent role (n=103)



Source: Technopolis analysis of GACD survey

In terms of years of research experience, early career researchers (those with 0-5 years of research experience) constituted the largest number of respondents (32%) followed by researchers with 6-10 years of experience (29%). Interestingly, nearly a fourth of the respondents were researchers with over 15 years of research experience (23%) while researchers with 11-15 years of experience were the smallest group (16%).

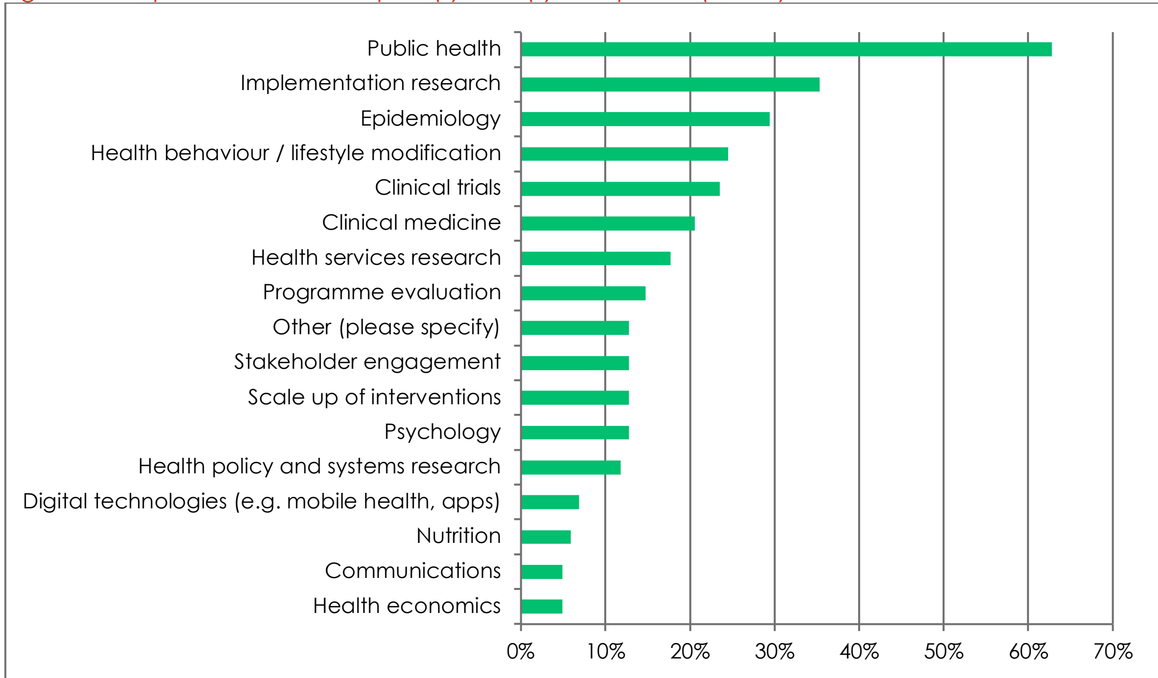
Figure 26 Respondent years of research experience at the start of the GACD grant (FTE)(n=95)



Source: Technopolis analysis of GACD survey

As for the main discipline(s)/area(s) of expertise of the respondents (multiple selection possible), the majority of respondents listed public health (63%) with the 2nd most common choice – implementation research – only selected by around half as many respondents (35%). Other commonly included expertise included: epidemiology (29%); health behaviour/lifestyle modification (25%); clinical trials (24%) and clinical medicine (21%).

Figure 27 Respondent main discipline(s)/area(s) of expertise (n=102)



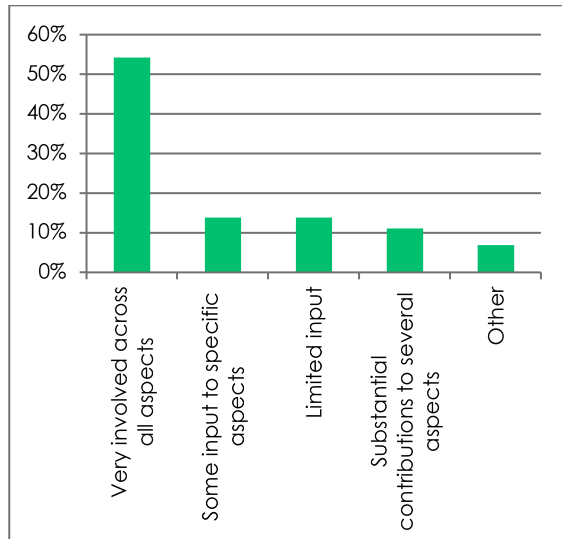
Source: Technopolis analysis of GACD survey

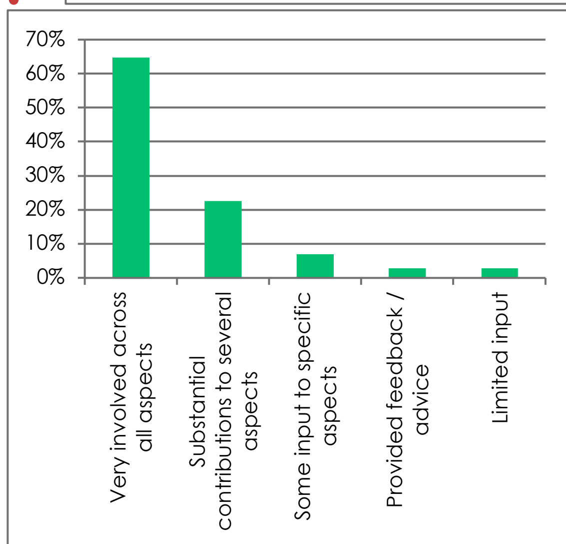
- **Involvement in project**

When asked to evaluate their level of involvement in the project, the majority of respondents indicated that they were very involved in the design of the project (54%, 39 of 72) and the delivery of the project (65%, 46 of 71). More respondents considered that they made substantial contribution to the delivery of the project (23%) than to the design (11%). And while 14% of respondents said they had limited input into the design, only 3% thought that they had limited input on the delivery.

Figure 28 Involvement in the design of the project, n=72 (a) and delivery of the project, n=71

(a) (b)





Source: Technopolis analysis of GACD survey

For 80% of respondents (n=71) their contribution to the project was in line with their expectations while 14% thought that it was mostly in line and only 6% indicated that their involvement did not meet their expectations.

C.2. GACD funding and activities

- **Main strengths of GACD funding and activities**

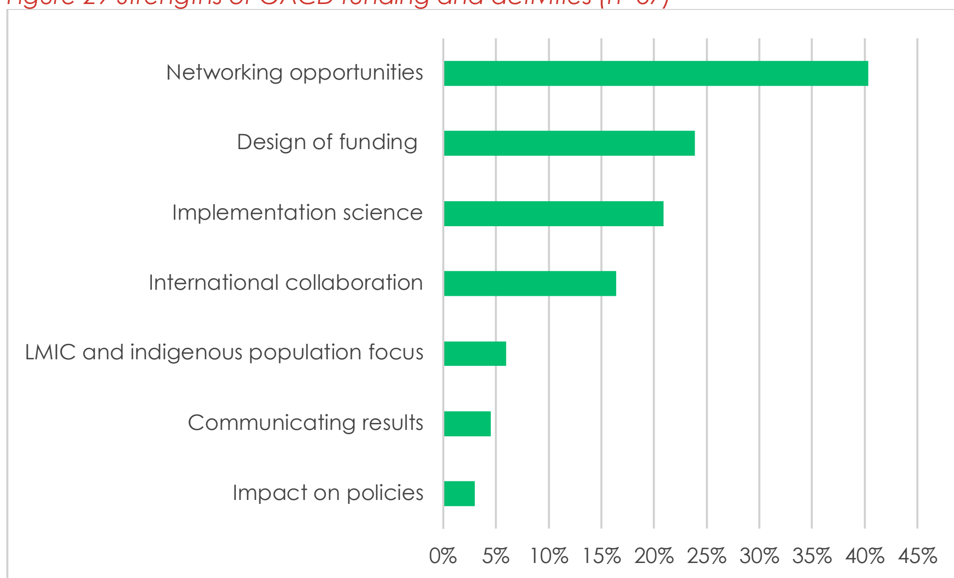
When asked to consider the strengths of GACD funding and activities 67 respondents provided qualitative answers. These were aggregated based on common themes, and where appropriate one response was attributed to multiple themes.

The most commonly mentioned strength of GACD was the networking opportunities provided (40%). These networking opportunities were appreciated for the capacity to link researchers together ("*Ability to network with others around the world to identify those with similar interests, both in terms of content areas as well as methodologies*") and translate the expanded networks into research collaborations ("*The network of professionals that has been created, because it promotes research collaborations*").

The GACD funding design was also a commonly mentioned strength (24%). Some respondents noted that GACD addresses funding gaps ("*It fills the gap by funding the projects on topics that may be not funded by other schemes, especially at national level*") while others appreciated how GACD creates a network of funding agencies and introduces common funding themes internationally ("*A major strength of the GACD is its network approach including launching a similar call in collaboration with several international funding agencies*").

Another noteworthy strength was the focus on implementation science (21%). Here, GACD's contribution was linked to increasing implementation science uptake – either in NCD research specifically ("*Provide platform & opportunities to help researchers for collaboration and training for implementation research (NCDs)*") or in general ("*Building common understanding of implementation science and a forum for people to share*").

Figure 29 Strengths of GACD funding and activities (n=67)



Source: Technopolis analysis of GACD survey

- **Main weaknesses of GACD funding and activities**

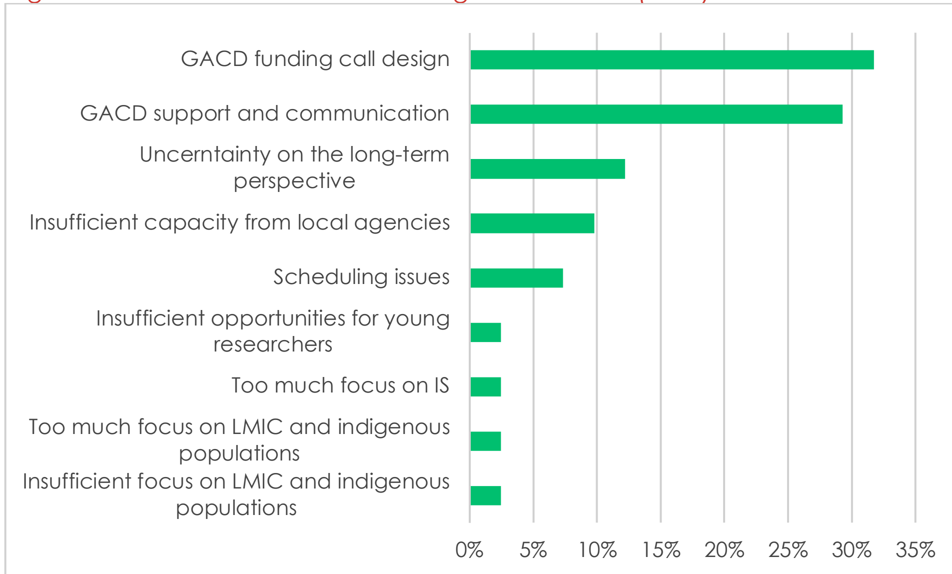
When it comes to weaknesses of GACD funding and activities, there was less agreement among the respondents (not to mention those who used the opportunity to say that there are no weaknesses). As before, the responses were aggregated based on common themes, and one response was attributed to multiple themes as appropriate.

The 2 most commonly discussed weaknesses were firstly the design of the GACD funding calls (32%) and secondly GACD support and communication (29%). Weaknesses related to funding calls were often connected to other issues, for example, inequalities in participation due to the funding being linked to national agencies ("*Differences in funding mechanisms make it difficult for all countries to participate in the same way*"), or variable performance of national funding agencies within GACD ("*GACD not having control over funding, some funders are unreliable*"). Insufficient capacity within local funding agencies is also among the weaknesses of the GACD (10%).

Weaknesses related to GACD support and communication linked to limited GACD involvement in the funding process ("*Communication and processes during application process could be complex and demanding with actual funding agencies in different parts of*

the world") and the management of the projects ("*Projects could have benefited from more engagement with one another and it would have been helpful to have a clearer understanding from GACD what their role in projects are and to have more active facilitation in our work*").

Figure 30 Weaknesses of GACD funding and activities (n=56)

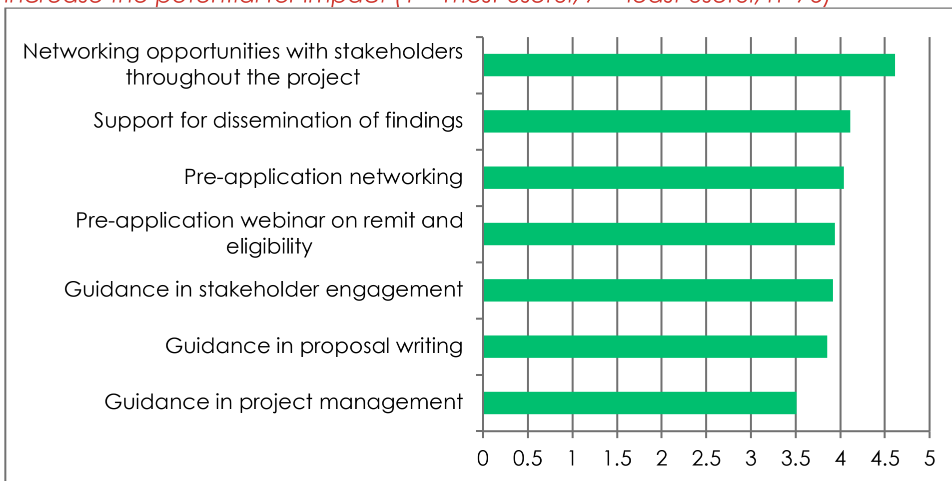


Source: Technopolis analysis of GACD survey

- **Further GACD support**

When asked to rate examples of additional GACD support activities that could be implemented (where 1 = most useful, 7 = least useful), the respondents generally considered that guidance for project management (score of 3.51) would be the most useful addition to GACD support (a sentiment echoed in the comments on GACD weaknesses). On the other hand, networking opportunities with stakeholders throughout the project were rated as the least useful potential addition to GACD support (score of 4.61).

