Implementation science in resource-poor countries and communities

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Abstract

Background: Implementation science in resource-poor countries and communities is arguably more important than implementation science in resource-rich settings, because resource poverty requires novel solutions to ensure that research results are translated into routine practice and benefit the largest possible number of people.

Methods: We reviewed the role of resources in the extant implementation science frameworks and literature. We analyzed opportunities for implementation science in resource-poor countries and communities, as well as threats to the realization of these opportunities.

Results: Many of the frameworks that provide theoretical guidance for implementation science view resources as contextual factors that are important to (i) predict the feasibility of implementation of research results in routine practice, (ii) explain implementation success and failure, (iii) adapt novel evidence-based practices to local constraints, and (iv) design the implementation process to account for local constraints. Implementation science for resource-poor settings shifts this view from "resources as context" to "resources as primary research object." We find a growing body of implementation research aiming to discover and test novel approaches to generate resources for the delivery of evidence-based practice in routine care, including approaches to create higher-skilled health workers—through tele-education and telemedicine, freeing up higher-skilled health workers—through task-shifting and new technologies and models of care, and increasing laboratory capacity through new technologies and the availability of medicines through supply chain innovations. In contrast, only few studies have investigated approaches to change the behavior and utilization of healthcare resources in resource-poor settings. We identify three specific opportunities for implementation science in resource-poor settings. First, intervention and methods innovations thrive under constraints. Second, reverse innovation transferring novel approaches from resource-poor to research-rich settings will gain in importance. Third, policy makers in resource-poor countries tend to be open for close collaboration with scientists in implementation research projects aimed at informing national and local policy.

Conclusions: Implementation science in resource-poor countries and communities offers important opportunities for future discoveries and reverse innovation. To harness this potential, funders need to strongly support research projects in resource-poor settings, as well as the training of the next generation of implementation scientists working on new ways to create healthcare resources where they lack most and to ensure that those resources are utilized to deliver care that is based on the latest research results.

Keywords: Implementation, Resource-poor settings, Resources, Capacity, Reverse innovation, Research methods, Capacity building

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Many of the physical constraints that impede the routine delivery of effective health interventions to those who can benefit are (by definition) far more severe in resource-poor than in resource-rich countries. For instance, for each citizen, the resource-poor countries of sub-Saharan Africa spend only a fraction of the amount on health that the resource-rich countries of Western Europe spend, and the numbers of doctors and nurses per population are orders of magnitudes lower in Africa than in Europe (Fig. 1). At the same time, amenable mortality—i.e., the mortality that existing effective healthcare technologies could eliminate if they were delivered successfully to all those who can benefit—is far higher in resource-poor countries than in resource-rich ones (Fig. 1) [1, 2]. This “inverse care law” in cross-country comparison—the “availability of good medical care tends to vary inversely with the need for it in the population served” [3]—is of course merely a global version of the classic inverse care law, which operates across communities within both resource-rich and resource-poor countries. In this editorial, we are addressing specific features of implementation science for both resource-poor countries and resource-poor communities, recognizing that scarcity and deprivation affecting the delivery of evidence-based healthcare exist worldwide and across all geographic areas and that there is a continuum from resource poverty to resource wealth in all countries.

An obvious approach to reduce the high levels of amenable mortality in resource-poor countries and communities is to increase the financial resources available for healthcare. This approach, however, requires either substantial economic growth—which may fail to emerge in both resource-poor countries and resource-poor communities [4]—a redistribution of existing resources across sectors—which is difficult to achieve for obvious political reasons [6]—or external assistance—which cannot be relied on over the long term as donor priorities shift frequently [7, 8]. Another approach is to create new resources to deliver effective health interventions given the existing financial constraints. Implementation science can contribute to this approach as the science of the discovery, design, and evaluation of novel approaches to deliver evidence-based healthcare practice.

