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COVID-19 INNOVATION IN LOW AND MIDDLE-INCOME COUNTRIES: LESSONS FOR DEVELOPMENT CO-OPERATION

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Abstract

This paper discusses innovation in low and middle-income countries, focusing on the role it has played in local and national responses to the COVID-19 pandemic, and the lessons from this effort for how innovation might be harnessed to address wider development and humanitarian challenges by mobilising resources, improving processes, catalysing collaboration and encouraging creative and contextually grounded approaches. The paper also examines how international development and humanitarian organisations can improve their support for local and national innovation efforts.

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Abbreviations and acronyms

DAC	Development Assistance Committee (OECD)
HIC	High-income country
ICU	Intensive-care unit
IDRC	International Development Research Centre
LIC	Low-income country
MIC	Middle-income country
PPE	Personal protective equipment
R&D	Research and development
SDG	Sustainable Development Goal
WHO	World Health Organization

Executive summary

Innovation efforts led by people in low-income countries (LICs) and middle-income countries (MICs) have been of vital importance to local and national responses to the coronavirus (COVID-19) pandemic. These efforts also carry broader significance: if supported and enabled in appropriate and meaningful ways, LIC and MIC innovation has the potential to make a tangible and significant contribution to achieving development and humanitarian impacts.

The global COVID-19 crisis inspired a range of national and local responses that leveraged the potential of innovation and could guide efforts to improve support to and empowerment of LIC and MIC innovators. Emerging findings also underscore the vital role of innovators in addressing problems faced in their communities and societies. Decision makers in OECD member countries as well as international development and humanitarian organisations should build on and build up these efforts to better enable innovation efforts to meet the challenges of poverty, vulnerability and exclusion.

Among the examples examined for this paper, some innovations enabled wholly new solutions and approaches to the impacts of the pandemic, such as digitally enabled tracking and tracing in the Kenyan public transport system. Others provided enhanced safety and protection and addressed bottlenecks, such as the collaboration of makers' collectives and the Indian government to produce personal protective equipment (PPE).

Across the range of examples examined for this paper, LIC and MIC innovations fulfilled five specific functions:

- They filled gaps in response processes or response coverage, improving public health outcomes nationally and internationally.
- They helped make specific aspects of the response more relevant and appropriate to national and local needs, opportunities and interests.
- They sped up or enhanced the efficiency and effectiveness of specific aspects of pandemic response processes, helping save time and money.
- They catalysed new relationships and mobilised capabilities when and where these were most needed.
- They built a sense of ownership about the related aspects of the response and fed into wider government and health system processes, and in some cases, catalysed necessary reforms.

Given the relatively early stage of many of these innovation efforts – and, indeed, of the global COVID-19 pandemic response – it is hard to say exactly what the downstream effects are likely to be. However, it is possible to extrapolate from the evidence at hand.

In the most successful examples, the innovative approaches have scaled and become part of national systems through adjustments, and they have led to changes to official policies, practices and institutions. The process of translating individual innovation and the related accumulation of knowledge into institutional capacity was dependent on getting the right mix of people involved in the process: influential leaders,

technical experts and network builders. By getting the right mix of individuals, the innovation process itself can be a means of enhancing collaboration and consensus.

There is an important role for the international community to play in brokering, facilitating and investing in the people and ideas that originate in LICs and MICs. The work undertaken for this policy paper suggests not only that more can be done by OECD Development Assistance Committee (DAC) members and their counterparts to **bridge the gap between international donors, agencies and innovators in low and middle-income countries, but also that more should be done and that this is the time to do it**.

This means changes in the way that innovation for development currently works. This will not be an easy or overnight shift. The roadmap for getting there requires a clearer rationale for and focus on LIC and MIC innovators; greater collective and concerted efforts to resource such innovations; strengthening LIC and MIC innovation processes and evidence; and establishing supportive collaborations. This work needs to be built on awareness of both similarities and differences in the opportunities and challenges facing innovators across low, middle and high-income countries. Done right, such measures should outlast the pandemic response and make a tangible contribution to a more balanced and equitable innovation system to deal with problems of poverty and vulnerability.

Bridging the gap will require further investments in research to assess the value for money of LIC and MIC innovation. This should be done in ways that are meaningful and not unfairly tilted towards comparisons with high-income country innovators, drawing on literature on value for money for adaptive programming and incorporating equity and inclusivity lenses in assessment frameworks. To improve efficient and effective support of LIC and MIC innovation and local ecosystems, bilateral development agencies should reassess their role in light of their specific comparative advantages and in consideration of their general evolution from solution provider to solution enabler. Doing so requires a more open discussion of trade-offs between balancing national interests and expanding markets for domestic innovators from donor countries, on one hand, and investments in local capabilities, ecosystems and markets, on the other.

To efficiently support local ecosystems and innovators, development organisations, especially bilateral agencies, need to invest in joined-up diagnostics and shared measurement frameworks that incorporate indicators on efficiency, dimensions of social capital and enhanced trust in established institutions. Wherever possible, international actors should encourage and leverage local LIC and MIC co-funding, including from the private sector and philanthropies, taking into account cultural and contextual factors that shape issues such as ownership, control and intellectual property.