Figure 31 Additional activities the GACD could support that would make research more effective and increase the potential for impact (1 = most useful, 7 = least useful; n=73)

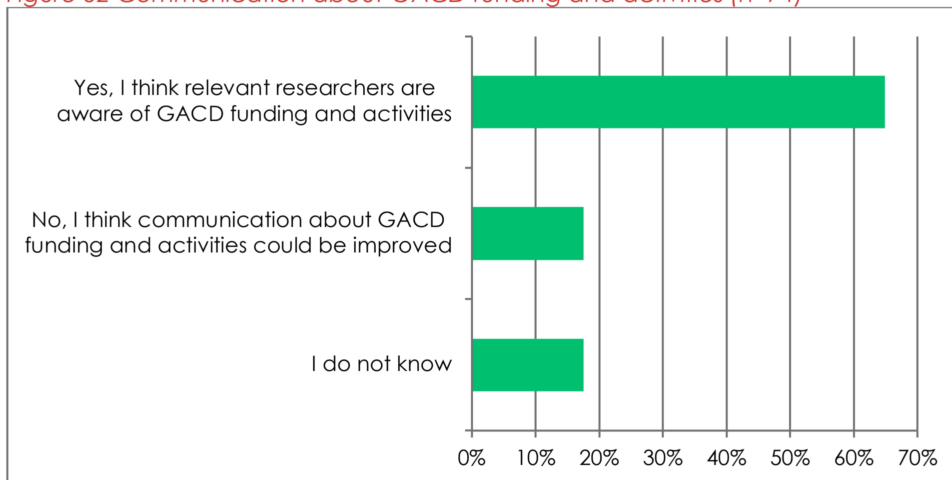


Source: Technopolis analysis of GACD survey

- **GACD communication channels**

When asked to consider whether GACD announcements (e.g. calls for proposals and other information on the GACD activities) are communicated through the right channels and reaching the relevant research communities, the majority of respondents (65%) thought that GACD communication activities are sufficient. However, 18% of the respondents felt the GACD's actions were not enough. Suggestions for improvement included increased communication through GACD social media and personalised messages ("*In addition to the promotion on the GACD website, send a message with the information of the new calls to the research groups that have previously participated*") or through local agencies ("*A partnership with national research agencies from low-income countries could increase participation of researchers from those countries*").

Figure 32 Communication about GACD funding and activities (n=74)



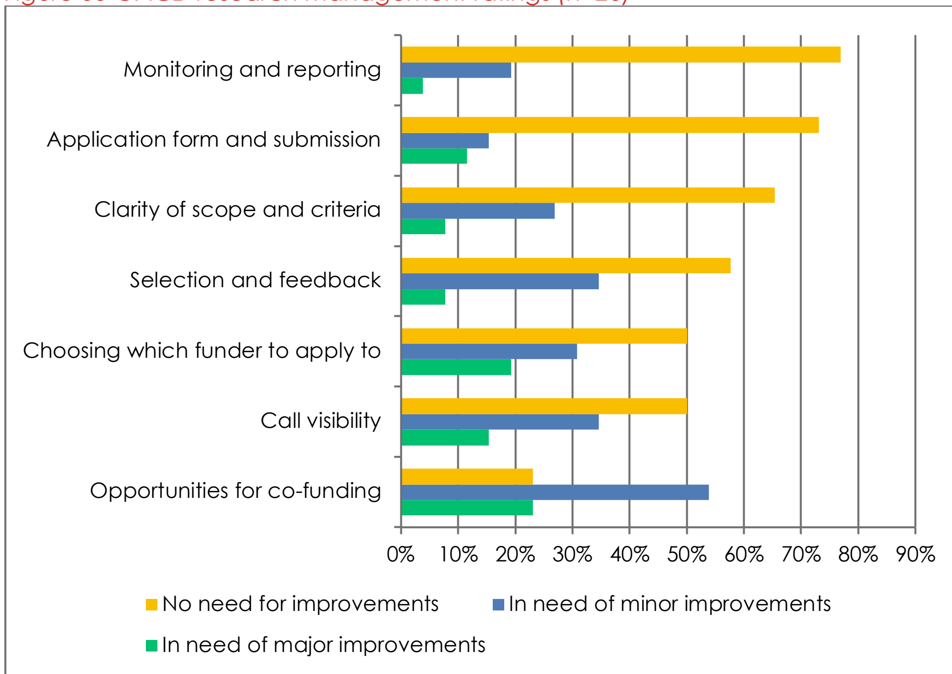
Source: Technopolis analysis of GACD survey

- **GACD research management**

Out of 27 respondents who commented on the GACD call design and requirements, 22 (81%) had no negative comments about these aspects.

Among research management aspects of the GACD, the majority of respondents felt that monitoring and reporting (77%) and application form and submission (73%) do not need further improvements. Opportunities for co-funding were in most need of change, with most respondents (77%) highlighting need for improvements (either major or minor). Call visibility and selection and feedback also seem in need of some work with respondents demanding minor improvements (35% each).

Figure 33 GACD research management ratings (n=26)



Source: Technopolis analysis of GACD survey

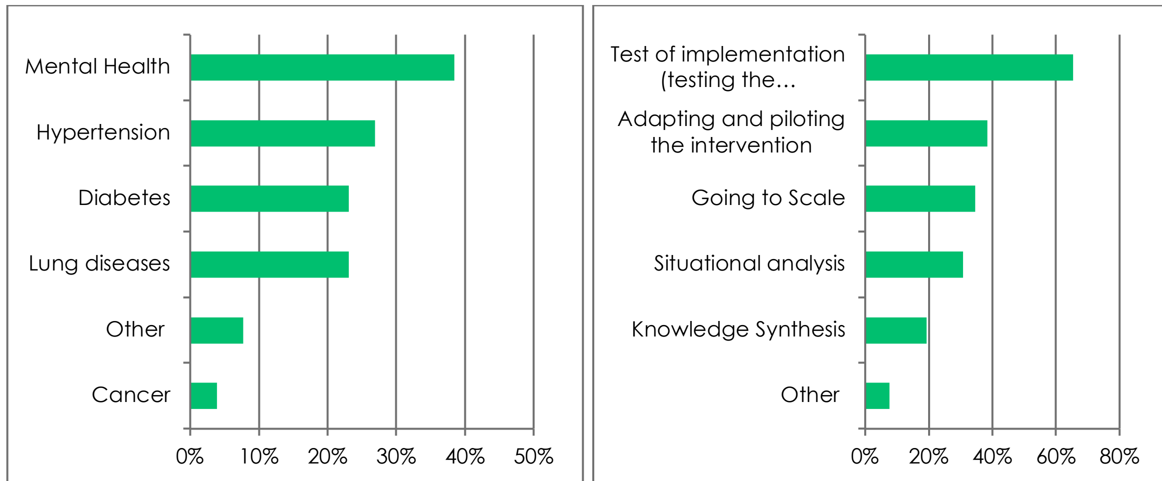
C.3. Profile of research projects

- **Project background**

In terms of disease areas, research projects were largely spread across mental health (38%), hypertension (27%), and diabetes and lung diseases (23% each). This reflected the GACD research programmes' focus.

Figure 34 Project focus in terms of disease areas (a) and implementation science (n=26)

(a) (b)



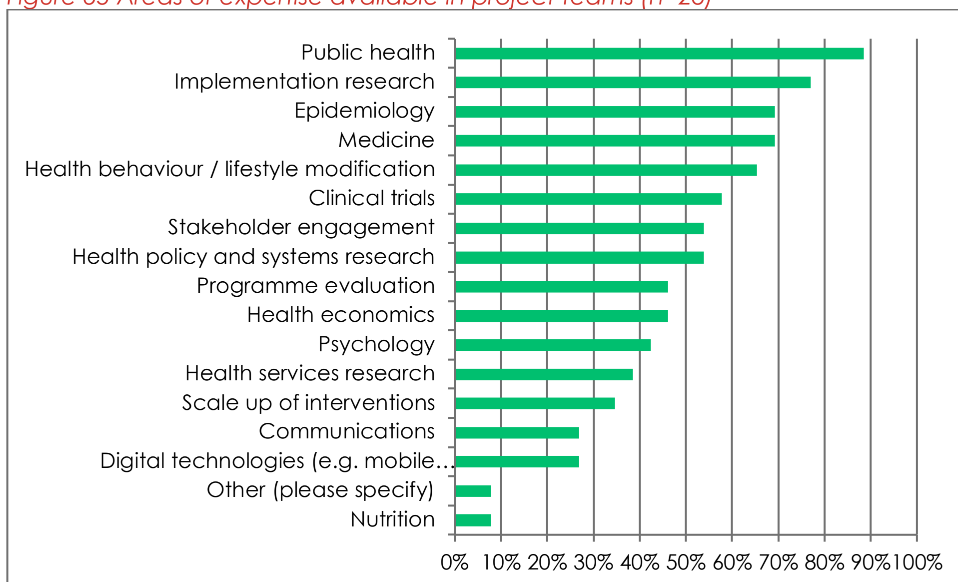
Source: Technopolis analysis of GACD survey

As for implementation science, the majority of projects used implementation science to test implementation of interventions (testing the intervention in real-world settings – implementation outcomes) (65%). Adapting and piloting the intervention (38%), going to scale (35%) and situations analysis (31%) was involved in roughly a third of the projects. Knowledge synthesis was less of a focus (19%).

- **Areas of expertise**

The majority of respondents suggested that their projects involved expertise in public health (88%) and implementation research (77%). Epidemiology and medicine were also highly represented in project teams (69% each) followed by health behaviour/lifestyle modification (65%). Nutrition (8%), digital technologies (27%) and communications (27%) expertise was least represented in research teams.

Figure 35 Areas of expertise available in project teams (n=26)



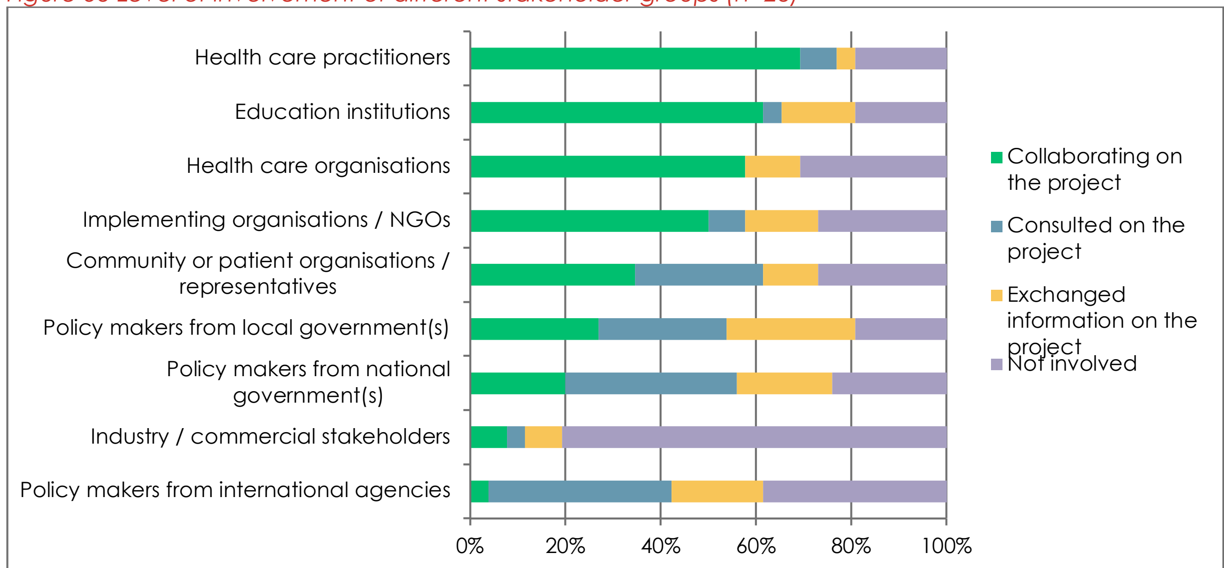
Source: Technopolis analysis of GACD survey

C.4. Stakeholder involvement

- **Level of stakeholder involvement**

Health care practitioners, education institutions, health care organisations and implementing organisations / NGOs were mostly likely to be collaborating on projects (close involvement) with 50% or more respondents stating that they collaborate with these stakeholder types in their projects. The lowest level of involvement was attributed to industry/commercial stakeholders (75% respondents report no involvement of this stakeholder type in their projects). Policy maker involvement was most varied with cooperation ranging from collaboration to consultation or information exchange. Policy makers from local government(s) were more likely to be collaborating than policy makers from national government(s) or international agencies who were more likely to be consulted on the project. Moreover, local policy makers were more frequently involved in projects, followed by national policy makers and then international policy makers.

Figure 36 Level of involvement of different stakeholder groups (n=26)

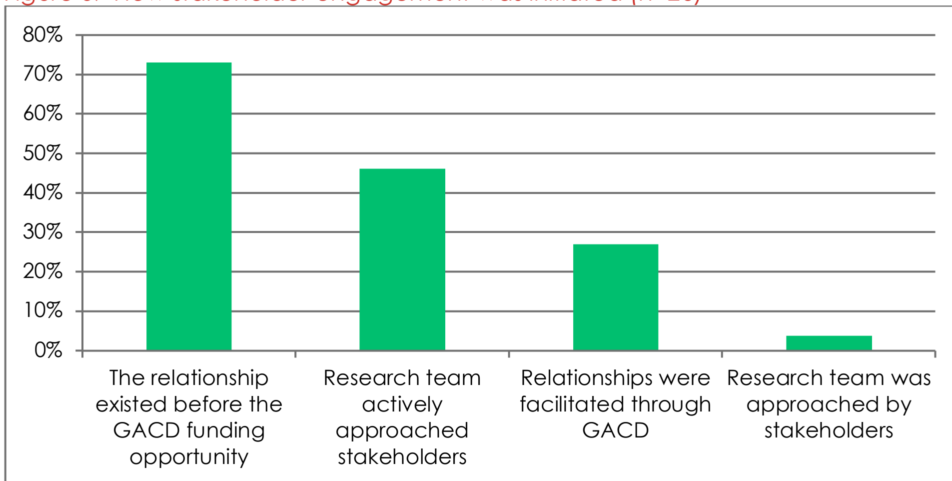


Source: Technopolis analysis of GACD survey

- **Stakeholder engagement routes**

When asked how the stakeholders became involved in the project, many of the respondents indicated that they had prior relationships with the stakeholders before the GACD funding opportunity came up (73%). However, nearly half of the respondents also showed that their projects involved new stakeholders that their research team actively approached (46%). This shows that while projects tended to leverage existing relationships, GACD fostered new relationships as well. In fact, over a quarter of the respondents (27%) stated the relationships with stakeholders were facilitated by GACD. Furthermore, 81% of the respondents (n=26) had a stakeholder engagement plan in their project, with 80% (n=25) indicating that the plan was useful or very useful for the project.