Creating resources
The goal of implementation science is to discover and test approaches “to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services” [9]. Many of the frameworks that provide theoretical guidance for implementation science feature resources and physical capacity to deliver evidence-based practice—such as health workers, drugs, supply chains, and healthcare facilities—as part of the context of implementation [10–27]. In these frameworks, assessments of the resources context are used to guide analysis or action, e.g., to (i) predict the feasibility of implementation of a novel evidence-based practice [16, 25, 28], (ii) explain implementation success and failure [11–13, 24, 26, 29], (iii) adapt a novel evidence-based practice to local constraints [15, 19, 20, 23, 30], and (iv) design the implementation process to account for local constraints [17, 22, 30]. As such, in these theoretical frameworks—and in the implementation science for resource-rich settings they have been derived from and guide—resources are viewed as important contextual factors. Implementation science for resource-poor settings shifts this view from “resources as context” to “resources as primary research object” [31]. Table 1 shows examples of implementation science in resource-poor countries and communities testing approaches to expand human resources for health—through tele-education, tele-medicine, task-shifting to lower-skilled health workers, task-shifting to clients, new models of care, and technological innovation—and to increase laboratory capacity and supplies. A large body of implementation science in resource-poor countries and communities has focused on creating resources for evidence-based healthcare. This research is likely to continue with vigor because “there need to be minimal human resources, financing, drugs, and supply systems before effective interventions can be delivered” [31]. In particular, research developing and testing community health worker programs [32]—which are widely viewed as one of the few viable solutions to the persistent health worker shortages in many resource-poor countries and communities [33–35]—and information and communication technologies—which can provide affordable training and decision support for health workers anywhere—will continue to attract increasing implementation research funding [36–38].

Changing behavior
In contrast to research aimed at increasing resources, to date, comparatively few studies in resource-poor settings have investigated approaches to change the behavior and utilization of those resources to ensure that research findings are translated into routine practice. A 2017 “overview of systematic reviews” on “implementation strategies for health systems in low-income countries” published in the Cochrane Database of Systematic Reviews is a case in point [39]. The 18 systematic reviews on different strategies to change health worker behavior in this overview article—education materials [40], internet-based learning [41], educational meetings and workshops [42–45], educational outreach [46–48], local opinion leaders [49], audit and feedback [50], reminders [51], tailored interventions [52], and multi-faceted
Fig. 1 Comparing resource-rich and resource-poor countries. Per-capita total healthcare expenditures and per-capita research and development expenditures are in 2011 international $. Physician, nurse, and researcher population densities are shown per 1000 population.
| Health systems function | Delivery innovation | Delivery control | Outcomes | Study design | Population | Country | Reference |
|-------------------------|---------------------|------------------|----------|--------------|------------|---------|-----------|
| Creating higher-skilled human resources for health through tele-education | | | | | | | |
| Training on neonatal resuscitation | Tele-education | Conventional classroom teaching | • Knowledge scores | RCT | Staff nurses | India | Jain et al. Journal of Perinatology 2010 [112] |
| Training on retinopathy of prematurity diagnosis | Tele-education | Standard onsite training | • Sensitivity of retinopathy of prematurity diagnosis | RCT | Ophthalmology residents | Mexico | Patel et al. Ophthalmology 2017 [113] |
| Education on nursing, public health, child and adolescent health, mental health | Tele-education | No control | • Tele-education participation | Process evaluation | Primary care staff | Brazil | Joshi et al. Journal of Telemedicine and Telecare 2011 [114] |
| Creating higher-skilled human resources for health through telemedicine | Teleneurology (tele-education and surgical treatment planning, teleconsultation, telepathology, teleradiology, and telesurgical conferences) | Standard of care at the time of the study | • Endocrine surgery rate | UBA | General surgeons | India | Pradeep et al. World Journal of Surgery 2007 [115] |
| Dermatological diagnosis | Internet-based teledermatology system | Face-to-face examination | • Agreement between the two diagnostic approaches | Validation study | Junior doctors | Brazil | Chao et al. Telemedicine Journal and Ehealth 2003 [116] |