International development organisations should furthermore improve monitoring, evaluation, learning and documentation of LIC and MIC innovation efforts, with a particular focus on understanding LIC and MIC innovation contributions and outcomes in a participatory way rather than solely by imposing externally defined criteria and indicators. To do so and to improve future innovation efforts, dedicated investments need to be made to bring the people and the successful LIC and MIC practices and lessons from past innovation endeavours into existing and new development and humanitarian programmes.

Internally, development and humanitarian organisations should position LIC and MIC innovation as a route to high-impact and relevant programming and as a means for furthering the sustainable development and leave no one behind agendas. The international co-operation vision for LIC and MIC innovation should be a vital part of transforming development from resource transfer models to genuine global co-operation based on mutual learning and partnerships, with funders playing context-appropriate roles including as facilitators, ecosystem conveners and intermediaries in the innovation process.

1 Coronavirus (COVID-19) and the growing acknowledgement of local innovation

The coronavirus pandemic has put the power of innovation to help manage crises and improve lives on full display. Here are three stories, real-world examples of problems faced and solutions found by leaders and decision makers in low-income and middle-income countries around the world.

***Problem**:* A health official in a large city in India is tasked with sourcing quality masks for hospitals dealing with COVID-19 cases across the city. Supply chains and manufacturing have shut down, and there are very few organisations with practical experience of how to do such work. Who can help?

***Solution**:* The official finds online videos of a maker group based in Mumbai that is repurposing its facilities to produce quality masks quickly and that is part of a global network of maker spaces. The group is inviting institutions that are responding to COVID-19 to get in contact. The official puts in a request, as do some hospitals. Within a few weeks, there is a national network of makers responding to such requests and producing over one million masks (Corsini, Dammicco and Moultrie, 2021[1]).

***Problem**:* A senior social inclusion specialist working for the Peruvian government at the height of lockdown needs a way to track safely the welfare and livelihood conditions of the country's elderly and vulnerable populations. What is the best way to tackle this urgent issue?

***Solution**:* The specialist works across government departments, international organisations and civil society organisations to organise Peru's first massive online volunteer scheme, which successfully mobilises 20 000 young people as digital track and tracers to connect to and learn about the health conditions and needs of almost half a million of society's elderly and most vulnerable (UN Volunteers, 2020[2]).

***Problem**:* A Nairobi bus fleet owner is working on the process of contact tracing for one of the most mobile populations in the world, where over 50% of people use public transport every day. How can this be achieved?

***Solution**:* The fleet owner gets all its public drivers and operators to sign up to a Kenya-developed app called mSafari using their vehicle registration numbers. All passengers then upload their details onto the app, which is used to trace future cases and clusters, trigger automated warnings to passengers exposed to known cases, and also to set and monitor the maximum safe number of passengers allowed on each vehicle. After an initial pilot, the government of Kenya is looking at wider legislative changes around the collection and use of public transportation information (WHO Regional Office for Africa, 2020[3]).

All three examples, as well as others that are the focus of this policy paper, are distinguished by the fact that these solutions were developed thanks to the novel ideas, approaches and methods of people in the countries where the problems arose. This paper explores this achievement from the perspective of innovators and creative change agents in LICs and MICs who are working on responding to COVID-19-

related challenges in their communities and strengthening the domestic COVID-19 response. These LIC and MIC innovators include:

- officials at the centre of government and in local municipalities
- staff of medical facilities and public health officials
- employees of companies working on addressing direct and indirect impacts of the pandemic
- people working for civil society organisations
- community activists
- individual inventors who pursue novel business ideas and social change and are often connected to local innovation labs, maker spaces and start-ups.

While there are numerous examples of LIC and MIC innovators leading successful processes, including the three described above, there could be many more with a step-change in how development organisations support and fund innovation. The international community has an important role to play in brokering, facilitating and investing in the people and ideas that originate in LICs and MICs. The work undertaken for this briefing paper suggests not only that **more can be done** by OECD DAC donors and their counterparts to bridge the gap between international funders and national innovators, but also that **more should be done** and that **this is the time to do it**.

Recently, the World Health Organization (WHO) has developed a cross-country analysis of innovations to deal with COVID-19. In this context the WHO undertook an in-depth examination of new or modified approaches across a range of response areas covering contact tracing, community engagement, treatment, laboratory systems, infection prevention and control, surveillance, and social protection. While the great majority of the examined innovations originated in North America, Europe and the People's Republic of China, almost 13% (some 128 of the 1 000 analysed) were from sub-Saharan Africa (Wasswa, Kelm and Chibi, 2020[4]). The WHO concluded that these data illustrate that African countries still lag behind in the development and adoption of innovation. They recommended that United Nations member states "build capacities and institutional mechanisms to harness and manage innovations that are tailored to local needs", including "key infrastructural developments" such as information and communication technologies and "policies and incentive frameworks to stimulate creativity and entrepreneurship" (Wasswa, Kelm and Chibi, 2020[4]).

International development and humanitarian actors also need to strengthen these capacities and mechanisms. In the first OECD DAC Peer Learning Exercise on innovation for development (March 2020), one of the most significant findings was that, with few exceptions, the development sector as a whole needs to get much better at involving national and local actors in prioritising, designing, selecting and rolling out innovation efforts (OECD, 2020[5]). Few systematic, consistent and sustained internationally backed efforts or mechanisms support national and local innovation in LICs and MICs. Notwithstanding the work that has been done in the name of innovation for development, a clear and widening gap exists between the funders of innovation for development and the growing number of individuals and organisations in low and middle-income countries that are undertaking innovation efforts to address the social, economic and political challenges they face.