Figure 37 How stakeholder engagement was initiated (n=26)

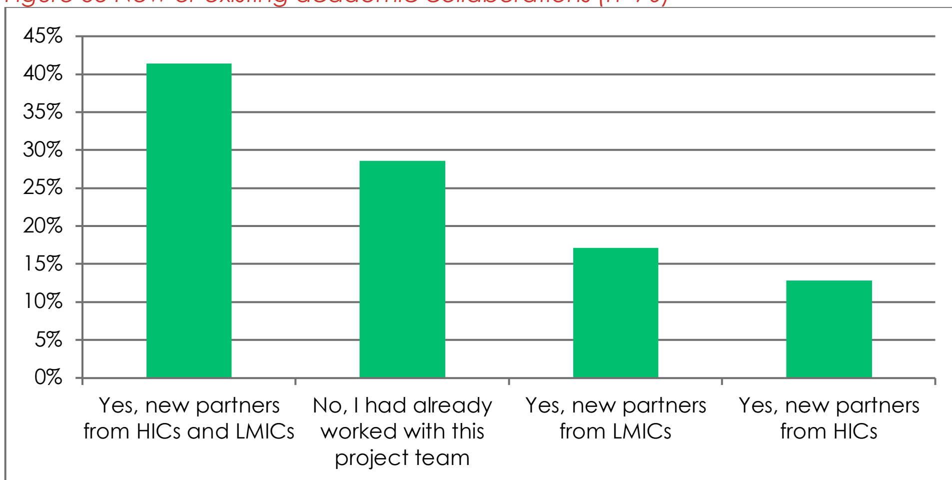


Source: Technopolis analysis of GACD survey

- **Collaboration with new academic partners**

Many of the survey respondents were able to expand their networks with new academic partners from both HICs and LMICs (41%). Some respondents were able to form new partnerships with academics only from LMICs (17%) or only from HICs (13%). However, over a fourth of the respondents did not connect with new academic partners (29%).

Figure 38 New or existing academic collaborations (n=70)

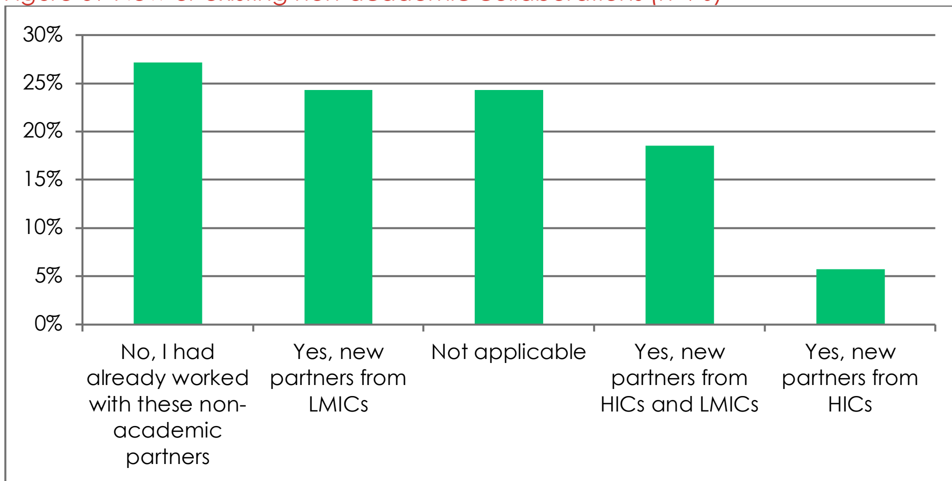


Source: Technopolis analysis of GACD survey

- **Collaboration with non-academic partners**

In terms of non-academic partners, the largest number of respondents leveraged partnerships with stakeholders they had already worked with (27%). Interestingly, GACD projects appear to have fostered a larger number of non-academic partnerships with LMICs (24%) than with both HICs and LMICs (19%). This is understandable owing to GACD's greater LMIC focus, and is confirmed by the relatively lower number (6%) of HIC partnerships leveraged – considerably lower than new academic partners from HICs.

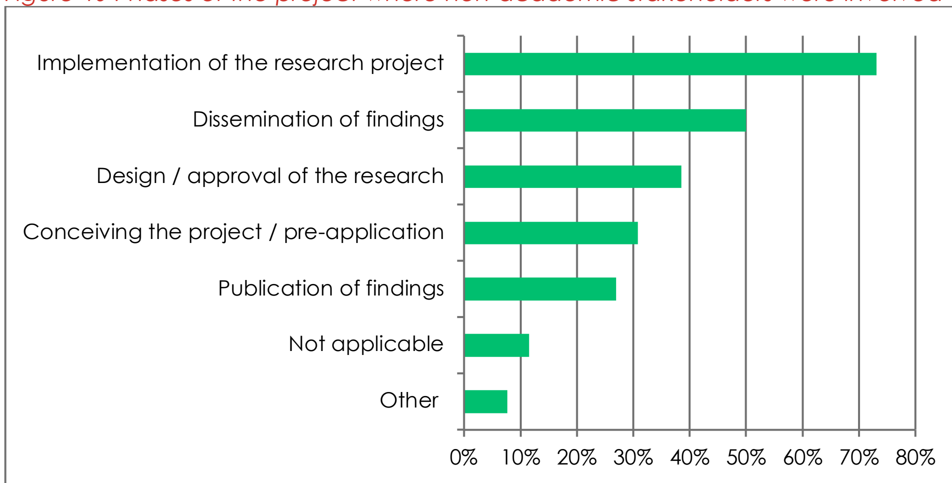
Figure 39 New or existing non-academic collaborations (n=70)



Source: Technopolis analysis of GACD survey

The majority of the responses suggest non-academic stakeholders are mainly involved with implementation of the research project (73%). In half of the cases (50%) the stakeholders were also involved in dissemination of findings, suggesting their importance in increasing the impact of the projects. Stakeholders also provided input in the design/approval of research (38%).

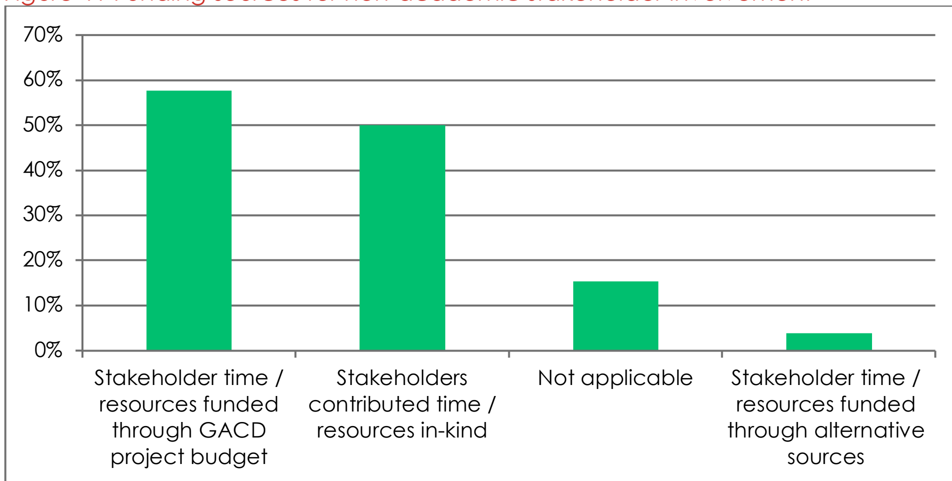
Figure 40 Phases of the project where non-academic stakeholders were involved (n=26)



Source: Technopolis analysis of GACD survey

The non-academic stakeholder involvement was largely funded through the GACD project budget (58% of responses). Furthermore, only 4% of respondents indicated that stakeholder involvement was funded through alternative sources. While GACD made the major financial contribution, stakeholders also contributed time/resources in-kind (50% of responses).

Figure 41 Funding sources for non-academic stakeholder involvement

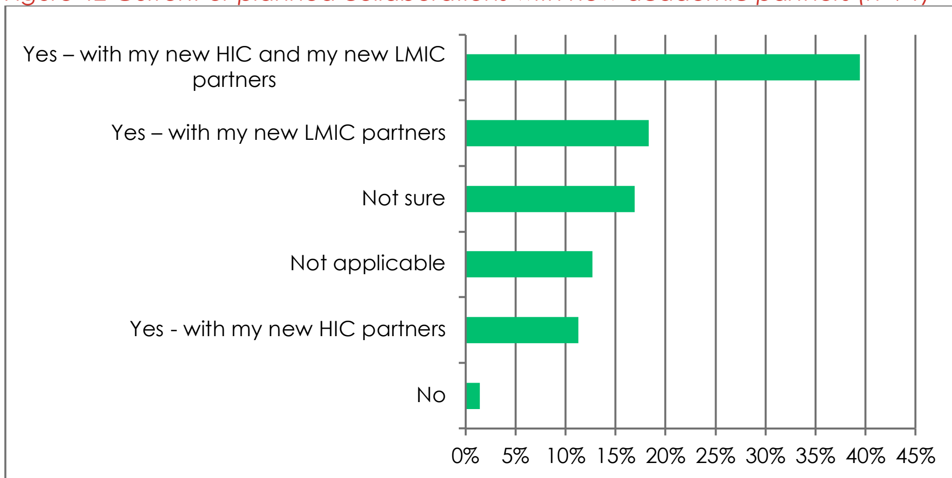


Source: Technopolis analysis of GACD survey

- **Further collaboration with academic and non-academic partners**

Asked to report whether they are, or are planning to, collaborate with the academic partners they met through the GACD-funded grant, respondents most frequently suggested they are or will continue collaborating with their new HIC and LMIC partners (39%). Similarly, respondents also are collaborating or planning to collaborate with their new LMIC (18%) or HIC partners (11%). Only a small percentage of respondents (1%) said they would not continue with the collaborations.

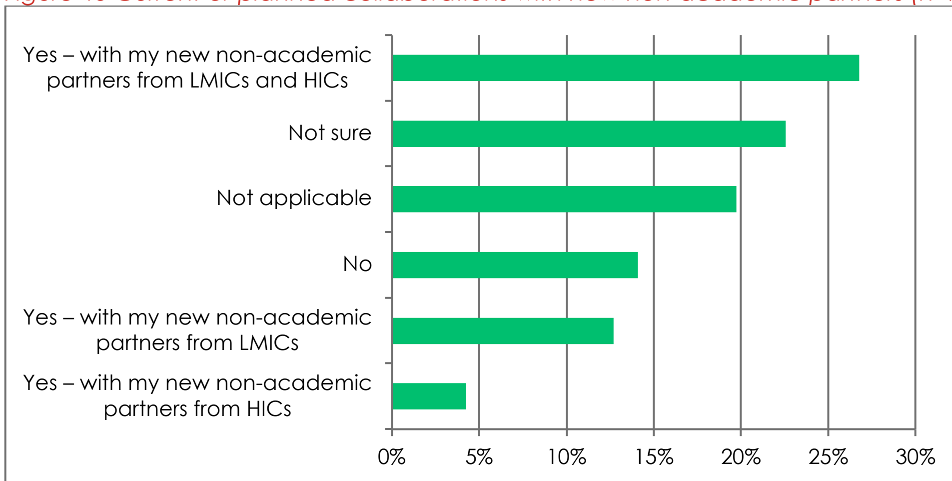
Figure 42 Current or planned collaborations with new academic partners (n=71)



Source: Technopolis analysis of GACD survey

Respondents indicated they would collaborate or plan to collaborate with new non-academic partners from both HICs and LMICs (27%), from LMICs only (13%) or HICs only (4%). This is a much smaller proportion compared to academic collaborations responses, with 14% of respondents stating that there are no current or planned collaborations with non-academic stakeholders they first encountered in their GACD project. A large proportion of respondents also indicated that they were not sure (23%) or the question was not applicable (20%) suggesting that there is uncertainty around sustainability of these newly formed networks.

Figure 43 Current or planned collaborations with new non-academic partners (n=71)



Source: Technopolis analysis of GACD survey

C.5. Project impacts

- **Impacts on research groups and/or institutions**

The respondents were asked to evaluate the extent to which participation in GACD-funded projects and activities led to impacts on the research group/institution (weighted average where high scores equal larger impact).

Figure 44 Extent to which GACD-funded project and participation in GACD activities led to the following impacts for research group/institution, weighted average (n=70)

Source: Technopolis analysis of GACD survey

The largest impact was evident in the extension of networks (weighted average of 3.32), further showing the GACD's impacts on networking. Furthermore, research experience and training within the GACD has resulted in improved knowledge and technical skills to undertake implementation research (weighted average of 3.14), while a considerable number of respondents reported that their GACD participation led to improved research leadership capabilities (weighted average of 2.99). The spill-over effect on GACD project participants' institutions appears to be less evident (weighted averages between 2.58 and 2.72). Career development was least impacted according to the survey responses (weighted average of 1.76).

- **Research findings**

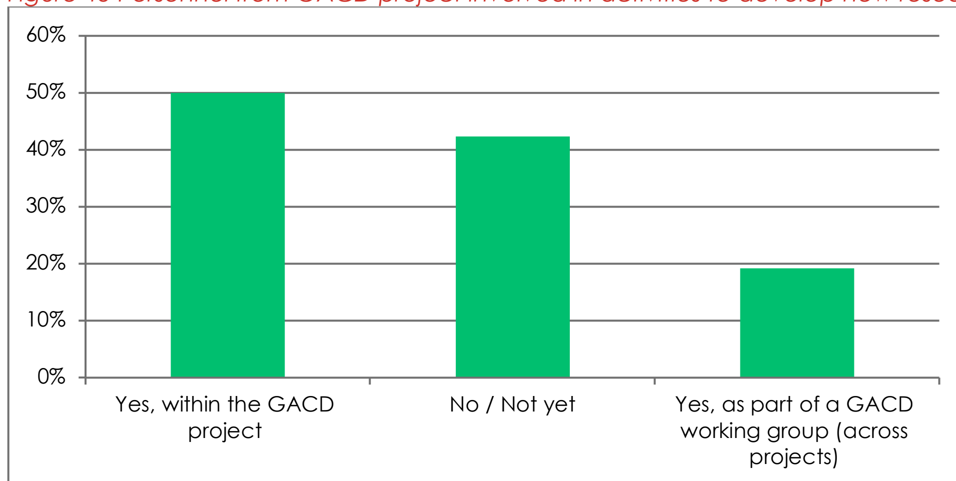
Half of the respondents (50%, n=26) indicated that their GACD-funded project resulted in research findings. Examples of research findings reported related to tobacco control ("*At least 20 research publications; key finding: the poor are not hurt by tobacco control, but they are hurt by tobacco use*"), mental health research ("*Implementation of a community intervention to improve effective access to mental health services in the communities of Chiapas*"), and healthcare worker training ("*Training primary health care providers increases the proportion of their patients whose alcohol consumption is measured ten-fold*").

56% (n=25) of the respondents had a pathway to impact for their project; 28% of respondents were not aware of such a plan in their project and 16% had no such plan. Of those that had a pathway to impact plan, 81% (n=16) of respondents considered the plan useful or very useful for achieving the impacts and 19% thought it was not useful at all.

- **Developing new research resources**

Half of the survey respondents (50%, n=26) were in projects where team members were involved in activities to develop new research resources, while nearly a fifth (19%) had personnel who were part of GACD working groups developing research resources. The most common type of research resources being created were data sets, followed by training material and research protocols.

