

Reciprocal Innovation: A New Approach to Equitable and Mutually Beneficial Global Health Research and Partnership

Thomas G Sors (✉ tsors@purdue.edu)

Purdue University <https://orcid.org/0000-0002-1492-2933>

Rish Chauhan O'Brien

Indiana University Center for Global Health

Michael Scanlon

Indiana University Center for Global Health

Li Yuan Bermel

Women's Global Health Institute, Purdue University

Ibrahim Chikowe

Pharmacy Department, Kamuzu University of Health Sciences

Adrian Gardner

Indiana University Center for Global Health

Jepchirchir Kiplagat

Academic Model Providing Access to Healthcare: AMPATH Kenya

Marya Lieberman

Department of Chemistry and Biochemistry, University of Notre Dame

Sharon Moe

Clinical and Translational Sciences Institute, Indiana University School of Medicine

Nydia Morales Soto

Eck Institute for Global Health, University of Notre Dame

Winstone Nyandiko

Department of Child Health and Paediatrics, Moi University School of Medicine

David Plater

Department of Health Systems Design and Global Health, Icahn School of Medicine at Mount Sinai

Betsy Cheri Rono

Jomo Kenyatta University of Agriculture and Technology

William M Tierney

Department of Global Health, Indiana University Richard M Fairbanks School of Public Health

Rachel C Vreeman

Department of Child Health and Paediatrics, Icahn School of Medicine at Mount Sinai

Sarah E Wiehe

Clinical and Translational Sciences Institute, Indiana University School of Medicine

Kara Wools-Kaloustian

Indiana University Center for Global Health

Debra K Litzelman

Indiana University Center for Global Health

Research

Keywords: Reciprocal innovation, learning, global health, mutual benefit, global local, CTSI

Posted Date: December 22nd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-1135284/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at The Lancet Global Health on March 1st, 2022. See the published version at [https://doi.org/10.1016/S2214-109X\(22\)00159-0](https://doi.org/10.1016/S2214-109X(22)00159-0).

Abstract

Background: Global health researchers and partnerships often discount the potential for mutual learning and benefit to address shared health challenges across high and low- and middle-income settings. Drawing from a 30-year partnership called AMPATH that started between Indiana University in the US and Moi University in Kenya, we describe an innovative approach and program for mutual learning and benefit coined “reciprocal innovation.” In this paper, we define reciprocal innovation and identify its core principles with illustrative examples and describe building a reciprocal innovation program established in 2018 at the Indiana Clinical and Translational Sciences Institute (CTSI).

Results: Reciprocal innovation harnesses a bidirectional, co-constituted, and iterative exchange of ideas, resources, and innovations to address shared health challenges across diverse global settings. The success of the AMPATH partnership in western Kenya, particularly in the areas of HIV/AIDS and community health, resulted in several innovations in Kenya being “brought back” to the US. To facilitate and promote the bidirectional flow of learning and innovations, the Indiana CTSI reciprocal innovation program hosts annual meetings (hosted in Indiana and Kenya) of multinational researchers and practitioners to identify shared health challenges across diverse global settings and facilitate partnership building and collaboration. The program supports pilot grants for projects that demonstrate reciprocal exchange and benefit. The program has produced a wealth of educational materials, including videos, webinars and an online dashboard, to train investigators on reciprocal innovation approaches in global health. Lessons learned in building a reciprocal innovation program include increasing awareness of reciprocal approaches among investigators and in supporting collaboration for global–local research. While many global health investigators have strong collaborators with international partners, a challenge has been partnering with “local” Indiana researchers to create reciprocal learning and benefit.

Conclusions: The transformative power of global health to address systemic health inequities embraces equitable and reciprocal partnerships with mutual benefit across countries and communities of academics, practitioners, and policymakers, as demonstrated through a reciprocal innovation approach. Leveraging a long-standing partnership, the Indiana CTSI has built a reciprocal innovation program with promise to redefine global health for shared wellbeing at a truly global scale.

Background

It is often assumed that global health partnerships primarily involve a unidirectional flow of expertise, innovation, and technology from high-income countries (HICs) to low- and middle-income countries (LMICs) [1]. The assumption that wealthier countries have less to gain or that they have a claim on innovation, expertise, and technology when engaging in international partnerships discounts the potential for reciprocity and mutual benefit to both HICs and LMICs engaging in global health partnerships that address significant health system challenges and health inequities that are applicable to their respective populations [2]. Renewed attention to global health’s neocolonial tendencies and systemic inequities

provides opportunities to critically examine practices and partnerships and for new paradigms to emerge that nurture *bidirectional* flows of knowledge and experience to promote global health equity [3, 4].

Recent efforts to shift the paradigm in global health have sometimes employed the concept of “reverse innovation,” originally developed in the field of business [5], to highlight the potential benefits of health-related expertise, innovation, and technology flowing from lower to higher income settings [2, 6]. Related terms such as “twinning” have arisen to describe the importance of partnerships across settings in facilitating the transfer of innovations and practices in global health [7]. Over the past decade, numerous examples of reverse innovations in healthcare delivery have appeared in the literature, including technological innovations like mobile-based care platforms and methodological innovations in care delivery strategies [8]. Examples of such activities include a community engagement strategy for patient safety in Baltimore, USA that was originally developed by the WHO’s African Partnerships for Patient Safety in sub-Saharan Africa [9]. In North Wales, UK, a primary care model and community health workforce was adapted from Brazil’s national primary care strategy [10], while an organization in New York City, USA drew its inspiration for peer coaches and community health workers from Kenya [11]. Another group described adapting a model developed for primary prevention of cardiovascular disease in Nairobi, Kenya for immigrant communities in the Netherlands [12].