This is the case even despite the growing recognition of resource-constrained innovation methods, such as frugal innovation, that tap into the ideas and skills of innovators in emerging markets and hold considerable potential for helping to achieve the Sustainable Development Goals (SDGs). The final report of the peer learning exercise recommended that "actors from the global South [have] a more central role in the innovation for development ecosystem" and that development and humanitarian actors work to "actively bridge gaps between innovation efforts in the global North and South" (OECD, 2020[5]).

The peer learning report reinforced the view that supporting innovation efforts in LICs and MICs to address development and humanitarian problems is not only the right thing to do but also the smart thing to do. For the past few years, the United Nations Conference on Trade and Development has been tracking the

progress of innovation efforts around the world. In 2019, it noted a gradual shift towards greater national involvement and ownership that should be capitalised upon. The successes related to this shift have been numerous and considerable: microfinance in Bangladesh, participatory governance in Brazil, community mobilisation for health in West Africa and digital innovations in Kenya, among many others. The message is that the gap can and should be bridged.

Unfortunately, as for many other aspects of our social, political and economic lives, COVID-19 has highlighted and deepened this gap. While some international actors have tried to span the two worlds or support local innovation directly through distinct funding models, such efforts tend to be episodic and in pockets here and there or just very small in scale and scope. At the same time, many governments in low-income and middle-income countries have encountered serious financial difficulties and lack the financial and technical resources to build the domestic innovation capabilities and ecosystems that are needed to respond and build resilience to COVID-19 and future crises (European Investment Bank, 2020[6]).

Based on a literature review, desk research and selected interviews, the authors set out to address the following three questions:

- What do different forms of LIC and MIC innovation for COVID-19 look like? What are their distinguishing features, if any?
- What benefits have resulted from LIC and MIC efforts in terms of both direct and indirect contributions to the pandemic response?
- What are the implications for innovation for development efforts, especially for funders and bilateral development agencies?

This paper seeks to answer these questions by drawing on the collective efforts of a wide range of innovators from LICs and MICs in response to the COVID-19 crisis, while also acknowledging that the scope and range of innovations – and innovators – from these countries are broad, diverse and distinctive.

As such, it should be read as a complement to a previous OECD paper by Ramalingam and Prabhu (2020[7]) that explored the range of COVID-19 innovations currently being supported by the international community and argued for a shift in how development agencies manage and fund development innovation.

2 Innovation in low and middle-income countries in response to coronavirus (COVID-19)

Diversifying innovation investments and efforts

Prior to the outbreak of the COVID-19 pandemic and its massive direct and indirect impacts, the world's governments were already facing challenges regarding the ambitious 2030 Agenda. In 2017, a paper for the Center for Global Development found that the SDGs are unlikely to be met by 2030 without rapid, ubiquitous innovation (Kenny and Patel, 2017[8]). In 2021, it is all too evident that innovation is essential to address the complex challenges that the world faces because of the COVID-19 pandemic. The needs range from dealing with the growing burden and direct impacts of the disease, through to the socio-economic impacts, and on to longer-term issues of widening inequities, environmental degradation and climate change. Importantly, as these problems are borderless and interconnected, so too are the required solutions.

There is an urgent necessity to move away from a model of innovation being funded, designed and delivered by high-income countries (HICs) and towards a rebalanced model of greater participation among and ownership by actors in LICs and MICs. The global effort for medical solutions to COVID-19 – from vaccine development and delivery to effective tests – has demonstrated the power of such co-operation. Effort and investment in cross-border research are growing, as is multidisciplinary work. Furthermore, there is a necessity to invest not only in more innovation but in different forms of innovation. The aforementioned OECD peer learning process on innovation found that bilateral development organisations invest predominantly in improvement-oriented innovations that seek to bring about enhancements to existing processes and often have a bias for innovations stemming from the global North (OECD, 2020[5]). While enhancing existing services and products is essential, there is a need to further diversify innovation investments and practices, including providing greater support for mission-driven transformative innovation and bottom-up local innovations.

How does this relate to LIC and MIC innovation efforts? The authors' recent work for the DAC on COVID-19 innovations suggests that in addition to the traditional model of development innovation – that is, technology transfer from HICs to LICs – three newer approaches to LIC and MIC innovation are being used:

- **Co-created innovation between LICs and MICs on one hand and HICs on the other:** Examples include work between the United Kingdom and African scientists to develop a one-dollar COVID-19 test suitable for use in low-resource settings.
- **Frugal innovation by LICs and MICs for LICs and MICs**: Examples include grassroots innovators working on manufacturing and distributing PPE in India and local, community-based mobilisation efforts in urban settings.

- **Reverse innovation by LICs and MICs for HICs:** Examples include low-cost social and community-based approaches to tracking and tracing developed in Africa that are being deployed across states in the United States and the government of Wales taking inspiration from decision-making processes that reflect on future generations across indigenous communities in North America to design its Futures Generation Act 2015 (One Newport, 2021[9]).

Reading across these efforts, a number of broad themes can be identified, as set out below.

What does low-income and middle-income country innovation look like?