Figure 45 Personnel from GACD project involved in activities to develop new research resources (n=26)

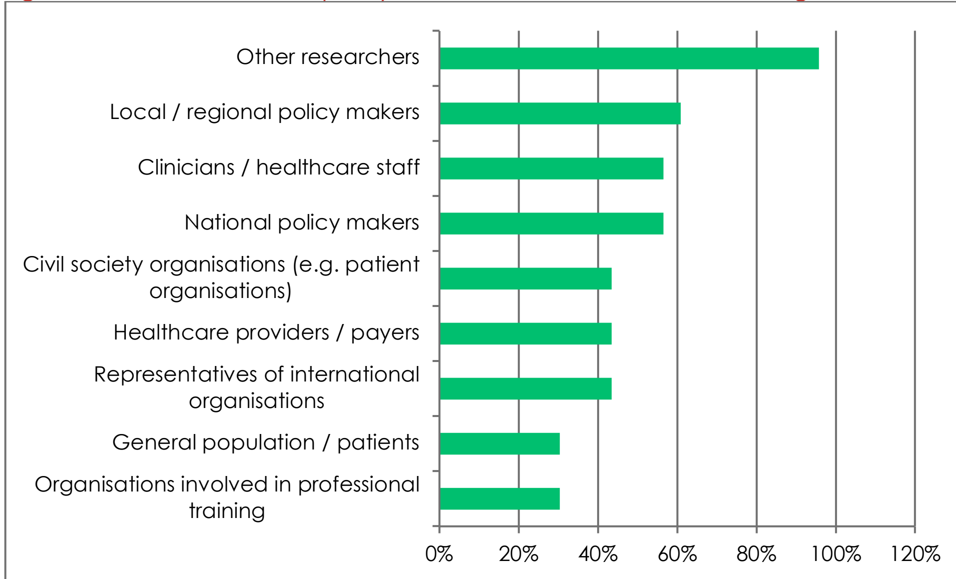


Source: Technopolis analysis of GACD survey

- **Sharing research findings with stakeholders and policy makers**

Unsurprisingly, the majority of respondents had shared the research findings with other researchers (96%). Local and regional policy makers cam next (61%) closely followed by national policy makers and clinicians/healthcare staff (each at 57%). Thus, GACD funded research is being disseminated to policy makers and practitioners.

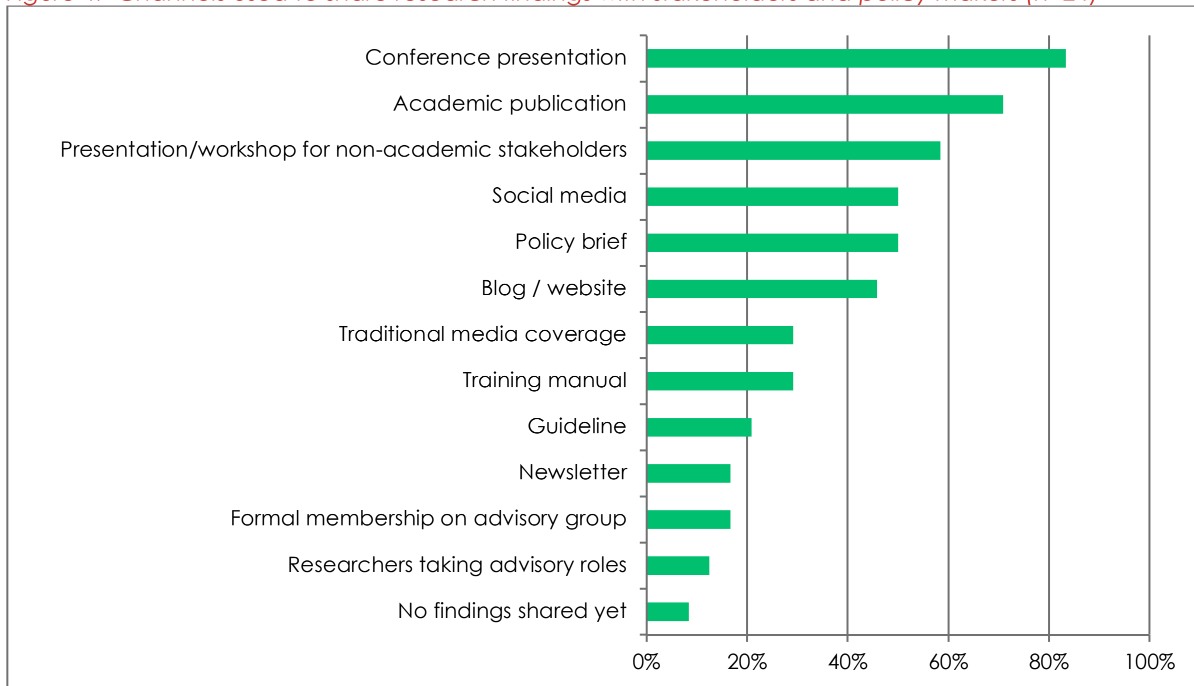
Figure 46 Stakeholders and policy makers with whom research findings were shared



Source: Technopolis analysis of GACD survey

Research findings were most commonly shared with stakeholders through conference presentations (83%) followed by academic publications (71%) and presentations to/workshop with non-academic stakeholders (58%). Social media was used by half (50%) of the respondents as a way to communicate research findings. Findings from few projects were disseminated through researchers taking on advisory roles for decision makers (13%) or formal memberships on advisory groups (17%).

Figure 47 Channels used to share research findings with stakeholders and policy makers (n=24)



Source: Technopolis analysis of GACD survey

With regard to advocacy, policy or communications support, an equal number of respondents (31% each, n=26) indicated that their project had either costed for dedicated advocacy, policy or communications specialists or such a specialist was already available to them, while 38% of the respondents did not include such a role in their projects.

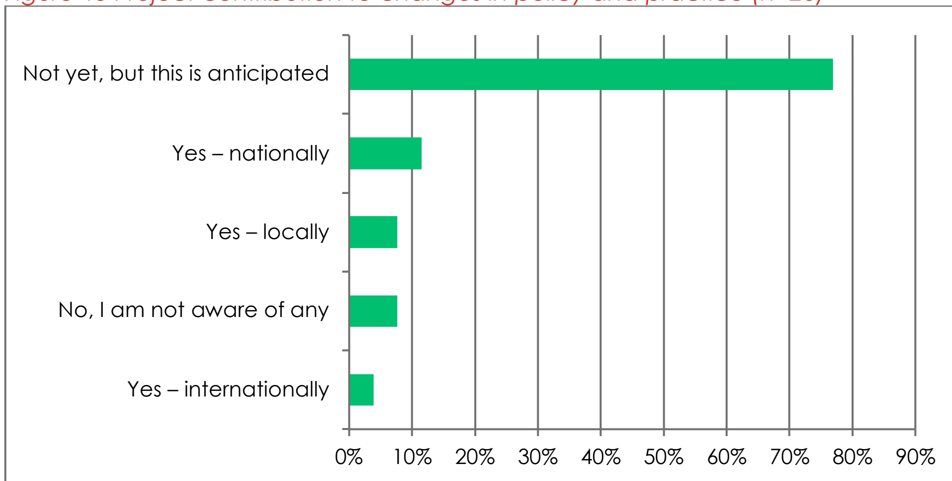
- **Use of project results by other researchers**

When asked whether they were aware of other researchers taking up project findings, or using new tools, databases, training materials, implementation pathways or methodologies developed as part of their GACD-funded project, 32% (n=25) of the respondents indicated they knew of such researchers while 68% were not aware. Notable examples of such uptake include contributing to existing research ("*Our project has contributed to improvement of methods of the Global Burden of Disease project from IHME (at UW)*") and providing material that is adapted for training ("*Other researchers have used our training materials as a template to deliver their own education*").

- **Research results contributing to policy and practice**

In their evaluation whether the projects contributed to any changes in policy and practice, the majority of PI respondents (77%, n=26) indicated that their projects have not yet resulted in such changes but they do anticipate such outcomes. Of the projects that have resulted in changes, the largest number (12%) occurred on the national level ("Our findings were incorporated in the national TB guidelines and strategic plans in Pakistan"), while changes at the international level (4%) were less visible, even though notable contributions on the international level were reported ("Results have been used in many countries and sub-national jurisdictions in the discussion of new legislation for tobacco control, including WHO reports").

Figure 48 Project contribution to changes in policy and practice (n=26)

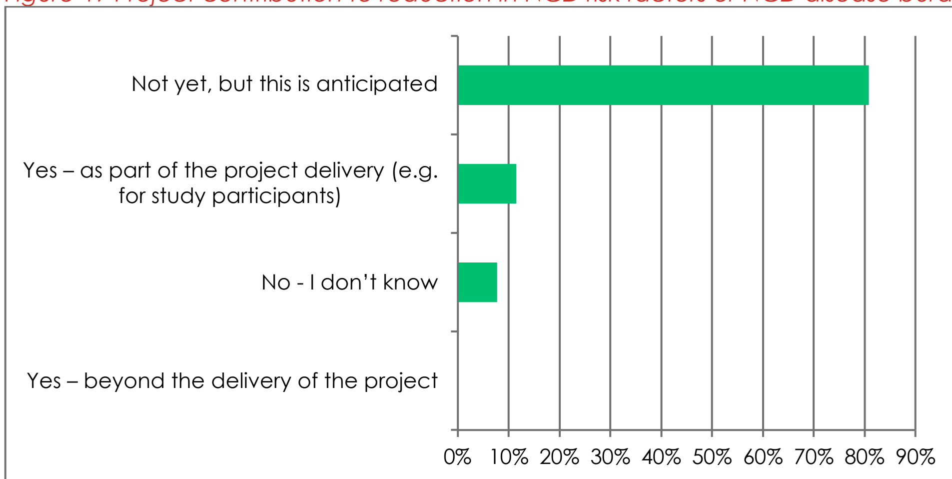


Source: Technopolis analysis of GACD survey

- **Research results contributing to reduction in NCD risk factors or NCD disease burden**

In terms of reducing NCD risk factors or NCD disease burden, none of the PIs could say for certain that their projects achieved this beyond the delivery of the project; however, 12% (3 PIs) did suggest that as part of project delivery these outcomes did occur. Furthermore, 81% (21) of respondents did indicate that they expect their projects to contribute towards this.

Figure 49 Project contribution to reduction in NCD risk factors or NCD disease burden (n=26)

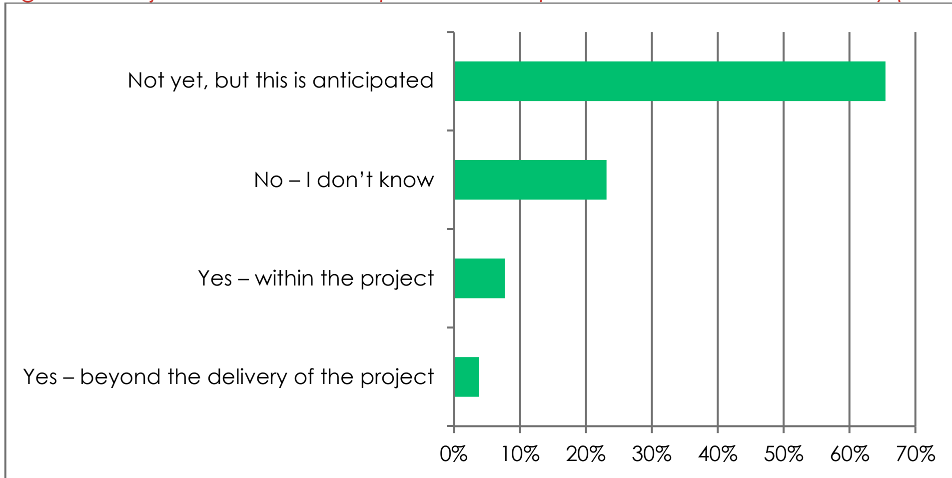


Source: Technopolis analysis of GACD survey

- **Research results contributing to public health policies or healthcare delivery**

Projects' contribution to public health policies or healthcare delivery was evaluated in terms of cost savings or enhanced efficiency, effectiveness, or equity. 8% (2) of respondents indicated that they achieve these contributions within the project while 4% (1) knew of such examples beyond the delivery of the project. However, 65% (17) also suggested that this contribution is expected.

Figure 50 Project contribution to public health policies or healthcare delivery (n=26)



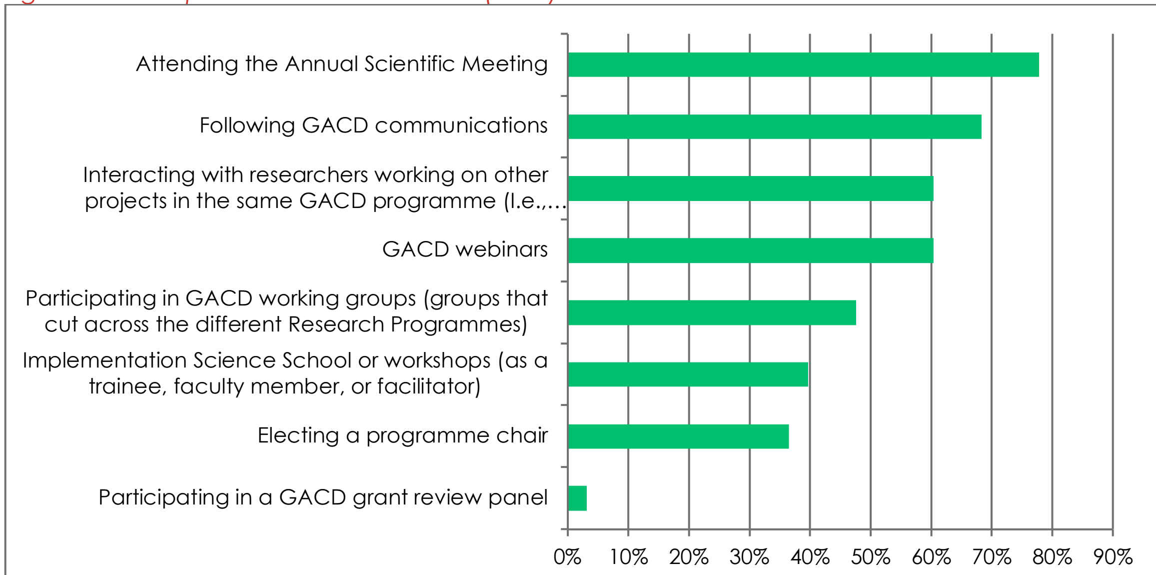
Source: Technopolis analysis of GACD survey

C.6. GACD activities

- **Participation in GACD activities**

The GACD activity that achieved the highest respondent attendance was the annual scientific meeting (78%) – in fact it surpassed following GACD communications (68%) which both speak about the strength of the annual meeting and perhaps the need to evaluate the GACD communication. 40% of respondents indicated that they took part in the Implementation Science School., while 60% participated in GACD webinars and interacting with researchers within the same GACD programme both achieved. The latter emphasises the role of the GACD in facilitating research networking.