| Intensive care | Tele-intensive care unit | Standard of care at the time of the study | • Number of ICU patients per month | UBA | Nurses | Syria | Moughrabieh et al. Annals of the American Thoracic Society 2016 [117] |
| Freeing up human resources through task-shifting to lower-skilled health workers | | | | | | | |
| HIV treatment initiation and management | Nurses | Standard of care at the time of the study (doctors) | • Mortality | RCT | Adult HIV patients in primary care | South Africa | Fairall et al. Lancet 2012 [118] |
| Depression and anxiety screening, diagnosis and treatment | Lay village health workers together with primary care doctors, supported by an electronic decision support system | Standard of care at the time of the study (trained mental health professionals) | • Mortality | UBA | Members of rural scheduled tribe communities | India | Maulik et al. Journal of Global Health 2017 [119] |
| Hypertension treatment | Community health nurses delivering the WHO Package of Essential NCD Interventions (WHO PEN) | Standard of care at the time of the study | • Blood pressure | RCT | Patients visiting community health centers | Ghana | Ogedegbe et al. Implementation Science 2014 [120] |
| HIV and HIV risk screening and linkage to care for children | Community health workers | Standard of care at the time of the study | • Identification of HIV-infected and HIV-exposed children | UBA | Children born to mothers living with HIV | Malawi | Ahmed et al. Journal of the International AIDS Society 2015 [121] |
| Health systems function | Delivery innovation | Delivery control | Outcomes | Study design | Population | Country | Reference |
|-------------------------|---------------------|------------------|----------|--------------|------------|---------|-----------|
| HIV treatment           | Lay health workers  | Standard of care at the time of the study (doctors and nurses) | - Viral suppression | RCT | Adult HIV patients in primary care | Tanzania | Geldsetzer et al. BMC Health Services Research 2017 [122] |
| Antenatal and postnatal counselling | Lay nurse aides using job aids | Professional nurses using job aids | - Coverage with correct antenatal and postnatal messages | NRC | Women in antenatal care | Benin | Jennings et al. Implementation Science 2011 [123] |
| HIV treatment initiation | Community health workers providing home-based HIV treatment initiation | Standard of care at time of the study (only facility-based initiation of HIV treatment) | - HIV treatment initiation | RCT | General population | Malawi | Macpherson et al. JAMA 2014 [124] |
| Freeing up human resources through task-shifting to clients | | | | | | | |
| HIV testing | HIV self-testing | Standard of care at the time of the study (facility HIV testing) | - HIV testing rates | RCT | Female sex workers | Uganda, Zambia | Ortblad et al. PLOS Medicine 2017 [125], Chanda et al. PLOS Medicine 2017 [126] |
| HIV testing | Unsupervised HIV self-testing | Provider-supervised HIV self-testing | - Sensitivity | RCT | Fisherfolk | Uganda | Asiimwe et al. AIDS & Behavior 2014 [127] |
| Cervical cancer screening | Vaginal self-collection of specimens | Cervical specimens collection by clinician | - Sensitivity | Validation study | Adult women | India, Nicaragua, Uganda | Jeronimo et al. International Journal of Gynecological Cancer 2014 [128] |
| Freeing up human resources through new models of care | | | | | | | |
| HIV treatment | Community-based adherence clubs | Standard of care at the time of the study | - Loss to follow-up | NRC | Adult HIV patients in primary care | South Africa | Grimsrud et al. AIDS 2016 [62] |
| Buruli ulcer detection and treatment | Buruli ulcer community of practice composed of hospital staff, former patients, CHWs, and traditional healers | Standard of care at the time of the study | - Buruli ulcer detection rate | UBA | General population | Cameroon | Awah et al. PLOS Neglected Tropical Diseases 2018 [129] |
| Family healthcare services | Community-based family health program | Standard of care at the time of the study | - Mortality rates | UBA | Children (aged 10–17) and adults | Brazil | Rocha et al. Health Economics 2010 [130] |
| Freeing up human resources through technological innovations | | | | | | | |
| Encouragement to remain in postpartum care | Text messages | Standard of care at the time of the study | - Maternal postpartum visit attendance | RCT | Pregnant women enrolled in public sector PMTCT program | Kenya | Odeny et al. AIDS 2014 [131] |
| Hypertension treatment | Automated self-management calls plus home blood pressure monitoring | Standard of care at the time of the study | - Systolic blood pressure | RCT | Adult patients with hypertension in primary care | Honduras and Mexico | Piette et al. Telemedicine Journal and Ehealth 2012 [132] |
### Table 1 Implementation research to increase resources (Continued)