LIC and MIC innovation has broad and diverse applications

There are many facets to innovation in LICs and MICs, just as there are diverse classes of innovators that range from government officials and activists to individuals who unleash their ingenuity to address a problem they are facing in their day-to-day lives. The scope of LIC and MIC innovation to address the COVID-19 pandemic has been considerable. Innovation dealing with both the direct challenges of the pandemic, such as testing, tracing and protection as noted above, and with wider factors such as the production efficiency of hospitals, the inclusion and reach of safety nets for communities and businesses, and the stability of social and economic institutions.

Regardless of the issue being addressed, successful innovations in LICs and MICs are those that focus on high-priority development and humanitarian challenges faced by people working in pandemic-affected countries. In some cases, the priority might be clear from the outset and driven by the impacts of the pandemic. For example, the Peruvian example of digital mobilisation was a response to a major challenge and a clearly articulated need. This was met with a government-designed programme, which was then implemented with the support of an active and vibrant civil society and international development organisations, working with and individuals and groups who had expertise in both innovation methods and context-appropriate technologies.

Background and experience in the process of innovation have proven to be key advantages in many contexts. The opportunity of locally sourced PPE became apparent thanks to the Makers' Asylum team members' early experimentation with both innovation approaches and methods and emerging technologies as well as their openness to sharing work in progress, thus creating a market where there was not one before (Maker's Asylum, 2021[10]).

LIC and MIC innovation often involves radical simplification

Low-income and middle-income contexts are often resource-constrained when it comes to solving problems, and the COVID-19 crisis has placed additional constraints. While the problems and related solutions are diverse, a common feature of the efforts examined for this study is that many innovators have worked to take existing technologies, tools or techniques and strip out features that are seen as surplus to requirements and/or exceeding resources. This was true of government innovators, health sector officials and activists. Interestingly, this process of radical simplification stands in contrast to the over-engineering of new products or services that characterises many efforts in the innovation for development endeavour.

For example, many initiatives seeking to design systems that enable contact tracing and immunity passports based on blockchain technology did not consider identifiable expected latency (i.e. the time that blockchain technology takes to complete one transaction) or expected scalability of the proposed blockchain technology (i.e. the maximum number of transactions that blockchain technology can process in a given time). According to a 2020 scoping review on the potential of blockchain to mitigate COVID-19 impacts, the technology is not mature enough to present value for money and to work at the required pace for pandemic responses (Abd-alrazaq et al., 2020[11]).

In part, this widespread over-engineering can be attributed to the culture of innovation in the development sector, which historically has given more prominence to novel, exciting technologies than to simple, low-cost ones (Ramalingam, 2016[12]). However, the tendency to over-engineer, to resort to a north-south tech transfer mindset, can also be caused by the distance from the user, the insufficient appreciation of contextual constraints and/or the mission creep that is inherent to designing far from a problem. Consequently, innovation efforts can get everything thrown at them in an attempt to fix many different kinds of anticipated challenges, rather than a single, clearly known challenge. For many LIC and MIC innovators, by contrast, the task to innovate meaningfully and successfully is as much about what to leave out as what to put in. Two examples illustrate this well: one in PPE production and one in intensive-care unit (ICU) operations. The need for face masks to protect and prevent the spread of the coronavirus has led to many different innovations, ranging from high-fashion designs (with one company producing a USD 1 000 face shield) to personalisation. One of the simplest approaches to PPE at the beginning of the pandemic was the use of A4 acetate sheets (of the kind used in traditional overhead projectors) with holes punched through and two head straps. This minimalist approach offered a simple and low-cost way to protect wearers' faces in combination with a face mask that could be locally produced.

Along similar lines of simplification, clinicians in low, middle- and high-income countries alike are adopting non-machine ventilation through techniques such as prone self-ventilation, also and more commonly known as prone positioning or proning. Lying in a prone position has been shown to reduce the symptoms of acute respiratory problems and improve oxygenation. Randomised control trials have shown that this technique alone can reduce mortality risk among acute COVID-19 cases by almost 20% (Siow et al., 2020[13]).

Low and middle-income country innovators seek novelty as close as possible to the problem

Much is made of the power of grassroots innovation and the idea that creative solutions emerge, bottom-up, in response to a challenge. This is not something that happens automatically in all situations. Many COVID-19 innovations developed in low and middle-income countries work on the principle of finding novel solutions and applying them to respond as close as possible to the problem faced. Perhaps the best demonstration of this is that in many LICs and MICs, affected communities have been leading key aspects of the COVID-19 response, including detection and prevention at the household level as well as at the first line of response. In some cases, the community member-led responses were a result of weak health systems and insufficient trust in governmental institutions; in other cases, community members worked hand-in-hand with the formal health apparatus. Much of the work in responding to COVID-19 has built on lessons and experiences of dealing with other recent disease outbreaks, most notably during the Ebola outbreak in West Africa in 2013-15. Significantly, this hyperlocal focus can often be seen as a reason for international actors to not invest in local innovators, despite the fact that many such efforts have proved to be eminently scalable across countries and regions – among them, microfinance, mobile money and community management of health, to name just three examples.

Novelty largely stems from combination, permutation and substitution

Making use of scarce resources often means rethinking how things will be put to use. The principles of combination (bringing two unrelated ideas together to make a new approach); permutation (testing out different configurations of an existing solution); and substitution (swapping around the inputs, processes or outputs of a solution) are widespread in low-income and middle-income contexts. Where simply finding more resources to throw at a problem is not practical or feasible, the process known as "combinatorial play" can be a powerful way of achieving more with less.