Many health innovations and technologies developed in LMICs are applicable in HICs. Underserved populations in LMICs and HICs often face similar barriers to care due to being uninsured or underinsured, distance and transportation challenges to accessing health care particularly in rural areas, and health-related stigma. As such, interventions developed in LMICs to address these challenges could be effective, and cost-effective, in HICs. Care providers, practitioners, and policymakers in LMICs often utilize novel processes and interventions, particularly amidst resource and other constraints, and provide more agile systems to experiment and implement at scale [2], leading to many examples of “doing more with less” [13]. There are also several recognized challenges to reverse innovation in global health, including neocolonial perceptions about the quality and adaptability of innovations and technologies developed in LMICs, identifying good candidates for adaptation, and regulatory hurdles for adapting and implementing them in HICs, among other challenges [14, 15].

The reality that discoveries in LMICs are often discounted by implementers and policymakers in HICs clearly illustrates the need for a paradigm shift to harness the benefits of reverse innovation across settings. In addition, while the potential benefits to HICs from the flow of expertise, innovation, and technology from LMICs are clear [6], models of reverse innovation in global health may not fully capture the potential for *mutual* benefit and *mutual* learning that emerge from sustained, bidirectional partnerships across HICs and LMICs to address global and local health inequities [16–18]. Building more equitable and reciprocal partnerships is essential to the future of global health [19, 20] and can work to address systemic and unequal power relations that disproportionately benefit both individual researchers and institutions in HICs. Researchers benefit through funding, research agendas, opportunities for training and career trajectory, and authorship on publications, while institutions stand to gain institutional infrastructure and capacity, reputational benefits that can lead to increased financial support, and access

to more diverse study populations [21–25]. At the broader level, societal benefits can also gain through better health interventions, technologies, and methodologies that may improve population health.

Building on the concept of reverse innovation and drawing from a 30-year global health partnership between Indiana University in the US and Moi University in Eldoret, Kenya, in this paper we propose a new concept, “reciprocal innovation,” that more explicitly harnesses a bidirectional, co-constitutive, and iterative exchange of resources, knowledge, and innovations among global health partners, as highlighted in Case Study 1. We argue that the transformative power of global health research to address systemic health inequities around the world rests on equitable and reciprocal partnerships within and across countries and communities of academics, practitioners, and policymakers. We describe establishing a reciprocal innovation global health program at the Indiana Clinical and Translational Sciences Institute (CTSI) and reflect on lessons learned and next steps for adopting a reciprocal innovation approach in global health to improve the health of underserved populations in Indiana, Kenya, and around the world.

Case Study 1: Establishing an HIV Clinic in Austin, Indiana, USA using a Kenyan model (2019)

Shared Challenge: An outbreak of HIV in Scott County, Indiana, USA resulted in an HIV prevalence rate that was comparable to or exceeded that of individuals in western Kenya where members of the Indiana University faculty had worked for decades. Healthcare access and transportation challenges were similar between western Kenya and southern Indiana.

Innovation: A physician who developed the initial standardized clinical protocols for the Academic Model Providing Access to Healthcare (AMPATH), a global health partnership in western Kenya, educated a US-based implementing team about how to create standardized HIV care and treatment algorithms and assisted them in developing their approach to the challenge of caring for persons living with HIV in Scott County.

Reciprocal Benefit to LMICs:

The AMPATH partnership led to the co-creation of standardized antiretroviral treatment (ART) guidelines for one of the largest HIV/AIDS treatment programs in sub-Saharan Africa, parts of which informed the Kenya Ministry of Health (MOH) HIV Care and Treatment Guidelines, providing significant assistance to the Kenyan MOH as Kenya initiated roll out of countrywide antiretroviral treatment.

Reciprocal Benefit to HICs:

The AMPATH partnership led to expertise in Indiana to inform the establishment of an HIV treatment clinic for Scott County, a rural county in southern Indiana, within 6 days, illustrating the power of shared learning from experiences in Kenya as evidenced by the creation of algorithms, enrollment, and follow-up forms that were easily adopted and utilized by non-specialist physicians and mid-level practitioners working in the community in Indiana.

References: [26]

Results

Reciprocal innovation for transformative global health

Reciprocal innovation evolves the concept of reverse innovation and is defined by three characteristics: (1) global health partnership rooted in the values of reciprocity, mutual learning, and equity across partner institutions in HICs and LMICs, (2) a bi-directional and co-constituted approach to identifying shared health challenges across settings in long-term engagements, (3) identification of high-quality innovations from global health partnerships for demonstration, replication, and dissemination in diverse settings, as demonstrated in Figure 1. Reciprocal Innovation Model.