Figure 51 Participation in GACD activities (n=63)

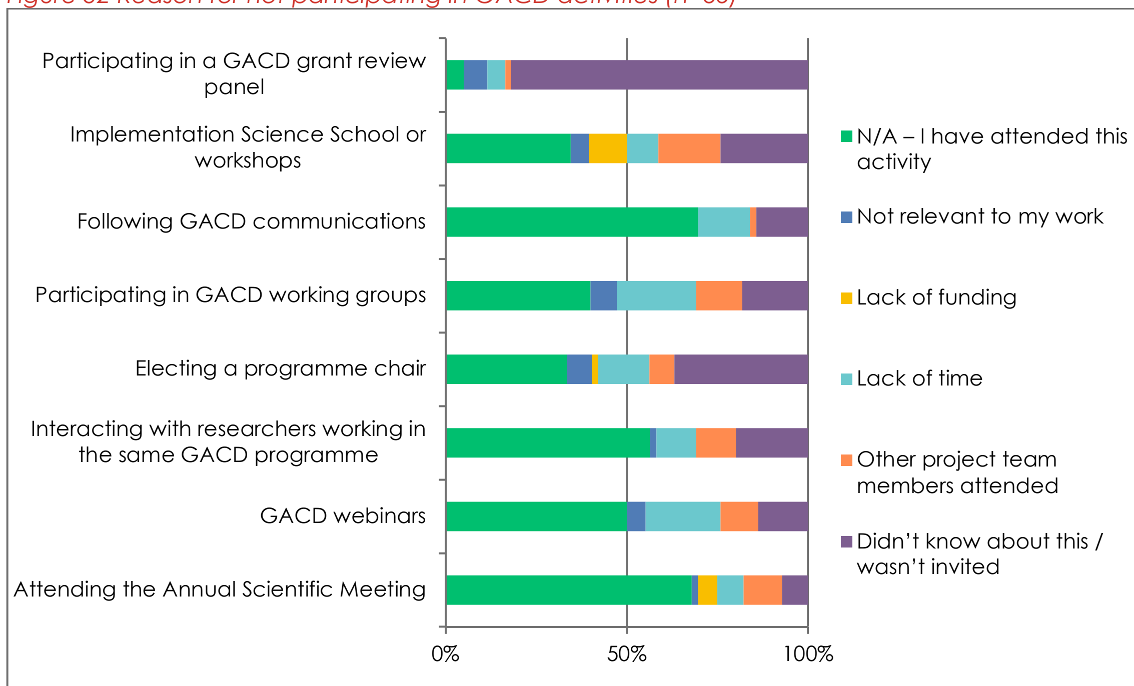


Source: Technopolis analysis of GACD survey

The reasons for not participating in GACD activities varied from activity to activity depending on the context. For example, while 82% of the respondents did not know about or were not

invited to the GACD grant review panel, this activity is not meant to be open to all researchers. However, 24% of respondents were also unaware of the Implementation Science School or workshops and 20% did not know about opportunities to interact with researchers working on other projects in the same GACD programme. These results do suggest that GACD communication about such opportunities may need improvement. Lack of funding most commonly affected attendance in Implementation Science School or workshops (10%) and Annual Scientific Meeting (5%). Lack of time contributed to respondents' being unable to participate in GACD working groups (22%) and GACD webinars (21%).

Figure 52 Reason for not participating in GACD activities (n=63)

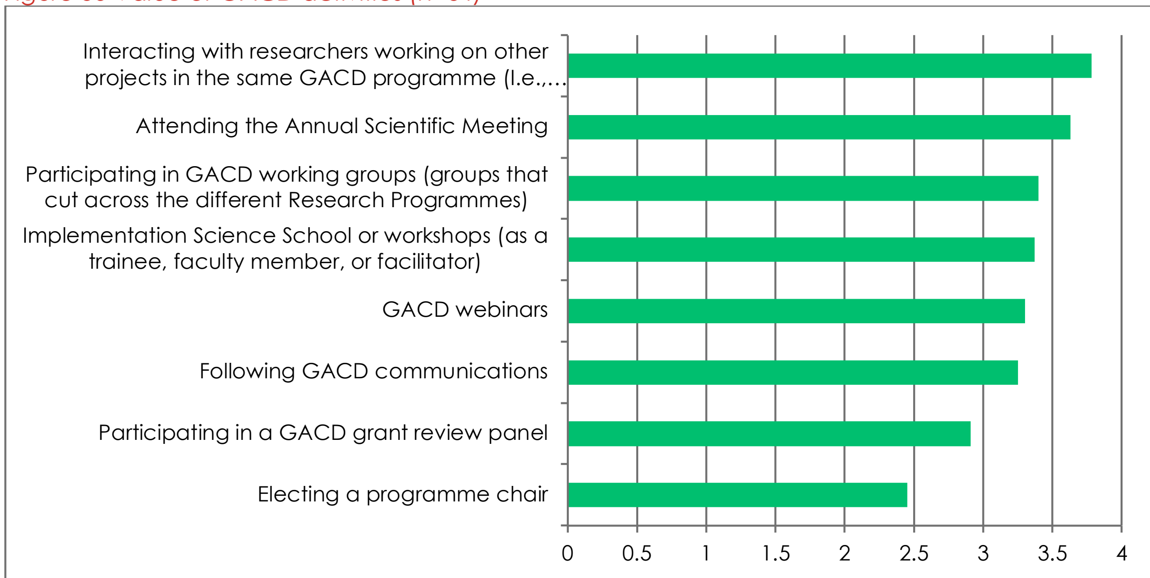


Source: Technopolis analysis of GACD survey

- **Value of GACD activities**

When asked to consider the value of GACD activities (results presented as weighted averages where a high score equals a higher value), opportunities to interact with researchers working on other projects in the same GACD programme (weighted average of 3.8), annual scientific meetings (weighted average of 3.6) and GACD working groups (weighted average of 3.4) were among activities that the respondents considered most valuable.

Figure 53 Value of GACD activities (n=64)

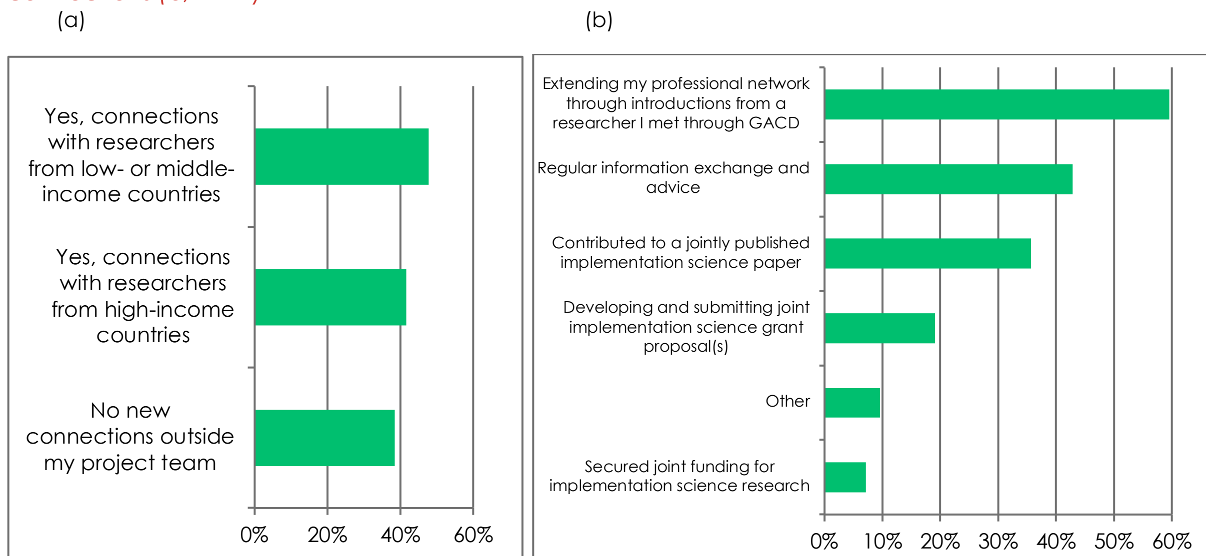


Source: Technopolis analysis of GACD survey

- **Establishing connections**

When asked whether they were able to form new connections outside of their research team, 48% of the respondents indicated that they formed new connections with researchers from LMICs while 42% indicated the same for researchers from HICs. Most commonly these connections were used to extend the professional network through introductions from a researcher met through GACD (60%) and regular information exchange and advice (43%). While over a third of these new relationships did contribute to a jointly published implementation science paper (36%), only a fifth of the relationships led to developing and submitting joint implementation science grant proposal(s) (19%) and even fewer allowed to secure joint funding for implementation science research (7%).

Figure 54 New connections with researchers outside of the project team (a, n=65) and nature of such connections (b, n=42)

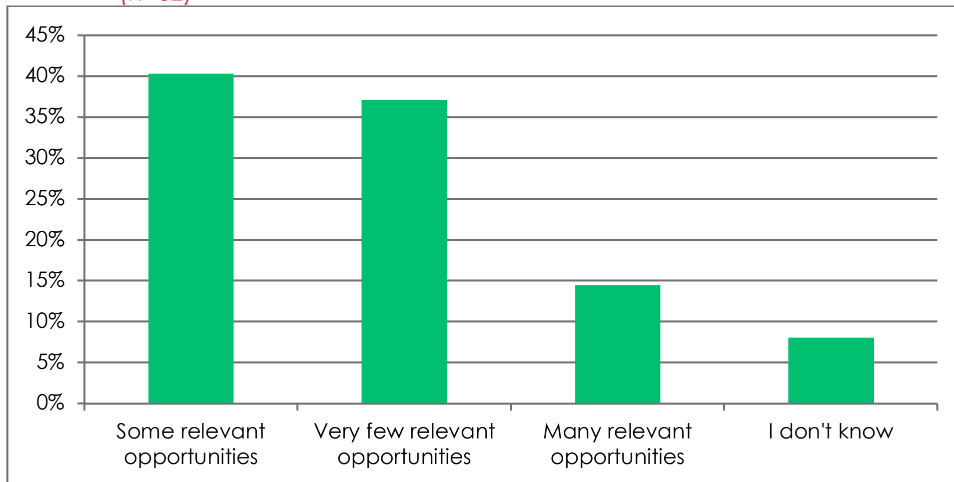


Source: Technopolis analysis of GACD survey

- **Opportunities outside of GACD to establish connections in implementation science in NCDs**

When asked to rate the opportunities outside of GACD to connect with researchers in implementation science in NCDs, many of the respondents felt that there are some relevant opportunities (40%) while a comparable number believed there are very few such opportunities (37%). While 15% knew of many opportunities, 8% were not aware of any. The results showcase the considerable role GACD has in establishing researcher networks for implementation science in NCDs.

Figure 55 Opportunities outside GACD to connect with researchers in implementation science in NCDs (n=62)



Source: Technopolis analysis of GACD survey

- **Impacting delivery of project results and the pathway for project impacts**

For 25% of respondents the GACD activities had a great impact on the delivery of their research project while for 44% there was some impact and finally 31% did not see any impact (n=64).

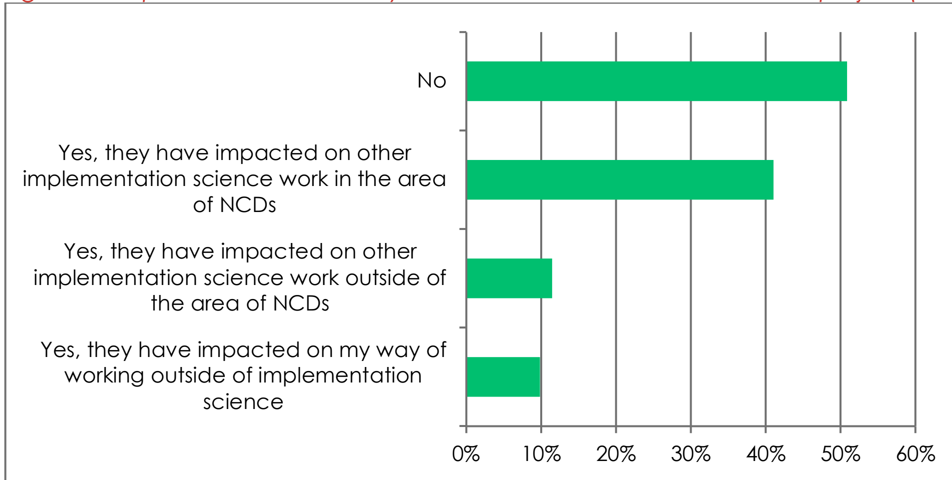
Often, these impacts were achieved due to the networking enabled by the GACD activities as the ability to share knowledge and have other researchers as sounding boards impacted the respondents research approach ("*Networking with other investigators at scientific meeting has influenced project design and implementation*"). Others highlighted how the Implementation Science School and workshop affected the quality of their research ("*Implementation Science workshops have improved the quality of our research*").

When asked if GACD activities facilitated the pathway to impact, 40% believed that the activities contributed to some extent while 16% believed the contribution was significant (n=25). Lastly, 44% did not think that the GACD activities facilitated the pathway for their project impacts.

- **Impacting work outside of the GACD-funded project**

While the majority of the respondents did not think that GACD activities had an impact on their work outside of the GACD-funded project (51%), a similar number also indicated that the GACD activities have impacted on other implementation science work in the area of NCDs (41%) and a smaller number considered the same to be true for work outside of the area of NCDs (11%).

Figure 56 Impact of GACD activity on work outside the GACD-funded project (n=61)

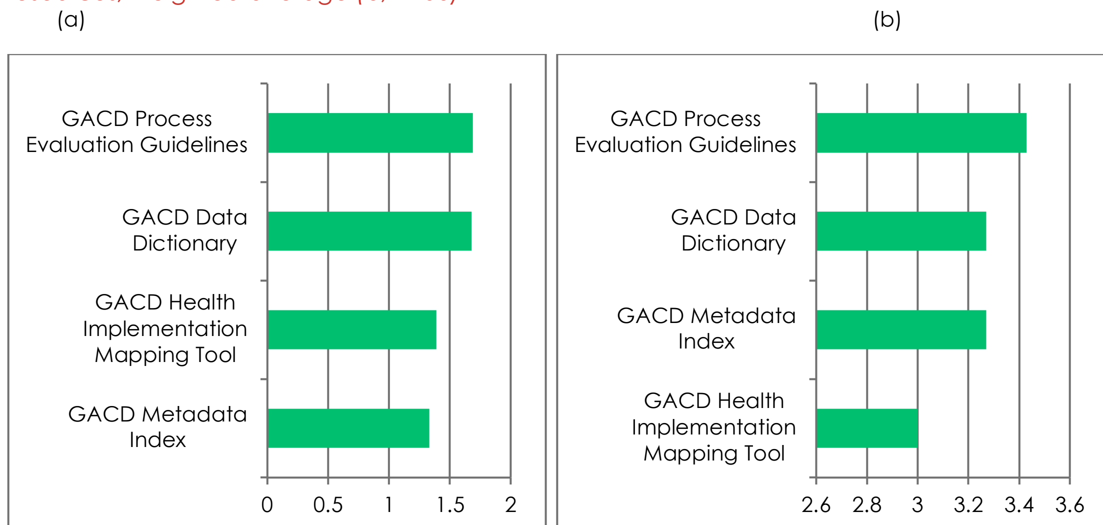


Source: Technopolis analysis of GACD survey

C.7. GACD resources

The survey also explored whether respondents knew of or had used GACD platforms and resources and whether they thought they were valuable (based on weighted average where high score equals to higher knowledge and use or value). The Process Evaluation Guidelines were the most known/used resource (weighted average of 1.69) and the most valued resource (weighted average of 3.43). The GACD Metadata Index was the least known and used resource (average score of 1.33) and the Health Implementation Mapping Tool was the least valued resource (3). Five individuals commented that they were not aware of the resources or had found it difficult to access them. One individual suggested that the Metadata Index should be expanded to include other areas.