For example, numerous ventilators created for use in developing countries are made almost entirely with off-the-shelf parts that can be found in hardware stores. One particular solution that quickly reached the Indian market is the AgVa portable ventilator. Among its features, it:

- does not require an oxygen supply as it oxygenates air from the room it is in
- builds on the computational power of mobile phones and a dedicated app
- weighs barely a tenth of what typical commercial ventilators weigh, and so is easily portable
- has open-source specifications, so it can be adapted for use in different countries and contexts
- costs less than a tenth of what conventional ventilators cost and can be produced much more quickly.

These processes of combination, permutation and substitution leverage ideas and insights from many different sources and put them together in the pot. For instance, there are examples of how the best hygiene responses to the COVID-19 pandemic integrated cultural understandings of cleanliness, local materials, traditional knowledge, and internationally accepted principles of behaviour change communication along with ethically sound means of experimentation and learning. One powerful response is the outreach and parallel testing of messages to encourage citizens to practice caution and adhere to hygiene guidelines during the Eid festival, a project of the non-governmental organisation Bangladesh Rural and Advancement Committee (BRAC) (COVID-19 Hygiene Hub, 2020[14]).

Low and middle-income country innovators reengineer resource use across critical processes

Whether they are in low, middle or high-income countries, entrepreneurial individuals everywhere have sought to improve how things are done in the face of these urgent problems or find novel ways of coping with demand and work pressures. In this paper, we are agnostic about where these innovators work: they might be in community-based or civil society organisations, local or national government authorities, within health care systems, small and medium-sized enterprises, or larger companies.

Regardless of the type of problem, their approach and their institutional context, LIC and MIC innovators – in common with innovators anywhere in the world – need to mobilise a range of material and knowledge-based resources to launch and implement innovation efforts. However, LIC and MIC innovators usually face contextual difficulties that are distinct from those faced by HIC innovators, many of whom benefit from a wider ecosystem of external actors, be they investors, suppliers or researchers. Not only do LIC and MIC innovators operate in very different contexts to their HIC counterparts, they also encounter a whole host of different institutional, organisational and individual barriers and biases.

For instance, tangible resources such as hard cash tend to come through in dribs and drabs, requiring LIC and MIC innovators to locate and release resources that might be locked up within the existing way of doing things. Resources are not only financial, of course, and LIC and MIC innovators are by necessity skilled at bringing in necessary human and technical resources from a variety of sources. For example, the application of frugal innovation principles to surgical care has already had considerable success in India. The careful reengineering of surgical procedures – with attention paid to who is doing what at which stage and why – has led to the development of equivalent practices in COVID-19 responses. Specifically, in many low-resource countries, ICUs have been reconceptualised from the perspective of how best to rapidly scale up the number of patients who can be seen over the course of a single day or week. This has meant bringing in staff of different skill levels to undertake key stages of the process, with consultants focusing on those aspects that they alone should undertake. This mentality of reengineering resource use across such processes has brought about changes in how ICUs look and operate.

The more limited ecosystems in which LIC and MIC innovators operate also means that many need to self-support their work on early prototypes, drawing on whatever is available and building up functionality and

focus over time. Although they do not explicitly describe it as such, these innovators work to reengineer resource usage across existing processes, much as big businesses use lean or Kaizen strategies to do the same across larger-scale efforts. This is also how the M-19 Initiative, which provided PPE to Indian hospitals, developed its COVID-19 programme over time.

What is especially telling in many successful innovations is their reliance on voluntarism as a critical resource. Voluntarism might be people giving their expertise and ideas freely to the research and development (R&D) process. Or it might, as in the digital youth mobilisation in Peru, relate to volunteers being the front line of implementing a particular innovation. Getting the right type and number of people – or not – can mean the difference between success and failure.

Low and middle-income country innovators are not only user-centred: They are user-led

Much innovation scholarship frames the process of innovation as a funnel, moving specific solutions from early recognition to development and testing and then to scale. This is generally a closed funnel wherein innovators work to develop ideas and potential users are brought into the mix at specific moments.

The reality for most LIC and MIC innovators is quite different: it is less an insulated product development process and more of a 'contact sport', with constant and ongoing engagement with users. The need or opportunity is identified, energy and attention are mobilised, and efforts move forward dynamically.

Successful LIC and MIC innovations are not user-centred but are usually user led, almost by default. The needs or opportunities that users face provide the clearest signal to would-be innovators, and the process of meeting these needs or capitalising on opportunities is what creates windows for moving ideas from concept to execution through intelligent brokering of relationships and ideas. This means that innovators are usually as focused on relationship management as on innovation management, with roles including formulating plans, strategising on how to address challenges and facilitating learning. Not only does such an approach make for better, more useful and user-friendly innovations, it also is essential for enabling relationships of trust to build up between innovators and users. It is furthermore a prerequisite for subsequent scale-up efforts.