The concept centers the values of reciprocity and equity in bilateral exchanges and partnerships in global health, which are increasing and being critically examined and documented [18]. Relationships in global health that are truly reciprocal are more apt to promote better science and developing, evaluating, and implementing effective health innovations in HIC and LMIC settings. Additionally, mutual learning allows for a reciprocal innovation to evolve and expand more robustly with proficient improvements that have a considerable impact on both populations. This iterative process allows for flexibility to adapt innovations within the settings where they are implemented. Francis Collins, director of the National Institutes of Health, affirmed the importance of reciprocal innovation in 2009 when he stated that, “Global health research should be a conversation with other countries not one in which the great United States tells the world what the answers are without listening to and learning from their experiences” [27].

The term reciprocal innovation was coined by the Indiana University Center for Global Health in 2018 and adopted by the Indiana CTSI to capitalize on the collective experiences and strengths in global health research and to, in part, use them to inform the sharing and building of global collective knowledge, data, and innovations in research across Indiana and around the world. Significant inspiration for the concept was derived from Indiana University's long-term partnership with Moi University, which today has grown into the Academic Model Providing Access to Healthcare (AMPATH). AMPATH is a unique and highly successful global health partnership representing over 30 years of collaboration between Moi University and Moi Teaching and Referral Hospital in Kenya and a consortium of North American academic institutions led by Indiana University [28]. AMPATH was founded on the principles of equity, mutual benefit, and long-term commitment, with partners working across a tripartite mission of care, education, and research. In partnership with the Kenyan Government, AMPATH serves a population of 8 million people across western Kenya at more than 500 clinical sites, with comprehensive care programs in HIV/AIDS, oncology, chronic diseases, and maternal child health, among others, and pioneering population health and community-based approaches to care [29]. The partnership facilitates bilateral exchanges for Kenyan and North American faculty, residents, and students, and leverages academic partnerships to build critical clinical and research infrastructure in Kenya, train global health researchers, and conduct research to improve the health of under-served populations in Kenya and globally [30–32].

Indiana CTSI Global Health Program

The Indiana CTSI Global Health Program was established in 2016 to address domestic and global health issues for underserved populations by bringing together research and expertise from three vibrant global health centers: IU Center for Global Health, University of Notre Dame Eck Institute for Global Health, and the Purdue University Institute of Inflammation, Immunology and Infectious Diseases. The Global Health

Program is led by seven faculty at the three Indiana CTSI institutions, with expertise in infectious disease, infant and maternal health, non-communicable diseases, population health, biology and chemistry. The program is supported by a full-time program manager to support program activities, including managing stakeholder meetings, the grants program, and creating educational resources for reciprocal innovation, which are described in more detail below. From 2016-2021, 30 grants totaling \$610,000 have been awarded to investigators and their partners in the areas of infant and maternal health, infectious disease, access to healthcare, prevention, chronic disease, and treatment. The CTSI Global Health Program also serves as a hub for investigators at Indiana CTSI and partner institutions in LMICs to access resources for reciprocal innovation, including informational videos and how-to guides, and to network and collaborate at annual meetings.

When the Indiana CTSI Global Health program was established, the program launched a small pilot grant program to strengthen global health research among the Indiana CTSI institutions. Pilot grants were mostly focused on research conducted in an LMIC setting and designed to address a specific identified need in that setting. One of these pilot grants is highlighted in Case Study 2.

Case Study 2: Rapid test for falsified drug detection in Malawi and combating the opioid problem in Indiana

Shared Challenge: Unregulated street drugs in HIC and pharmaceuticals in weak regulatory environments in LMIC are often adulterated, which makes them dangerous to users.

Innovation: A paper test card, the PAD, was developed at the University of Notre Dame to detect falsified antibiotics. The PAD was designed as a rapid and inexpensive screening test to detect these problematic products at the point of use.

Reciprocal Benefit to LMICs: Testing showed that critical antibiotics in markets in Malawi were of good quality, but there were pervasive problems with dispensing practices such as repackaging and selling antibiotics to patients without a prescription.

Reciprocal Benefit to HICs: Using lessons learned from the Malawian implementation, the card was redesigned to detect a wide range of controlled substances and cutting agents found in street drugs in the US and is being tested by harm reduction groups in Chicago to empower people who use drugs to identify particularly hazardous constituents in street drugs.

References: [33–35]

In 2018, the program underwent a major transition to focus explicitly on reciprocal innovation, and shifted its funding priorities to projects that demonstrated potential for mutual benefit to both a partner LMIC setting as well as in Indiana. To support the transition from a traditional global health program to a reciprocal innovation program, we conducted an environmental scan to assess the available infrastructure and interest among partners and stakeholders in reciprocal innovation. Information gained from the environmental scan was used to organize an initial “stakeholder meeting” that brought together Indiana CTSI institutions, researchers at partner institutions in LMICs, and members of local public health and community organizations. At this meeting, stakeholders identified and discussed health priorities in Indiana and in partner LMIC settings and potential areas for reciprocal innovation research and partnership. Using information from the environmental scan and the stakeholder meeting, a reciprocal

innovation grants program and call for applications was created that focused on specific areas for reciprocal innovation identified in the environmental scan and stakeholder meeting.

This unique approach, namely the environmental scan, stakeholder meetings, and grants program, to building and supporting reciprocal innovation is shown in Figure 2. Reciprocal Innovation Process. The process continuously and explicitly engages local and global partners to identify shared health challenges and fosters research collaborations and partnerships to identify, test, and adapt shared solutions. Each of these steps in our approach are discussed in more detail below.