| Health systems function | Delivery innovation | Delivery control | Outcomes | Study design | Population | Country | Reference |
|-------------------------|---------------------|------------------|----------|--------------|------------|---------|-----------|
| Encouragement to adhere to hypertension treatment | Text messages | Standard of care at the time of the study | • Systolic blood pressure | RCT | Adult patients with hypertension in primary care | South Africa | Bobrow et al. Circulation 2016 [133] |
| Encouragement to adhere to HIV treatment | Text messages | Standard of care at the time of the study | • Adherence • Viral suppression | RCT | Adult patients with hypertension in primary care | Kenya | Lester et al. Lancet 2010 [134] |
| Neurocognitive impairment screening | NeuroScreen mobile app administered by a lay health worker | Neuropsychological test battery administered by research psychometrist | • Sensitivity • Specificity | Validation study | Adult HIV patients in primary care | South Africa | Robbins et al. Journal of Medical Internet Research MHealth UHealth 2018 [77] |

Increasing laboratory capacity through technological innovations

| Viral load monitoring | Point-of-care viral load test using capillary blood | Laboratory viral load test using venous blood | • Sensitivity • Specificity | Validation study | Adult HIV patients in primary care | Mozambique | Jani et al. Journal of Clinical Microbiology 2016 [135] |
|-----------------------|--------------------------------------------------|-----------------------------------------------|--------------------------|-----------------------------|---------------------|-------------|-----------|
| CD4 testing           | Point-of-care CD4 test using capillary blood     | Laboratory CD4 test using venous blood       | • Sensitivity • Specificity | Validation study | Adult HIV patients in primary care | Zimbabwe | Mitapuri-Zinyowera et al. Journal of Acquired Immune Deficiency Syndromes 2010 [136] |
| CD4 testing           | Point-of-care CD4 test using capillary blood     | Laboratory CD4 test using venous blood       | • Loss to follow-up      | UBA | Adult HIV patients in primary care | Mozambique | Jani et al. Lancet 2011 [137] |
| Tuberculosis diagnosis| Point-of-care TB test performed by nurses in primary care clinics | Laboratory TB test using venous blood | • Sensitivity • Specificity • Same-day diagnosis • Same-day treatment initiation • Loss to follow-up | cRCT | Adult primary care patients | South Africa, Tanzania, Zambia, Zimbabwe | Therion et al. Lancet 2014 [138] |
| Breast cancer screening | Point-of-care breast imaging device | Standard of care (clinical breast examination) | • Sensitivity • Specificity • Positive predictive value • Negative predictive value | Validation study | Healthy women visiting a hospital | India | Somashekar et al. Indian Journal of Gynecologic Oncology 2016 [139] |

Increasing the availability of medicines through supply chain innovations

| Nevirapine (NVP) prophylaxis for HIV-exposed infants | Pratt Pouch delivery system | No control | • Administration of NVP to infants • Infant dried blood spot NVP concentration | Process evaluation | HIV-exposed infants and their mothers | Tanzania | Dahinten et al. Pediatric Infectious Diseases 2016 [140] |
|-----------------------------------------------------|-----------------------------|------------|-----------------------------------------------|------------------|-----------------------------|---------|-----------|
| Access to artemisinin-based combination therapy (ACT) antimalarials | Private-sector Accredited Drug Dispensing Outlet (AADO) | Public sector distribution | • Uptake of ACT • Availability of ACT | UBA | Adults and children | Tanzania | Rutta et al. Health Research Policy and Systems 2011 [141] |
| Access to oral rehydration salts (ORS) and zinc for children | Private-sector distribution channels (Coca Cola) | Public sector distribution | • Availability of ORS and zinc at rural retail outlets • Distance traveled by caregivers to obtain ORS and zinc • Use of ORS and zinc in infants | CBA | Community retailers, children and their caregivers | Zambia | Berry et al. Endline report: ColaLife Operational Trial Zambia 2014 [142] |
| Vaccine supply chain | Public-private partnership for vaccine supply | Government-managed supply | • Vaccine stock • Immunization coverage | UBA | Regional zone stores, primary healthcare facilities | Nigeria | Molemoodile et al. Global Public Health 2017 [143] |
interventions [42, 47, 50, 53]—synthesized 820 primary studies. Among these primary studies, which can be viewed as the global knowledge base on strategies to change health worker behavior, only 13 (or 1.6%) took place in a low-income country and only 82 (10.0%) took place in a middle-income country. There is thus strong potential for resource-poor countries to learn from the experiences in resource-rich countries. Clearly, some evidence generated in resource-rich settings is highly relevant for resource-poor settings—if “the implementation strategies considered ... address a problem that is important in low-income countries, would be feasible, and would be of interest to decision-makers in low-income countries” [39]. Equally clearly, however, studies systematically investigating the transferability of the large body of evidence on strategies to change health worker behavior generated in resource-rich countries are urgently needed. In addition to the obvious resources gradient, reasons why evidence on effective practice cannot be transferred from resource-rich to resource-poor settings may include important differences in political and institutional factors [54–56]. While transfer of evidence from any one to any other context will always need to take account of these factors, there will often be particularly large differences in the answers to questions such as those posed by the “Tailored Implementation for Chronic Diseases Checklist” (TICD Checklist) when considering evidence transfer from resource-rich to resource-poor settings: Do “influential people”, “political stability”, and “corruption” facilitate or hinder implementation of necessary changes?” [30]. In many cases, successful implementation of evidence-based practice in resource-poor settings will thus require research to learn how to best adopt strategies that have proven effective in resource-rich settings, as well as the discovery and evaluation of wholly new approaches.