Integrated approaches to data, analysis and reflection

The best innovation efforts are strategic, dynamic learning processes. Some of the best LIC and MIC innovations have been those that incorporate data, analysis and reflection into existing processes as a means of enhancing their efficiency and effectiveness. Sometimes, this might involve integrating new physical technologies into previously manual processes. For example, incorporating real-time data into contact tracing can be a powerful means for understanding where cases might be and identifying at-risk populations. However, it is worth noting that few of these examples seem to involve a focus on data privacy risks that might arise. Moreover, there are challenges around connectivity and access that predate the COVID-19 pandemic and shape effective responses. With more than 600 million people lacking access to mobile technologies and 3.6 billion people still not online (GSMA, 2020[15]; ITU, 2019[16]), there is a need for local and national innovators to develop either analogue or hybrid solutions. While the potential of digital solutions is considerable, it will not be realised without careful attention to the analogue foundations of health and well-being. For example, culturally appropriate, context-adequate and socially safe doorstep visit programmes can help understand the needs and requirements of the most vulnerable in society (Ludwick et al., 2020[17]), and can provide the basis of digitally enabled solutions. However, attempting to leap directly to digital solutions is unlikely to resolve and may even exacerbate existing forms of exclusion they seek to address.

3 What are the broader implications of innovation efforts in low and middle-income countries?

Low and middle-income country innovation creates positive benefits for the knowledge and learning of the individuals, groups and institutions involved

LIC and MIC innovation efforts provide many knowledge and learning benefits:

- They are based on a clear and contextual understanding of the range of problems, from the medical to the socio-economic, which must be overcome to control and/or eliminate COVID-19.
- Designs that take better account of local needs, opportunities, political considerations and power dynamics can and do enhance take-up and use in positive ways.
- Participating individuals acquire new knowledge and skills: conceptual learning about the issue in question, for instance, and/or highly practical applied knowledge of how to do certain things.
- By their very nature, these efforts provide a rich source of lessons and insights about innovation and provide opportunities to learn about contextual factors, such as social and cultural considerations, that might help catalyse, stifle, dampen or scale innovations in a given setting at a given time.
- They can create new kinds of relationships and partnerships, domestically and internationally.
- Innovation efforts also lead to changes in attitudes: they can increase awareness of possibilities for enhanced development processes and reforms; build confidence that a particular path is in fact a viable option for the country in question; and create a sense of shared conviction that adaptation and change are not only possible, but also essential.

LIC and MIC innovation also can pose challenges and risks:

- Radical simplification and combination can generate additional risks and problems. For example, use of frugal data innovation is incredibly exciting in terms of sheer potential. Yet, when taking a frugal approach, innovators rarely have sufficient resources to address issues such as privacy and data rights. At the same time, even having sufficient resources, as do innovation efforts in many high-income countries, does not mean these issues are fully addressed. This is a potentially useful topic for collective learning across high-, middle- and low- income countries.
- There are natural trade-offs in innovation processes between lowering costs and simplifying and losing functionality. There is a need to ensure, as in all innovation efforts, that good enough does not start to negatively impact principles such as mutual respect, duty of care and patient rights, quality, and standards.
- Because innovation efforts focus on immediate problem solving for target users, they can be perceived as short-term and transient in nature as well as highly localised and therefore not suited

to be integrated into and scaled up within wider systems and policies, despite their transformative potential.

- Quality analysis and comparative data are weak across the board, in part because the data requirements of innovation are defined far from the problem and the context. LIC and MIC innovators can and should be more integrally involved in co-developing baseline and progress indicators relating to different development challenges and potential local solutions.

Support for LIC and MIC innovation provides an alternative to the technology transfer model that still underpins much innovation for development work. To better support local innovation, development organisations should review existing innovation portfolios in light of their strategies and comparative advantages as funder and supporter of innovation. In most organisations, the existing portfolios seem to be the result of decentralised decisions and are not coherent, nor explicitly designed or managed. A portfolio review can generate a snapshot of existing investments and practices and help assess trade-offs and strategic choices. This includes reflection on potential conflicting outcomes between addressing national interests of bilateral funders and investing in local innovators and ecosystems.

Wider contributions can be extrapolated, but the evidence is not strong

There are many clear examples of national and local COVID-19 responses that simply would not have been possible without innovation efforts. Some are innovations that enabled wholly new and different things, such as the digitally enabled tracking and tracing on Kenyan public transport. Other innovative responses provided safety and protection and addressed bottlenecks, such as the makers' collectives for PPE.

Across all of these cases, LIC and MIC innovations fulfilled five specific functions again and again:

- They filled gaps in response processes or response coverage, improving public health responses.
- They helped make specific aspects of the response more relevant and appropriate to national and local needs, opportunities and interests.
- They sped up or enhanced the efficiency and effectiveness of specific aspects of pandemic response processes, helping save time and money.
- They catalysed new relationships and mobilised capabilities when and where these were most needed.
- They built a sense of ownership about the related aspects of the response, fed into wider government and health system processes, and in some cases, catalysed necessary reforms.

Given the relatively early stage of many of these innovation efforts, and indeed the pandemic response, it is hard to say exactly what the downstream effects are likely to be, apart from by extrapolation. Saving time and money in a pandemic response would seem to indicate a downstream contribution to better health outcomes and saved lives. However, these data were simply not available for many of the efforts examined here. LIC and MIC innovation clearly has the potential to make a tangible contribution to achieving development impacts, but additional work and time are needed to understand this more fully. This research suggests that these results are best thought of in terms of innovation's contribution to development impacts. To analyse this contribution systematically, the best approach is to locate efforts in a constellation of wider influences. This means taking a more in-depth case study approach than has been possible in the present study and asking the question: What did the innovation influence and shape, and with what benefits?