Figure 57 Knowledge/use of GACD resources, weighted average (a, n=61) and value of GACD resources, weighted average (b, n=56)



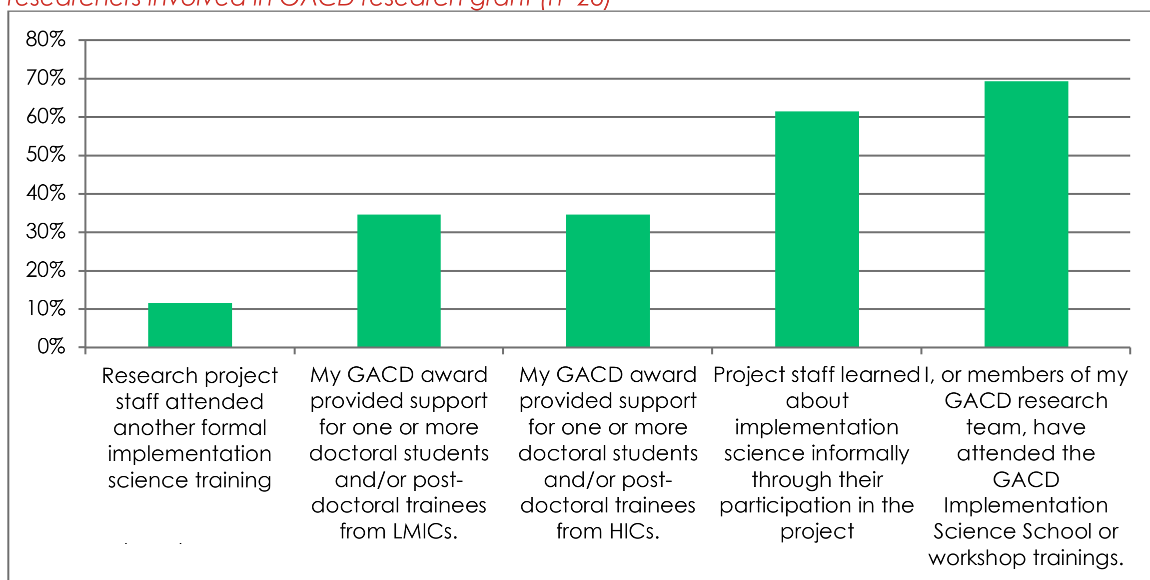
Source: Technopolis analysis of GACD survey

C.8. Training opportunities

- **GACD training opportunities in implementation science**

Across the survey respondents, the most common GACD-enabled pathway to implementation science was the Implementation Science School or implementation science workshops - 69% of the respondents indicated that they or members of their GACD research team had attended either of those. These opportunities appear to have good spill-over results as 62% of respondents also said that their project staff learned about implementation science informally through their participation in the project. As for opportunities for doctoral and post-doctoral students, an equal number of respondents (35%) indicated that the GACD award provided support to students from HICs and LMIC. Thus, HIC and LMIC students seem to have an equal opportunity to increase their training in implementation science.

Figure 58 GACD contribution to training opportunities in implementation science for academic researchers involved in GACD research grant (n=26)

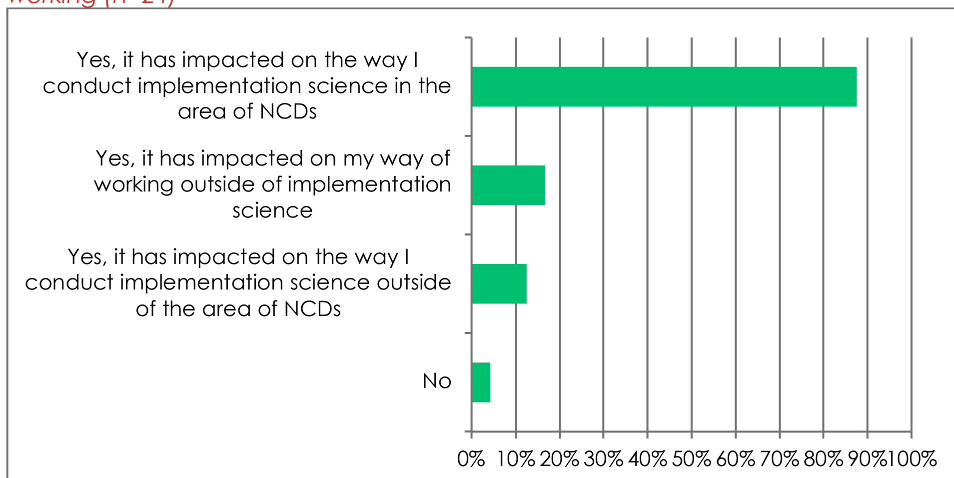


Source: Technopolis analysis of GACD survey

- **Implementation Science School and Implementation Science Workshop impact on ways of working**

When considering how the Implementation Science School and workshop impacted their ways of working, many respondents responded that these GACD training activities affected how they conduct implementation science in the area of NCDs (88%) ("*It has increased my skills in implementation research in the area of NCDs and resulted in a new proposal for GACD funding in collaboration with a global expert that was accepted and has already started*") while for others this carried over to non-NCD areas (13%).

Figure 59 Implementation Science School and Implementation Science Workshop impact on ways of working (n=24)

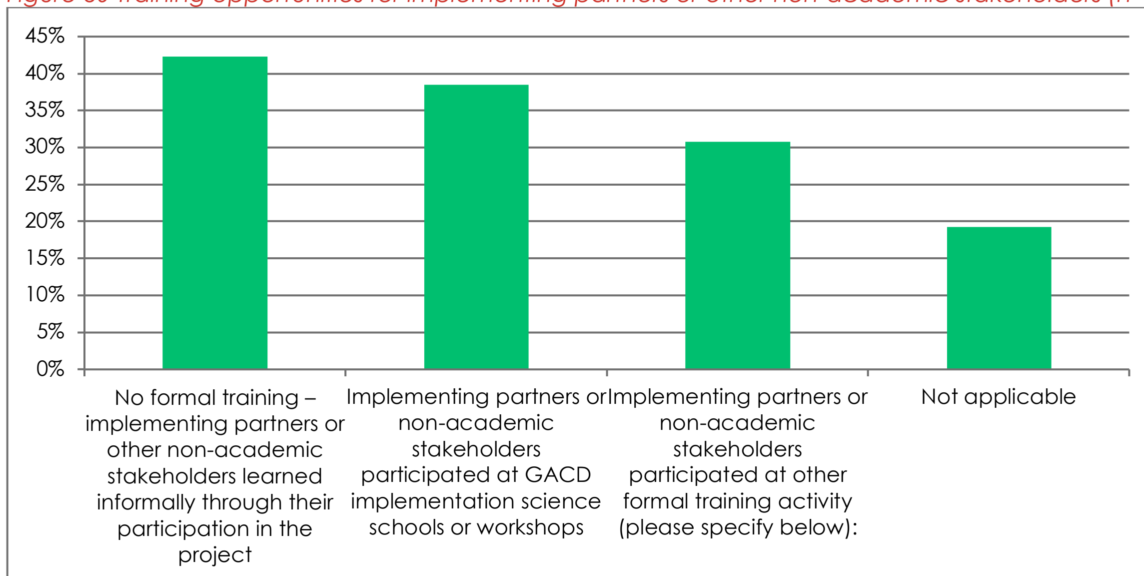


Source: Technopolis analysis of GACD survey

- **Training for implementation partners**

When asked about training opportunities for implementing partners or other non-academic stakeholders, the largest share of respondents indicated that their grants did not include formal training but implementing partners or other non-academic stakeholders learned informally through their participation in the project (42%). However, a comparable number of respondents reported that implementing partners or non-academic stakeholders participated at GACD implementation science schools or workshops (38%) or at other GACD formal training activity (31%). Many of the alternative training opportunities involved transfer of knowledge from the project team and were built into the project design ("*We developed a training package for health workers, assessed its utility, and then used it to train health workers. This package is freely available online*").

Figure 60 Training opportunities for implementing partners or other non-academic stakeholders (n=26)

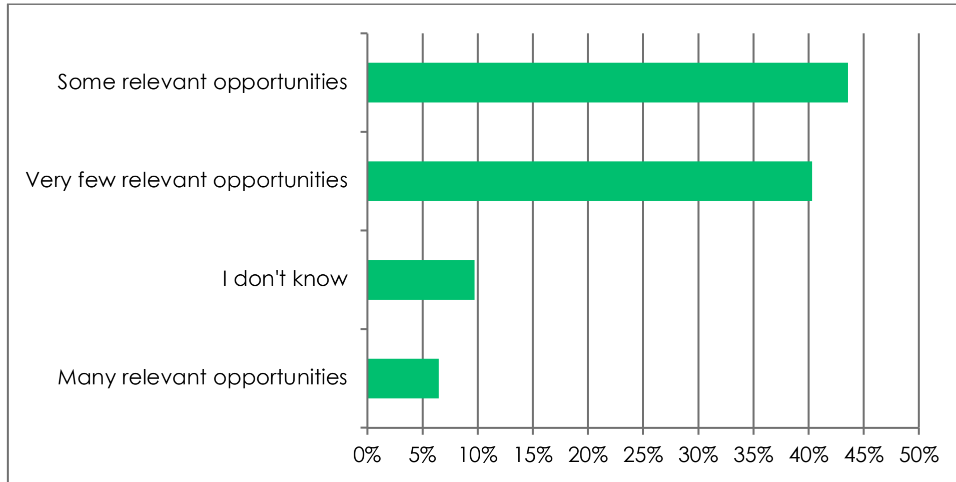


Source: Technopolis analysis of GACD survey

- **Other opportunities to develop skills in NCD-implementation science**

GACD contribution towards skills in NCD-implementation science is highlighted when the respondents consider the existence of similar opportunities from other sources. Only 6% of the respondents were aware of many options while most either knew some (44%) or very few (40%) relevant opportunities. Interestingly, 10% of respondents did not know of any other similar opportunities. This signifies how important GACD is for training researchers to conduct implementation research in NCDs.

Figure 61 Training opportunities outside the GACD to develop skills in NCD-implementation science (n=62)

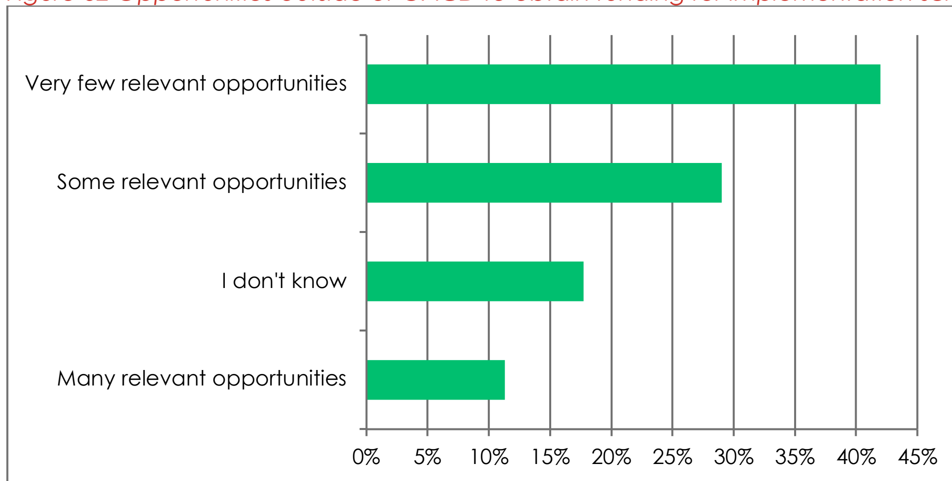


Source: Technopolis analysis of GACD survey

- **Other opportunities to fund implementation science**

The value of GACD support to implementation science is further evidenced when the respondents regarded opportunities to fund implementation science outside of the GACD. The largest number of respondents (42%) were aware of very few relevant opportunities and only some (11%) knew of many such opportunities. Together with data on other training options, the survey results suggest that GACD has an important place in fostering implementation science in the area of NCD research.

Figure 62 Opportunities outside of GACD to obtain funding for implementation science research (n=62)



Source: Technopolis analysis of GACD survey

C.9. Challenges

- **Project challenges encountered in undertaking the research project**

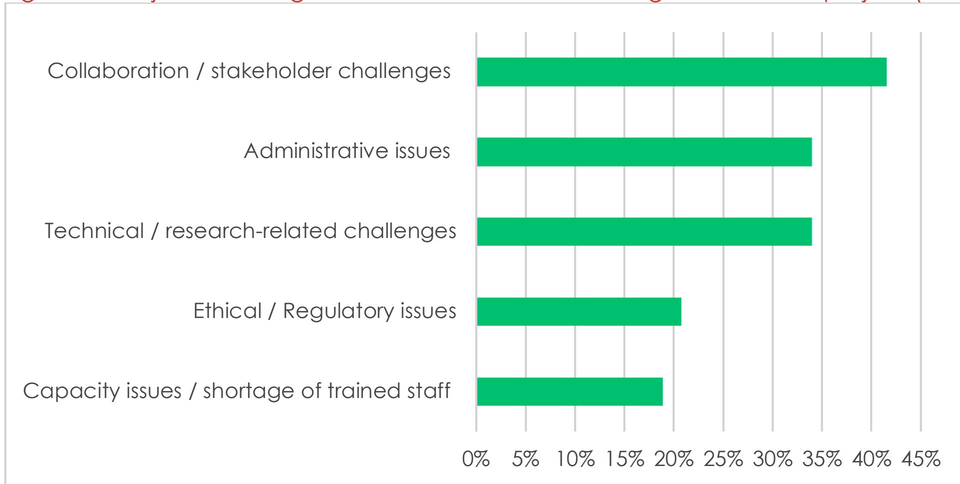
When asked to consider which challenges they encountered over the course of the project, the largest number of respondents reported challenges related to collaboration/stakeholders (42%). These challenges concerned managing expectations and needs of stakeholders and coming to a common understanding ("*Too many stakeholders, hard to agree in everything all of them*") or ensuring commitment of stakeholders ("*Stakeholder involvement has always been a challenge, since some project activities were considered to be work overload*"). However, some of these challenges were also related to COVID-19.

Challenges related to administrative issues and technical/research-related challenges were equally common across the projects (34%) with technical challenges connected to the use of IT and its use ("*Translation and cultural adaptation of study material, data transfer between sites and coordinating centre*"). Specific mentions were made of how LMIC technical infrastructure and capacity would not always align with the needs of the projects ("The study activities had to be adapted to an online modality, which has been very challenging in disadvantaged contexts, especially in LMICs that do not have the infrastructure in place"). Administrative issues concerned funding and management of grants, which was linked to the funding agencies ("*Excessive bureaucracy of the fund manager*").