Environmental Scan

The environmental scan was an essential “first step” in building a reciprocal innovation grants program. The goal of the environmental scan was to engage stakeholders both in Indiana and internationally to: (1) gauge interest and understanding of the concept of reciprocal innovation, (2) catalogue the available infrastructure for reciprocal innovation, including existing partnership, (3) identify the critical challenges to moving forward the reciprocal innovation concept/process, and (4) begin to identify key health priorities both in Indiana and in our partner countries that might be amenable to addressing through a reciprocal innovation approach. The environmental scan also provided a roadmap to identify stakeholders and topics for the stakeholder meeting where global and local partners reviewed the challenges, priorities, and opportunities identified in environmental scans with the goal of developing priority investment areas for the Indiana CTSI’s Reciprocal Innovation and Grant Programs. The environmental scan was first done to gain perspective from both local and international partners so that implementers in each setting could identify and articulate their own challenges, priorities, and opportunities, and then come together to see where they overlap, and focus research efforts there.

An environmental scan of critical areas of need with key health stakeholders in Indiana and at the Indiana CTSI member institution’s key international partner sites was conducted over a six-month period with a special emphasis on the AMPATH partnership in Kenya. The first phase of the scan included interviews with 75 key stakeholders from IU, Purdue, Notre Dame, Indiana state government, local health practitioners, community groups, and long-standing LMIC partners. Semi-structured, in-person interviews were conducted to introduce the concept of reciprocal innovation, assess interest in reciprocal innovation, identify additional key stakeholders and start exploring critical health challenges, stakeholder priorities, and resources and opportunities. Interviewers provided written summaries of each interview to identify key themes. In follow-up to the preliminary stakeholder interviews, 121 Indiana-based and LMIC stakeholders were identified and invited to complete an online questionnaire to provide further input on how the reciprocal innovation program could best serve populations in Indiana and around the globe. Responses from Indiana stakeholders and LMIC stakeholders were tallied individually in order to analyze priorities, challenges, and barriers by country and compared with each other to identify commonalities. Overall, we found that the majority of stakeholders expressed support for the concept of reciprocal innovation and that they could identify several opportunities or candidates for a reciprocal innovation process to address health challenges in Indiana and in Kenya. Among identified barriers to reciprocal

innovation the three most cited were 1) lack of funding, 2) challenges in gaining community acceptance of reciprocal innovation projects, and accessing relevant populations, and 3) the lack of protected time and qualified people to conduct reciprocal innovation.

Stakeholder Meetings

Annual reciprocal innovation stakeholder meetings were started in 2019 to disseminate the concept of reciprocal innovation, engage more stakeholders in the reciprocal innovation process, and to identify key priorities and targets for reciprocal innovation. The first meeting in 2019 focused on Indiana stakeholders and priorities while the second meeting in 2020 focused on East Africa led by long standing partners at AMPATH in Kenya. A third meeting was held in 2021 to deepen connections between global and local investigators and provide support for the upcoming round of reciprocal innovation grants. At the first meeting, key stakeholders included researchers from Indiana CTSI institutions, the Indiana State Department of Health, and local organizations and used small groups to identify key health issues in Indiana and brainstorm potential topics for reciprocal innovation. Stakeholders identified the following priority areas for reciprocal innovation: 1) reducing chronic disease, 2) reducing substance abuse, 3) addressing infant and maternal health, and 4) strengthening access to healthcare. The second meeting focused on East African health priorities for reciprocal innovation, and due to the COVID-19 pandemic was held virtually in 2020. Key stakeholders attended from Moi University, Moi Teaching and Referral Hospital, Kenya Ministry of Health, Indiana CTSI institutions, and global health partners in the AMPATH consortium. Reciprocal innovation priorities identified by East African stakeholders were mental health, non-communicable diseases, infectious disease, infant and maternal health, and access to quality healthcare as top health challenges, illustrating significant overlap and shared health challenges with those identified in Indiana. The third meeting in 2021 was a two-day virtual conference. The first day was a reciprocal innovation workshop where globally- and locally-focused investigators were broken into small groups to build relationships, share reciprocal innovation ideas, and get feedback from CTSI Global Health leadership on potential reciprocal innovation grant projects. The second day was a plenary session hosted by Dr. Roger Glass, Director of the Fogarty International Center and Associate Director for International Research, followed by a panel discussion on the applications of reciprocal innovation and its role during global crises.

Reciprocal Innovation Grants Program

Based on the findings of the environmental scan and shared health priorities identified at the stakeholder meetings, a competitive reciprocal innovation grants program was established. Eligible applicants were investigators from an Indiana CTSI institution who had to either propose a plan to form or have an existing partnership with at least one investigator in an LMIC. The program established two types of grants - a reciprocal innovation planning grant of \$10,000 for one year to support partnership development and project planning, and a reciprocal innovation demonstration grant of \$50,000 for two years to conduct reciprocal innovation research activities.

Planning grants support preliminary partnership development and project planning that will ideally provide the groundwork for reciprocal innovation projects. The CTSI Global Health Program leadership felt that it was critical to support these early efforts to establish partnerships in reciprocal innovation since the concept and aims of the program were so new to many investigators. Planning grant applications are open on a rolling basis and reviewed by the Indiana CTSI Global Health Leadership team, with the program funding up to two planning grants per year.