What can be said now is that, at their most effective, these innovation efforts generated relevant, timely and sustainable inputs for use in the design, development and implementation of national pandemic response efforts. In the most successful examples, these newly innovative approaches have scaled and

become part of national systems through adjustments and have led to changes to official policies, practices and institutions. The process of translating individual innovation and the related accumulation of knowledge into institutional capacity was dependent on getting the right mix of people involved in the process: influential leaders, technical experts and network builders. By getting the right mix of individuals, the innovation process itself can be a means of enhancing collaboration and consensus.

Low-income and middle-income country innovations still receive a very small share of investment

Despite the wide range of LIC and MIC innovations, most of the efforts analysed as part of this research did not receive much attention or support from the international development and humanitarian communities. Some efforts were supported by official development assistance, some by R&D investments of businesses in HICs, and others solely by governments and companies from LICs and MICs. Some LIC and MIC innovations also drew on technical advice and inputs at key stages from international actors. However, for the most part, the efforts were either self-financed or responded to emerging market needs. Internationally funded COVID-19 innovations are much more likely to be driven and led by actors in HICs according to priorities set by development agencies and other funders, and are often based on discussions and interests that are far removed from the governments, businesses, civil society and citizens of low and middle-income countries.

This disparity is widely acknowledged, including in the OECD DAC's Peer Learning Exercise on Innovation for Development, the World Intellectual Property Organization's Global Innovation Index 2020 and WHO work on COVID-19 innovations cited earlier in this paper. There are calls to reorient investments to support development and humanitarian innovation efforts led by those living and working closest to the problems to be solved. A starting point would be to make more resources and funding directly available to innovators in LICs and MICs. While some mechanisms are doing this, including the United Kingdom government's COVID Action Platform, they are far from the norm.

At the same time, there are issues in many LICs and MICs that need to be addressed. Among these are low levels of science and technology activities; high reliance on government or foreign funders as principal sources of R&D; limited science-industry linkages; low absorptive capacity of firms; limited use of intellectual property; a challenging business environment, including limited access to credit and finance; insufficient social safety nets that provide few fallback options for innovators; and, most recently and of particular relevance for COVID-19 innovations, the health and safety considerations raised by the pandemic. These issues can become binding constraints in the places that are most in need of innovation, including disaster-prone, fragile and conflict-affected contexts.

Development organisations and other funders around the world are now working to address these issues head on. These include the Global Challenges Research Fund in the United Kingdom and the United Nations Development Programme Accelerator Labs network, which are working to fund genuine multi-stakeholder partnerships and orchestrate regional and global learning networks with an emphasis on solutions that might be described as for LICs and MICs, from LICs and MICs. There also is renewed work by the government of Sweden, the Wellcome Trust and others on investing in research capacity and training in low and middle-income countries. In addition, the Bill & Melinda Gates Foundation and others are developing new kinds of research and innovation partnerships to steer the international community through both the ongoing pandemic and the socio-economic and environmental issues that gave rise to it.

Yet, in LICs and MICs, one of the most common complaints from innovators is that they are expected to have solutions that are ready to go and lack patient, or indeed any, support for their work. Other widespread criticisms relate to the organisational requirements for engaging with development and humanitarian organisations and the unwillingness of players in the aid system, and/or their inability, to engage with grassroots, indigenous and activist innovators or anyone who might not be a so-called "usual suspect"

proficient in the language of official development assistance. We know innovation is a risky endeavour in high-income countries. Nevertheless, many decision makers in development organisations seem much less willing to trust in such processes when they are led by southern innovators.

4 Conclusions and recommendations for international co-operation

Based on the findings of this paper, low and middle-income country innovation efforts appear to be both valuable and practically useful for pandemic response in a range of settings. The ideas and inputs from their own countries received by government officials, health care providers, public health officials, business owners and other stakeholders looking for creative solutions are often more culturally and contextually relevant than any imported from the outside. Moreover, the people working on innovations are able to understand their own achievements, demonstrate their progress and have a positive influence on others. Even more importantly, when they are successful, such efforts are able to bring about remarkable and often dramatic contributions to solving problems, overcoming challenges, using context-appropriate technology and catalysing collective action.

These experiences and lessons stand in contrast to many lessons that have emerged from international efforts in innovation for development. Whether their approaches are termed frugal, resource-constrained, *jugaad* (improvised) or any of the other terms that have been developed, it is clear that, by necessity, innovators in low and middle-income countries have had to develop alternative ways of going about the process of inventing, testing and scaling their ideas. The lessons that we have learned from this work are more than simply inspiring: they carry the promise of emerging ways of recognising, valuing and supporting the vital importance of LIC and MIC innovators to how development and humanitarian organisations think about and do innovation work in the future.