Ethical and regulatory issues (identified in 21% of the projects) were connected to working with government agencies (i.e. Ministries of Health) for getting approval to conduct research ("*The Ministry of Health in one of our partner countries has been unresponsive in approval of the study proposal*"). This issue could be magnified if many countries were involved necessitating multiple approvals from government officials ("*Obtaining Ethics approval in 12 countries was difficult*").

Lastly, while capacity issues were encountered the least (19%), in many cases respondents reported staff turnover rates affecting their ability to conduct research ("*High turnover of key staff in the consortium leading to fragmentation in project management, content delivery, and clinical service delivery*").

Figure 63 Project challenges encountered in undertaking the research project (n=53)



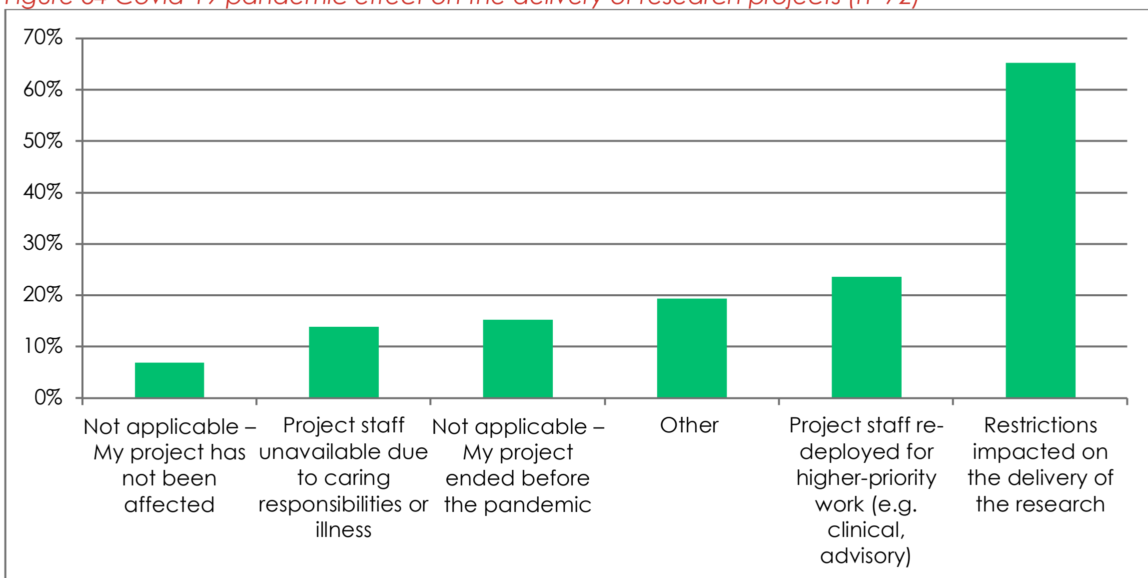
Source: Technopolis analysis of GACD survey

Lastly, it should be mentioned that across the identified challenges there were examples where issues arose from having to suddenly deal with COVID-19 ("*COVID-19 provoked limitations on time available for final stage of dissemination and analysis by our staff, by stakeholders. We are continuing these activities without cost to the best of our abilities*").

- **COVID-19**

When asked to consider in what way the COVID-19 pandemic affected the delivery of their research project, the largest group of respondents (65%) indicated that COVID-19 related restrictions impacted on the delivery of their research. Around a third of the respondents said that it affected the project staff, either because staff had to be re-deployed for higher-priority work (24%) or they became unavailable due to caring responsibilities or illness (14%). And just over a fifth of the projects were not affected, either because the project had ended before the pandemic (15%) or took place during the pandemic but was not affected (7%).

Figure 64 Covid-19 pandemic effect on the delivery of research projects (n=72)



Source: Technopolis analysis of GACD survey

Appendix D Implementation Science School-Implementation Science Workshop survey analysis

D.1. Overview

- **Location of respondents (by country)**

In total, 13 individuals responded to the survey. The geographical distribution of respondents was fairly even – in total 10 countries were represented with India having the highest number of respondents (3, or 23%) and South Africa being 2nd (with 2 or 15% of the respondents). The remaining countries were each represented by a single respondent.

Table 21 Respondents to the ISS ISW survey, by country

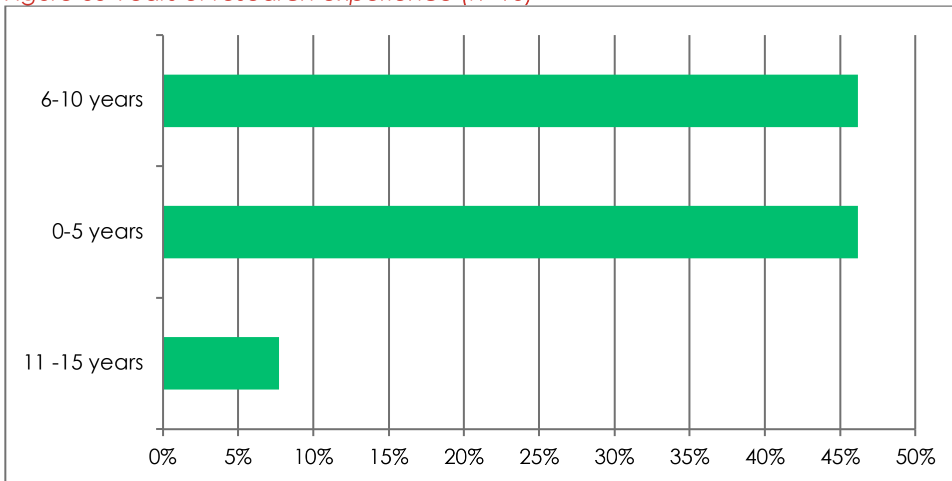
Country	No. of respondents
India	3
South Africa	2
Albania	1
Australia	1
Ghana	1
Japan	1
Nepal	1
New Zealand	1
Nigeria	1
Thailand	1

Source: Technopolis analysis of ISS survey

- **Respondent profiles**

The respondents were mostly early- or mid-career researchers (at the time of participating in a GACD training activity). Of the 13 respondents, 6 (46%) had 0-5 years of research experience and 6 (46%) had 6-10 years; only 1 respondent reported 11-15 years' research experience. There was an even gender representation with 46% (6) identifying as male and 54% (7) as female. Interestingly, female respondents constituted the majority (5 out of 6) of early career researchers (0-5 years of research experience) and a third (2 out of 6) of those with 6-10 years' experience.

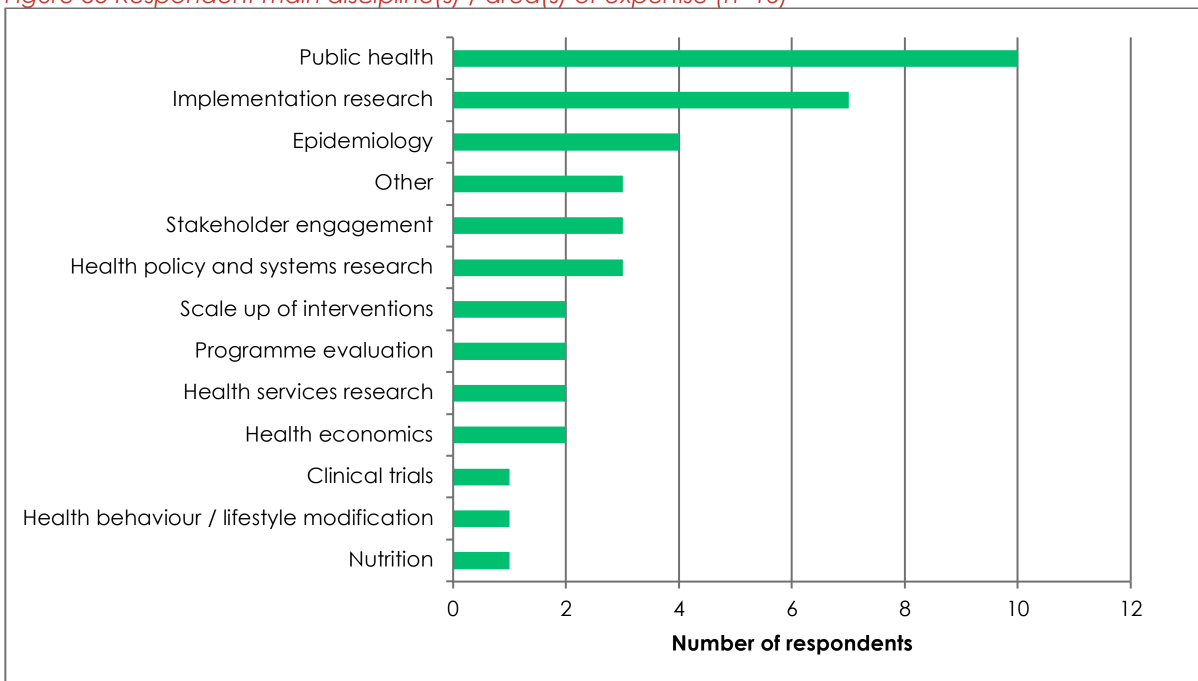
Figure 65 Years of research experience (n=13)



Source: Technopolis analysis of ISS survey

When it came to the main discipline(s)/area(s) of expertise of the respondents (multiple selections were possible), the majority (77%, 10 of 13) selected public health while 54% (7) also selected implementation research and 31% (4) chose epidemiology. Other expertise represented among the respondents included health economics (2 respondents), health services research (2), scale up (2), health policy and systems research (3), and stakeholder engagement (3). Interestingly, only researchers with over 5 years of experience indicated expertise in nutrition (1 respondent), health behaviour / lifestyle modification (1), clinical trials (1), and programme evaluation (2).

Figure 66 Respondent main discipline(s) / area(s) of expertise (n=13)



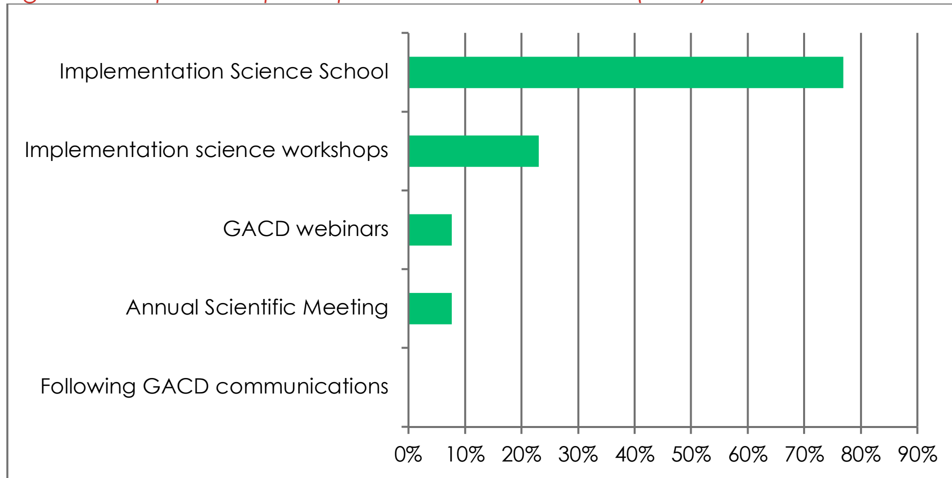
Source: Technopolis analysis of ISS survey

D.2. GACD activities and impacts

- **Participation and value of GACD activities**

When it comes to participation in GACD activities, the majority of respondents (77%, 10 of 13) took part in the Implementation Science School (ISS). Implementation science workshops (ISW) were 2nd with 23% of respondents (3) taking part.

Figure 67 Respondent participation in GACD activities (n=13)

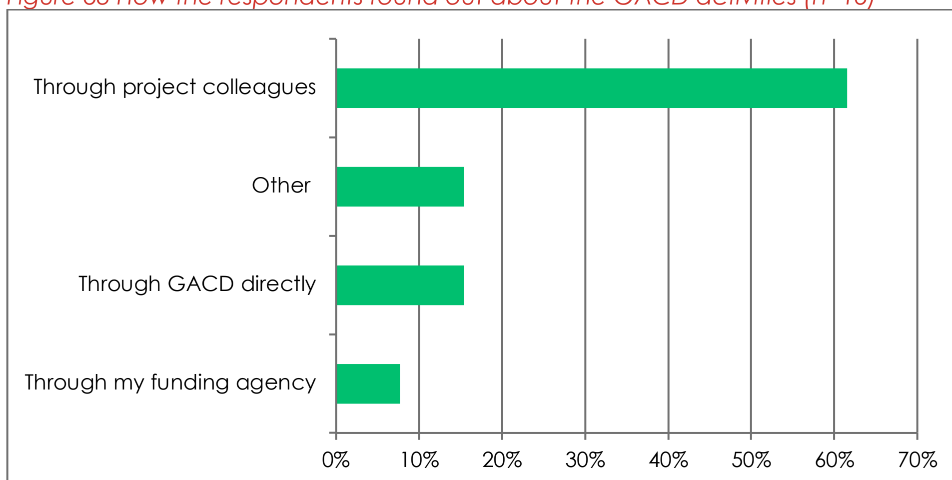


Source: Technopolis analysis of ISS survey

The primary source of information about the GACD activities was project colleagues (61%, 8 of 13) while 15% (2) found out directly through GACD and a further 8% (1) received information from their funding agency. Other sources included hearing about the activities in a conference and from a former Implementation Science School participant (who the respondent knew through university).

According to the respondents, their participation was funded by their institution (38%, 5), themselves (self-funded, 30% or 4 respondents), a non-GACD project grant (15%, 2), a GACD project grant (8%, 1), or a training grant (8%, 1).

Figure 68 How the respondents found out about the GACD activities (n=13)

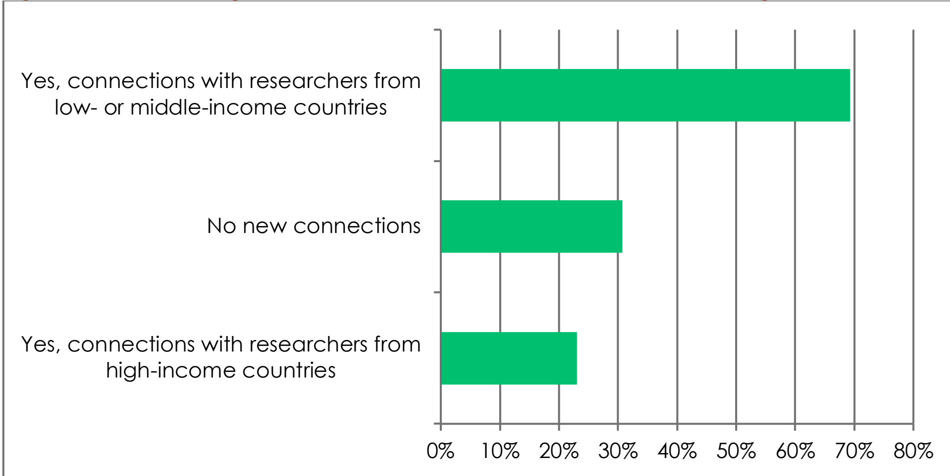


Source: Technopolis analysis of ISS survey

- **GACD activities as facilitators of networking**

69% of respondents (9) indicated that GACD activities allowed them to establish connections with researchers from low- or middle-income countries while 23% (3) had the same experience for researchers from high-income countries. Lastly, for 31% (4) of the respondents the GACD activities did not lead to new connections.