Demonstration grants support existing global health research partnerships of the Indiana CTSI partner institutions to pilot implementation and assessment of innovations with a high potential to positively impact outcomes in the identified priority areas. The goal of the demonstration grant is to assist teams in generating pilot data for reciprocal innovation that can then be used to support additional extramural funding. Applications for demonstration grants are released once per year and reviewed by a formal selection committee modeled on an NIH proposal review committee, with representation from the Indiana CTSI institutions, Indiana State Department of Health, and international partners. The involvement of our international partners in the review and selection process for these awards continues to be an important aspect in the process of prioritizing innovations in a reciprocal way. The process was initially developed using teleconferencing and the novel use of video conferencing (at the time) to engage reviewers. We worked diligently to ensure that reviewers who had not participated in NIH style reviews were prepared. The creation of a robust selection process and team was a key feature of this process that was developed early on in the creation of our pilot awards. This provides an important platform for supporting true reciprocity in this process and it is a feature that's not always present in the selection processes sponsors use. It is worth highlighting this aspect as one of the key components of the reciprocal innovation process the Indiana CTSI established.

Educational Resources for Reciprocal Innovation

To increase awareness and support for the concept of reciprocal innovation, the Indiana CTSI Global Health Program created a series of videos and presentations on reciprocal innovation principles, the grants program, and previously funded projects. Moreover, we found that while global health investigators have strong connections to international partners in LMICs, they often are not well connected to locally-based researchers in Indiana. To support potential connections between locally- and globally-focused investigators, a Global Health Innovation Exchange was created as an online repository of reciprocal innovation projects. The repository is a living dashboard that is used to share updates on project progress, outcomes, and published materials. In addition to the repository, the annual reciprocal innovation stakeholder meetings provide further opportunities to link locally- and globally-focused researchers and foster the development of these partnerships. The program is also working to create additional educational modules for undergraduate and graduate students interested in public and global health, with a goal of increasing interest in reciprocal innovation, providing potential funding opportunities for graduate research projects, and increasing the pipeline of global health investigators harnessing reciprocal innovation approaches in their work.

Discussion

Lessons Learned

Several lessons have emerged in establishing and building a program for reciprocal innovation at the Indiana CTSI. First, given that the concept of reciprocal innovation is new to investigators, there continues to be an important educational component to our program to define the core principles and scope of reciprocal innovation in global health. This has been especially important in our grants program so that applicants align their approach and activities with reciprocal innovation. To address this challenge, we created educational videos on the concept of reciprocal innovation and specifically outlined the types of projects and approaches supported by the grants program. We also provide mentorship and consultation for investigators on their applications and provide guidance on how to better tailor to a reciprocal innovation approach. While the mentorship and consultation process is time consuming for the program, it provides significant benefit in strengthening reciprocal innovation applications and fosters a new generation of investigators who are fluent in the concept of reciprocal innovation. Still, introducing new approaches and funding mechanisms to support reciprocal innovation has been challenging and time intensive.

Second, as noted above, US investigators in global health have strong partnerships with international collaborators, but often face significant challenges in identifying and partnering with investigators working domestically. Conversely, domestic community-embedded researchers are often unaware of the global health work being done by investigators at their own institution. Partnerships between these core groups of investigators are key components of reciprocal innovation. To support linkages between locally and globally-focused researchers, we are developing a virtual platform to facilitate and foster collaborations between globally- and locally-focused investigators at Indiana CTSI institutions and international partners. We are in the process of creating a virtual commons that will be a meeting place to learn about reciprocal innovation approaches, present ongoing work in reciprocal innovation, and identify new areas and collaborations for reciprocal innovation. The continuous sharing of lessons learned and collaboration between globally- and locally-focused investigators alongside international partners in LMICs will leverage the power of developing, testing, and disseminating shared health solutions to shared health challenges.

Plans for the Future

The expansion goals for reciprocal innovation stretch both nationally and globally. To further connect global health and local researchers, the team's long-term goal is to expand the Global Health Innovation Exchange by including investigators and projects from other clinical and translational science awards (CTSA), linking to other exchanges, and/or serving as a reference directory for interested global and local investigators. This would leverage the unique strengths of different CTSA and increase opportunities for: 1) identifying investigators to partner in reciprocal innovation projects; 2) identifying internal and extramural funding opportunities; and 3) testing proof of concept that reciprocal innovation represents a powerful approach to research that can be successfully replicated at other CTSA. Partner CTSA and

their investigators would have access to and contribute to building a variety of resources through the reciprocal innovation platform developed and piloted at the Indiana CTSI Global Health Program.

The Indiana CTSI has long standing and strong international partnerships with investigators in Kenya. Although funded reciprocal innovation projects can and have taken place in different countries around the world, a majority of them are rooted in Kenya. To expand globally, we are working to identify and include other global partnerships and institutions in LMICs to engage in reciprocal innovation projects. As first steps, we have invited other global partners to attend annual stakeholder meetings, presented the concept of reciprocal innovation at academic conferences, and engaged leadership at AMPATH Consortium schools that have budding partnerships in Ghana, Mexico, and Nepal. Once these foundations of long-term commitment are built, we can extend beyond the north-south framework to include south-south and multilateral partnerships.