These findings build on lessons from a range of programmes from OECD member countries. These include the UK Aid flagship programme, What Works to Prevent Violence Against Women and Girls, which funded 15 innovative interventions with potential to be taken to scale across 12 countries in Africa and Asia. A key ingredient of its success was seizing the potential of partnerships with local stakeholders who contributed contextual knowledge and capabilities as researchers, policy entrepreneurs and advocates. In particular, the programme benefitted from partnering with local research institutions for greater contextualisation and to identify critical factors for scaling up successful interventions (UK Aid, 2020[18]). Another example of focussing on LIC and MIC innovators and enabling environments is the work of the International Development Research Centre (IDRC) in Canada, one of the few organisations in the world concerned specifically with supporting and building sustainable capacity for research and researchers in developing countries. For example, IDRC directly funded the Think Tank Initiative, a global network of 43 Southern think-tanks dedicated to leveraging quality local data and research to enhance debate on the SDGs. The 2018 OECD Development Co-operation Peer Review of Canada identified a number of key success criteria, including IDRC's long-term perspectives on strengthening local capabilities, its investments in drawing lessons from its work on bringing results from science to scale, and its emphasis on providing practical guidance (OECD, 2018[19]).

There is an important role for the international community to play in brokering, facilitating and investing in the people and ideas that originate in LICs and MICs. The work undertaken for this briefing paper suggests not only that **more can be done** by DAC members and their counterparts to bridge the gap between international funders and national innovators, but also that **more should be done** and that **this is the time to do it**. It also highlights the importance of engaging with innovators as well as with governments in low

and middle-income countries to unlock the potential of different types of innovation and emerging technologies. To do so productively, it is necessary for bilateral, multilateral and other development organisations to enhance co-ordination and collaboration, focus on the comparative advantages of the respective players, and build on lessons from past, successful programmes.

Changing the way that innovation for development currently works will not be an easy or overnight shift. The roadmap for getting there requires a clearer rationale for and focus on LIC and MIC innovators; greater collective and concerted efforts to resource such innovations; strengthening LIC and MIC innovation processes and evidence; and establishing supportive collaborations. This work needs to be built on awareness of both similarities and differences in the opportunities and challenges facing innovators across low, middle and high-income countries. Done right, such efforts should outlast the pandemic response and make a tangible contribution to a more balanced and democratic innovation system to deal with problems of poverty and vulnerability.

The four recommendations below are aimed at decision makers in development organisations, and primarily in bilateral donor agencies.

Increase focus on, and develop clearer rationales for, low and middle-income innovation efforts

- Internally, development and humanitarian organisations should position LIC and MIC innovation as a route to high-impact and relevant programming and as a means for furthering the sustainable development and leave no one behind agendas. This will require further investments in research to assess the value for money of LIC and MIC innovation in ways that are meaningful and not unfairly tilted towards comparisons with HIC innovators, drawing on literature on value for money for adaptive programming and incorporating equity and inclusivity lenses in assessment frameworks.
- The international co-operation vision for LIC and MIC innovation should be a vital part of the transformation of development from resource transfer models to genuine global co-operation based on mutual learning and partnerships, with funders playing context-appropriate roles including as facilitators, ecosystem conveners and intermediaries in the innovation process.
- To improve efficient and effective support of LIC and MIC innovations and local ecosystems, bilateral agencies should reassess their role in light of their specific comparative advantages and unique strengths and in consideration of their general evolution from solution provider to solution enabler. This will mean assessing national and local needs of LIC and MIC innovators as well as facilitating and investing in mechanisms and processes that can support them.

Resource low and middle-income innovation efforts

- International actors should make concerted and collective investments in innovation capabilities across the entire ecosystem, including in science, education and business and in support for ecosystem convening and relationship and movement building.
- This work should emphasise participation in and ownership and sustainability of research and innovation programmes, including dedicated windows whereby southern innovators can compete with each other on a more even playing field rather than against better-resourced Northern stakeholders. This requires more open discussion of trade-offs between balancing national interests and expanding markets for domestic innovators from donor countries, on one hand, and investments in local capabilities, ecosystems and markets, on the other.

- To efficiently support local ecosystems and innovators, development organisations, especially bilateral agencies, need to invest in joined-up diagnostics, shared measurement frameworks and focus on specific areas, aligned to the comparative advantages of each agency.
- Wherever possible, international actors should encourage and leverage local LIC and MIC co-funding, including from the private sector and philanthropies, taking into account cultural and contextual factors that shape issues such as ownership, control and intellectual property.

Strengthening low and middle-income country innovation processes and evidence base

- International actors should further refine and agree on tools and frameworks to understand the potential value-add of LIC and MIC innovation investments and to highlight priority areas and sectors.
- Tools and methods already used by LIC and MIC innovators need to be better understood, shared and used to develop guidance that is relevant for national and local innovators and to take account of the reality of their innovation processes and ecosystems.
- Improve monitoring, evaluation, learning and documentation of LIC and MIC innovation efforts, with a particular focus on understanding LIC and MIC innovation contributions and outcomes in a participatory way, rather than imposing externally defined criteria and indicators.
- Efforts should be made to bring LIC and MIC innovators, successful practices, and lessons from past innovation endeavours into existing and new development and humanitarian programmes. To do so successfully, development organisations need to reflect on existing barriers and steps to ensure a supportive and enabling environment for LIC and MIC innovators, especially those who usually do not work with international organisations.

Establish supportive collaborations

- International actors should support more South-South and triangular co-operation in innovation, enabling more regional co-operation across MICs and LICs that face similar challenges and share an interest in new kinds of South-South learning processes.
- International development organisations should maximise the potential, space and incentives for international staff and partners to play a strong facilitating and supportive role in LIC and MIC innovation efforts through adjustments and changes to strategies, policies, programmes and processes.

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