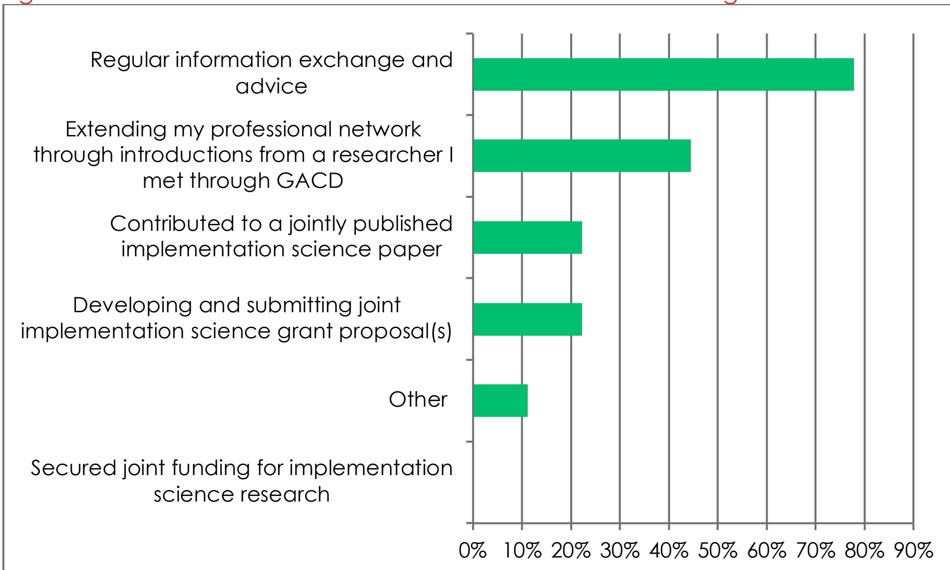
Figure 69 Establishing new connections to other researchers through GACD activities (n=13)



Source: Technopolis analysis of ISS survey

Of those respondents who did form new connections, the majority indicated that their relationship includes regular information exchange and advice (78%, 7 of 9) while 44% (4 of 9) said that they had extended their professional network. However, 22% (2) each made connections that led to jointly published implementation science papers, or joint implementation science grant proposals. None of the new relationships led to securing joint funding for implementation science research.

Figure 70 The nature of the new connections established through GACD activities (n=9)

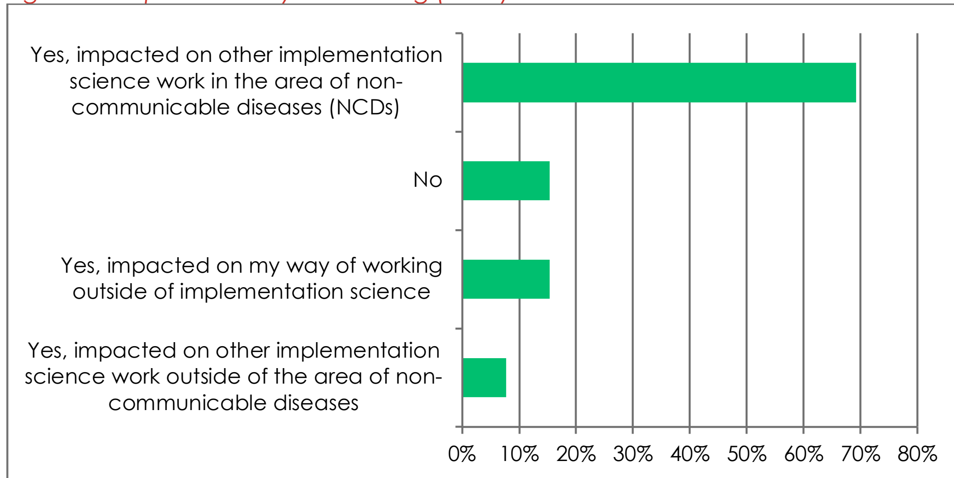


Source: Technopolis analysis of ISS survey

- **Impacts of Implementation Science School or Implementation Science Workshop – ways of working**

For 69% of respondents (9 of 13), the ISS or ISW impacted their other implementation science work related to NCDs. One person stated that the ISS had affected their work outside of NCDs while for 15% (2) the ISS or ISW affected how they approach research outside of implementation science. Thus, overall the training experience is modifying researchers' ways of working.

Figure 71 Impact on ways of working (n=13)



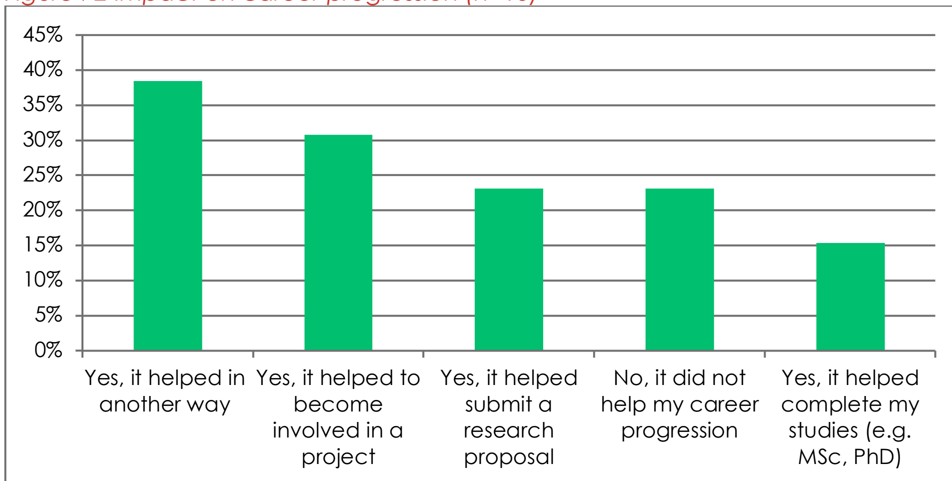
Source: Technopolis analysis of ISS survey

- **Impacts of Implementation Science School or Implementation Science Workshop – career progression**

Around a third of respondents (31%, 4 of 13) indicated that through their training (and the knowhow gained), they were able to become involved in a new project while 23% (3) stated that the ISS or ISW enabled them to submit a new research proposal. Several respondents (38%, 5) indicated that the ISS or ISW helped them in another way e.g. increased their understanding of implementation research, helped them to write a new project protocol, or opened up new dissemination opportunities and connections, and helped them to start a PhD.

Lastly, 2 respondents (15%) indicated that the ISS or ISW helped them to complete their studies. Thus, participation in a ISW or ISS enabled education outcomes in 3 respondents (23%) overall.

Figure 72 Impact on career progression (n=13)

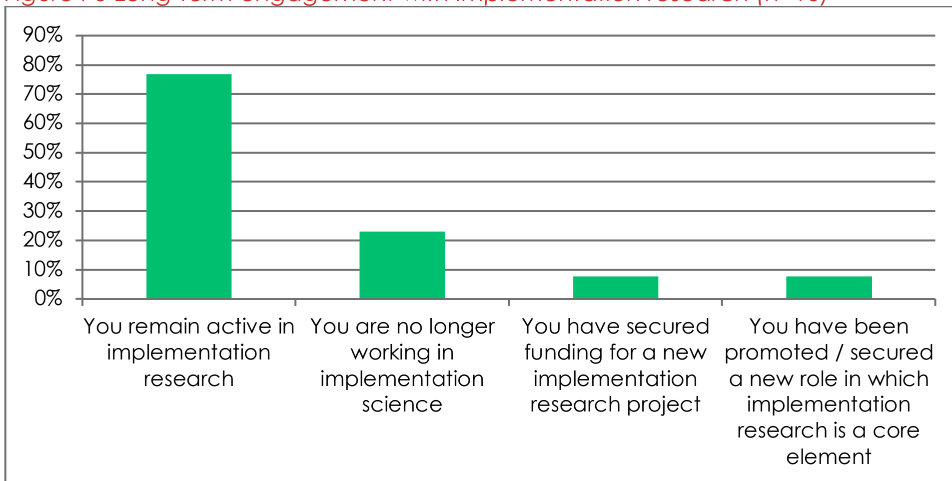


Source: Technopolis analysis of ISS survey

- **Impacts of Implementation Science School or Implementation Science Workshop – long-term engagement with Implementation Science**

Overall, most respondents (77%, 10 of 13) said that they continue to be active in implementation research. One respondent each secured funding for a new implementation research project and secured a position with implementation research at its core. On the other hand, 23% (3) of the respondents are no longer involved in implementation research.

Figure 73 Long-term engagement with Implementation research (n=13)



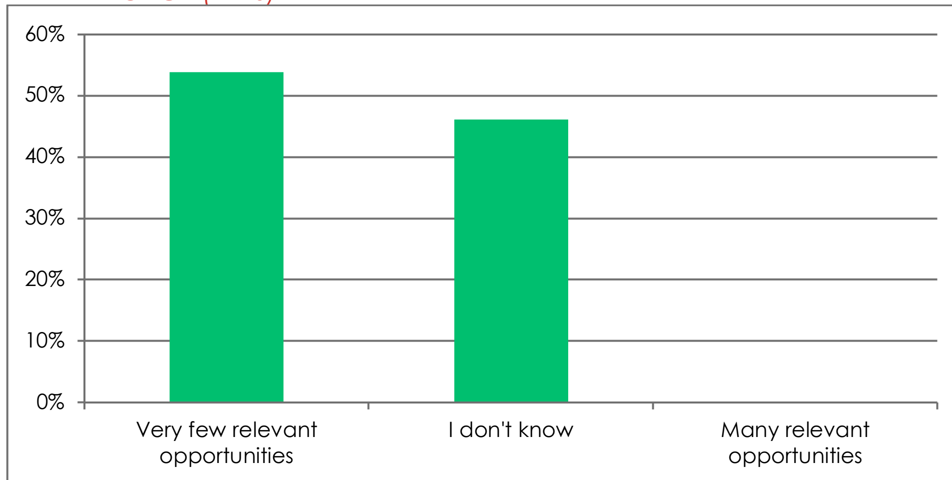
Source: Technopolis analysis of ISS survey

D.3. Opportunities outside of GACD

- **Rating implementation science funding opportunities**

Opportunities for implementation science research in NCDs outside GACD appear to be rare according to the survey respondents. Almost half of the respondents (46%, 6 of 13) were not aware of outside opportunities, while the rest (54%, 7) acknowledged that there were few relevant opportunities.

Figure 74 Opportunities to obtain funding for implementation science research in NCDs outside of GACD (n=13)

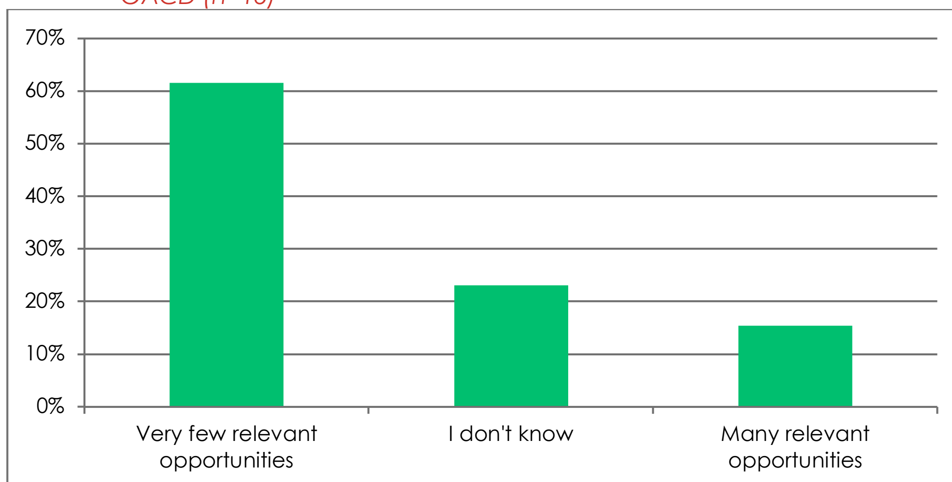


Source: Technopolis analysis of ISS survey

- **Opportunities for connecting with researchers doing implementation science research in NCDs**

62% of respondents (8 of 13) were aware of a few relevant opportunities while 15% (2) knew of many relevant opportunities to connect with researchers in the implementation science-NCD field. This suggests that networking opportunities are more widespread than funding opportunities outside the GACD.

Figure 75 Opportunities to connect with researchers doing implementation science in NCDs outside of GACD (n=13)

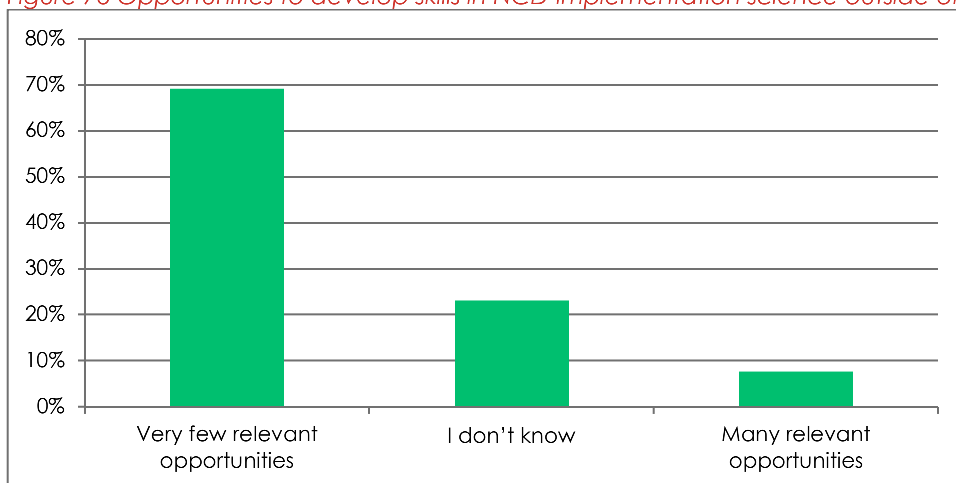


Source: Technopolis analysis of ISS survey

- **Opportunities to develop implementation science skills in NCD research**

A similar situation is evident with opportunities to develop NCD related implementation science skills. While one respondent was aware of many relevant opportunities, the majority (69%, 9 of 13) knew of at least a few relevant opportunities.

Figure 76 Opportunities to develop skills in NCD-implementation science outside of GACD (n=13)



Source: Technopolis analysis of ISS survey

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