Finally, building support for reciprocal innovation requires recognizing and measuring the mutual benefits that are gained from such an approach in global health. Considering the current global COVID-19 pandemic and the crucial lessons being learned from international partnerships [36], it is difficult to justify not investing in such programs with the potential for bilateral gains and advances. Investments made are returned several-fold as new innovations and perspectives benefit all parties, as demonstrated in Case Study 3. Compiling high quality evidence for mutual benefit and returns on investment on projects often funded by HICs are critical for sustained and increased funding in global health. This is one reason why we believe that research programs in reciprocal innovation have such an important role to play.

Case Study 3: Approaches to Maternal Health in Indiana using the Kenyan model

Shared Challenge: In both Kenya and Indiana, maternal and infant mortality are unacceptably high, and there are insufficient healthcare providers to meet all maternal child healthcare needs. Even when healthcare providers are available, access to care remains a barrier.

Innovation: Training and deploying community health workers (CHW) to provide care and education throughout their own communities in western Kenya and Indiana provides evidence-based, patient-centered social care and support by training CHW in techniques to guide and support mothers, fathers and caregivers toward behavior changes that decrease risk factors for infant mortality.

Reciprocal Benefit to LMICs: Women in the intervention group, compared with the control group, had significantly better outcomes including: more frequent hospital deliveries; shorter time in labor; exclusive breastfeeding; earlier return to work in the tea fields; and less anemia. This method of delivering services has been integral to the success of AMPATH's HIV care and control program and has expanded to address economic empowerment, chronic disease care, and maternal-child health.

Reciprocal Benefit to HICs: Utilizing this model, in Indiana infant mortality rates in Marion County, Indianapolis were targeted by training CHW in techniques to guide and support mothers, fathers and caregivers toward behavior changes that decrease risk factors for infant mortality.

References: [37]

Conclusion

Reciprocal innovation represents a new approach to engaging partners in deep and mutually beneficial ways in global health partnerships that are more apt to addressing critical health needs. We recognize that the importance of investing to improve the health and security of our global population is also an opportunity to improve the health and security of our local community in the US. As we grapple with the global COVID-19 pandemic, it continues to be evident that investments in health security on a global scale have direct economic implications in the health and wellbeing of US populations as well. What we have learned from these experiences is that a more equitable and bi-directional approach to global health partnerships will be essential in order to build stability through evidence-based interventions, new technological advancements, and novel healthcare delivery approaches. For example, members of the Community Health Impact Coalition advocated early in the COVID-19 pandemic for deploying CHWs to buffer the impact on the poor and vulnerable in LMIC who were being disproportionately affected by the pandemic. The US similarly identified disparities in the impact on vulnerable populations [37]. Heeding the Coalition's recommendation to deploy CHW, research in Central Indiana demonstrated the positive impact CHW had on assisting vulnerable older adults stay connected to essential medical and social resources during the pandemic [38]. Global health equity priorities are also US health priorities and we have developed the Indiana CTSI reciprocal innovation approach and program in an effort to improve the efficiency and effectiveness of our global health investments through mutual benefit and a focus on equity.

Methods

Not applicable.

Declarations

Ethics approval and consent to participate

n/a

Consent for publication

n/a

Availability of data and materials

n/a

Competing interests

The authors declare that they have no competing interests.

Funding

The Indiana CTSI Global Health Program is supported by the Indiana Clinical and Translational Sciences Institute which is funded in part by Award Number UL1TR002529 from the National Institutes of Health, National Center for Advancing Translational Sciences, Clinical and Translational Sciences Award. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The funding agency had no role in the writing of the manuscript.

Authors' contributions

TS, LYB, ML, SM, NMS, SW, KWK, and DL conceived of the overall design and provide leadership for the Indiana CTSI Global Health Program and this manuscript. All authors have been engaged in programmatic activities that informed the manuscript. TS, RO, and MS led the writing of the initial draft of the manuscript. All authors (TS, RO, MS, LYB, IC, AG, JK, ML, SM, NMS, WN, DP, BR, WT, RV, SW, KWK, DL) provided significant input and feedback on subsequent versions of the manuscript and approved of the final version. KWK and DL are recognized as co-senior authors of this manuscript.

Acknowledgements

n/a

Authors' information

n/a

Footnotes

n/a

References

1. Packard RM. A history of global health: interventions into the lives of other peoples. Baltimore: Johns Hopkins University Press; 2016.
2. Syed SB, Dadwal V, Martin G. Reverse innovation in global health systems: towards global innovation flow. *Global Health*. 2013;9:36.
3. Horton R. Offline: is global health neocolonialist? *The Lancet*. 2013;382(9906):1690.
4. Kim JU, Oleribe O, Njie R, Taylor-Robinson SD. A time for new north-south relationships in global health. *Int J Gen Med*. 2017;10:401–8.
5. Immelt JR, Govindarajan V, Trimble C. How GE is disrupting itself *Harv Bus Rev*. October 2009.
6. Syed SB, Dadwal V, Rutter P, Storr J, Hightower JD, Gooden R, et al. Developed-developing country partnerships: benefits to developed countries? *Global Health*. 2012;8:17.
7. Cadee F, Nieuwenhuijze MJ, Lagro-Janssen AL, De Vries R. The state of the art of twinning, a concept analysis of twinning in healthcare. *Global Health*. 2016;12(1):66.

8. Harris M, Dadwal V, Syed SB. Review of the reverse innovation series in globalization and health - where are we and what else is needed? *Global Health*. 2020;16(1):26.
9. Ibe CA, Basu L, Gooden R, Syed SB, Dadwal V, Bone LR, et al. From Kisiizi to Baltimore: cultivating knowledge brokers to support global innovation for community engagement in healthcare. *Global Health*. 2018;14(1):19.
10. Johnson CD, Noyes J, Haines A, Thomas K, Stockport C, Ribas AN, et al. Learning from the Brazilian community health worker model in North Wales. *Global Health*. 2013;9:25.
11. Singh P. Bringing the concepts of peer coaches and local health workers from Africa to Harlem. *Health Aff (Millwood)*. 2012;31(12):2801–2.
12. van de Vijver S, Oti S, Moll van Charante E, Allender S, Foster C, Lange J, et al. Cardiovascular prevention model from Kenyan slums to migrants in the Netherlands. *Global Health*. 2015;11:11.
13. Ahmed F, Ahmed N, Briggs TWR, Pronovost PJ, Shetty DP, Jha AK, et al. Can reverse innovation catalyse better value health care? *Lancet Glob Health*. 2017;5(10):e967-e8.
14. Bhattacharyya O, Wu D, Mossman K, Hayden L, Gill P, Cheng YL, et al. Criteria to assess potential reverse innovations: opportunities for shared learning between high- and low-income countries. *Global Health*. 2017;13(1):4.
15. Harris M, Macinko J, Jimenez G, Mullachery P. Measuring the bias against low-income country research: an Implicit Association Test. *Global Health*. 2017;13(1):80.
16. Crisp N. Mutual learning and reverse innovation—where next? *Global Health*. 2014;10:14.
17. Depasse JW, Lee PT. A model for 'reverse innovation' in health care. *Global Health*. 2013;9:40.
18. Harris M, Weisberger E, Silver D, Dadwal V, Macinko J. That's not how the learning works - the paradox of Reverse Innovation: a qualitative study. *Global Health*. 2016;12(1):36.
19. Koplan JP, Bond TC, Merson MH, Reddy KS, Rodriguez MH, Sewankambo NK, et al. Towards a common definition of global health. *Lancet*. 2009;373(9679):1993–5.
20. Pai M. Reciprocity in global health: here is how we can do better. *Forbes Magazine*. March 6, 2020.
21. Citrin D, Mehanni S, Acharya B, Wong L, Nirola I, Sherchan R, et al. Power, potential, and pitfalls in global health academic partnerships: review and reflections on an approach in Nepal. *Glob Health Action*. 2017;10(1):1367161.
22. Crane JT. Unequal 'partners'. *AIDS, academia, and the rise of academic global health*. *Behemoth: a Journal of Civilisation*. 2010;3(3):78–97.
23. Crane JT, Andia Biraro I, Fouad TM, Boum Y, 2nd, D RB. The 'indirect costs' of underfunding foreign partners in global health research: A case study. *Glob Public Health*. 2018;13(10):1422–9.
24. Gautier L, Sieleunou I, Kalolo A. Deconstructing the notion of "global health research partnerships" across Northern and African contexts. *BMC Med Ethics*. 2018;19(Suppl 1):49.
25. Smith E, Hunt M, Master Z. Authorship ethics in global health research partnerships between researchers from low or middle income countries and high income countries. *BMC Med Ethics*. 2014;15:42.

26. Janowicz DM. HIV Transmission and Injection Drug Use: Lessons From the Indiana Outbreak. *Top Antivir Med.* 2016;24(2):90–2.
27. Collins says global health is one of his top priorities. Washington, D.C.: Global Health Matters Volume 8, Issue 4. Fogarty International Center. Available at: https://www.fic.nih.gov/NEWS/GLOBALHEALTHMATTERS/Pages/0809_collins.aspx; July-August 2009.
28. Einterz RM, Kimaiyo S, Mengech HN, Khwa-Otsyula BO, Esamai F, Quigley F, et al. Responding to the HIV pandemic: the power of an academic medical partnership. *Acad Med.* 2007;82(8):812–8.
29. Mercer T, Gardner A, Andama B, Chesoli C, Christoffersen-Deb A, Dick J, et al. Leveraging the power of partnerships: spreading the vision for a population health care delivery model in western Kenya. *Global Health.* 2018;14(1):44.
30. Goodrich S, Siika A, Mwangi A, Nyambura M, Naanyu V, Yiannoutsos C, et al. Development, Assessment, and Outcomes of a Community-Based Model of Antiretroviral Care in Western Kenya Through a Cluster-Randomized Control Trial. *J Acquir Immune Defic Syndr.* 2021;87(2):e198-e206.
31. Tierney WM, Nyandiko WN, Siika AM, Wools-Kaloustian K, Sidle JE, Kiplagat J, et al. "These are good problems to have... establishing a collaborative research partnership in East Africa. *J Gen Intern Med.* 2013;28 Suppl 3:S625-38.
32. Turissini M, Mercer T, Baenziger J, Atwoli L, Einterz R, Gardner A, et al. Developing Ethical and Sustainable Global Health Educational Exchanges for Clinical Trainees: Implementation and Lessons Learned from the 30-Year Academic Model Providing Access to Healthcare (AMPATH) Partnership. *Ann Glob Health.* 2020;86(1):137.
33. Chikowe I, Bliese SL, Lucas S, Lieberman M. Amoxicillin Quality and Selling Practices in Urban Pharmacies and Drug Stores of Blantyre, Malawi. *Am J Trop Med Hyg.* 2018;99(1):233–8.
34. Lockwood TE, Huynh P, Richard A, Sightes E, Bailey K, Ray B, et al. Community overdose surveillance: Comparing substances collected from the death scene investigation to toxicology results. *Drug Alcohol Depend.* 2021;224:108722.
35. Lockwood TE, Leong TX, Bliese SL, Helmke A, Richard A, Merga G, et al. idPAD: Paper Analytical Device for Presumptive Identification of Illicit Drugs. *J Forensic Sci.* 2020;65(4):1289–97.
36. Bump JB, Friberg P, Harper DR. International collaboration and covid-19: what are we doing and where are we going? *BMJ.* 2021;372:n180.
37. Ballard M, Bancroft E, Nesbit J, Johnson A, Holeman I, Foth J, et al. Prioritising the role of community health workers in the COVID-19 response. *BMJ Glob Health.* 2020;5(6).
38. Hodges M, Butler D, A. S, Litzelman D. The role of community health workers in assisting older adults during the COVID pandemic. Abstract at the American Geriatrics Society Meeting, May 14, 2021 (Virtual).

Figures

Shared Health Challenges

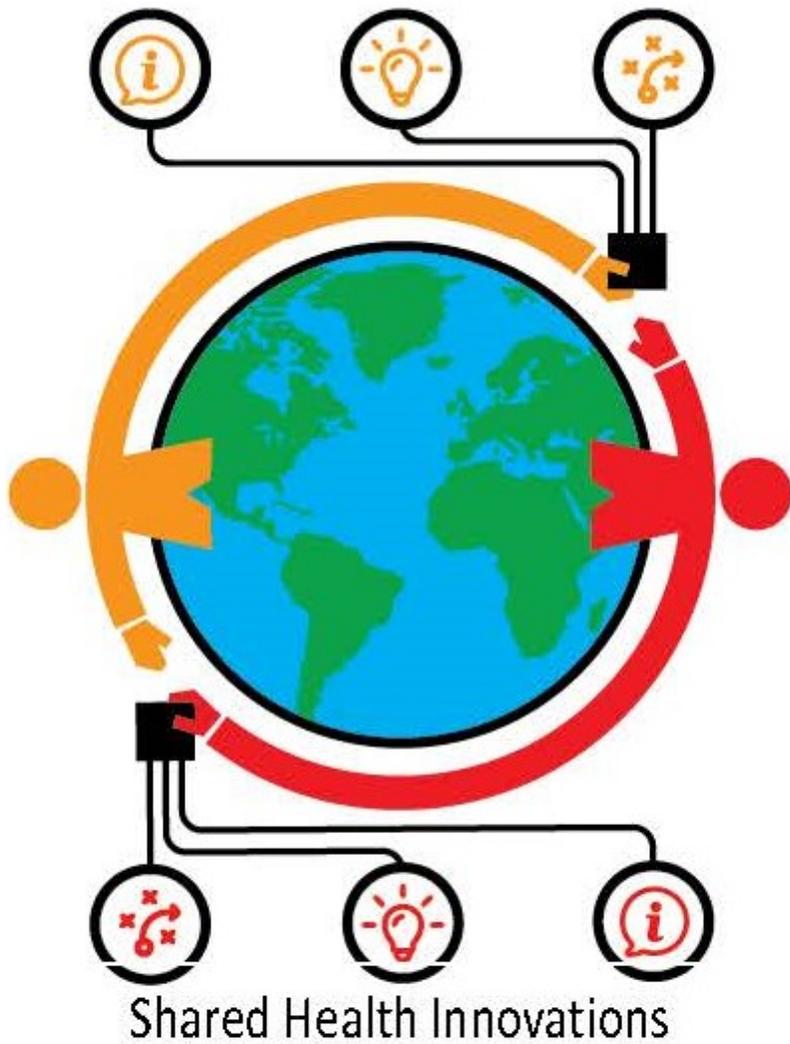


Figure 1. Reciprocal Innovation model: Our 'reciprocal innovation' model in global health starts by engaging key US and international partners in a bidirectional process that identifies and prioritizes the health challenges to be addressed, and leads to delivering solution  through co-development of healthcare innovations  and exchange of information .

Figure 1

See image above for figure legend.



Figure 2

The Indiana CTSI process for identifying priority areas of opportunities for Reciprocal Innovation supported through Planning and Demonstration Grants. In the first step of the process stakeholders are identified through an “environmental scan” that includes both “local” and “global” partners. This is followed by a Stakeholders Meeting whereby shared healthcare priority areas are identified. This allows for the convergence of local and global partner priorities that are then used to inform a competitive Reciprocal Innovation grants program funded by the Indiana CTSI.