**Creativity and reverse innovation**

Resource constraints, however, are not only an important object of implementation research in resource-poor countries and communities, but they are also a powerful stimulus for creativity [57]. The psychological and marketing literature shows that creativity thrives when choices are restricted [58–60]. It is likely that the severe human and physical resources constraints in the health systems of resource-poor countries and communities have boosted discovery in implementation science for health. Routine healthcare in resource-poor countries and communities is often provided by nurses and community health workers, without access to basic medical equipment, in primary care clinics or in homes without reliable referral chains to higher-level care. As a result of these constraints and the large differences between “ideal” and “real-world” delivery in resource-poor countries and communities, innovation is likely to thrive, because greater creativity is required to ensure that scientific innovations can be delivered in routine health-care practice.

The implementation research leading to novel approaches to deliver HIV care in resource-poor countries and communities illustrates this creativity. Implementation researchers have worked with implementers to discover, design, and test such highly innovative approaches as social clubs [61–66], street dispensing machines [67, 68], and drones [69, 70] to deliver HIV antiretroviral drugs, as well as mobile phone technology to provide HIV prevention education [71–73]. In many other areas, major and minor innovations are continuously increasing capacity and quality of care in resource-poor countries and communities, such as the multitude of novel eHealth [74, 75], mHealth [76–79], and telemedicine [80] applications. This creativity under constraints leads to potential for “reverse innovation” [81, 82], i.e., innovation arising first in resource-poor
settings and only later spreading to resource-rich settings. According to a recent review, important areas for future “reverse innovation” in healthcare include “rural health service delivery; skills substitution; decentralization of management; creative problem-solving; education in communicable disease control; innovation in mobile phone use; low technology simulation training; local product manufacture; health financing; and social entrepreneurship” [83]. In several research areas—e.g., skills substitution and innovation in mobile phone use (Table 1)—evidence is likely to continue to increase substantially in resource-poor—but not in resource-rich—settings, opening up opportunities for “reverse” flows of innovation and experience.

**Methods innovations**

The definitional characteristic of resource-poor settings, resource poverty, also has implications for the methods of implementation science, stimulating the development of new approaches. For instance, the stepped-wedge cluster randomized controlled trial—in which clusters, such as communities or clinics, are randomized to an exposure sequence over time rather than to one-time-invariant exposure as in the traditional parallel-arm trial—was first envisioned, developed, and used for a study in The Gambia in 1987 [84]. The stepped-wedge trial remains a methods mainstay of implementation science in resource-poor countries today [85–89]. One of the motivations for choosing a stepped-wedge over a parallel-arm design is that in the latter all communities “within the study eventually receive the intervention, thereby improving equity and acceptability” [90]. In contrast, traditional parallel-arm cluster randomized trials withhold the intervention that is tested from the communities in the control arm over the entire course of the study. This assignment can lead to political opposition to a study, because community members perceive value in the intervention to be tested. Such political opposition, in turn, is typically stronger in resource-poor than in resource-rich communities, because the former often lack many of the basic amenities and services that the latter have good access to.

Other methods innovations in implementation science in resource-poor countries have been driven by a lack of resources for science. On average, low-income countries spend far less money on science and have far fewer scientists per population than high-income countries [91] (Fig. 1). To overcome resource constraints in research, implementation scientists have developed novel approaches to collect and analyze data using information and communication technologies. These innovations include field workers and community health workers using mobile phones to collect survey data [92], screen for diseases [93], and record healthcare utilization events [94]. Resource poverty can also cause or exacerbate variation in the scale-up of novel interventions across communities and—because of rationing—across individuals [95]. Such exposure variations, in turn, offer opportunities for innovative quasi-experiments to evaluate implementations of health interventions. Examples of such quasi-experimental designs include regression discontinuity—which can be used when threshold rules are used to determine eligibility for an intervention [96, 97]—and difference-in-differences—which exploits changes in intervention exposure in one set of communities while the exposure in another set remains unchanged [98, 99]. Quasi-experiments have the added advantage that they are typically far cheaper to carry out than experiments which require a prospective research infrastructure and substantial investment in trial processes. Finally, quasi-experiments take place in “real-life” without the distorting influences of experimental intervention which can introduce artificiality into the implementation context [100]. As such, quasi-experiments have been popular to establish causal impacts of interventions in resource-poor countries and communities [101], but they are of course equally valuable in resource-rich settings [102].

**Creating research capacity**

Implementation science is unlikely to be an exception to the general rule that resource-poor countries have far fewer researchers per population than resource-rich countries (Fig. 1). It may be possible to overcome the resulting “inverse care law” of implementation science—capacity is lowest where need is highest—with innovative solutions for training the next generation of implementation researchers in resource-poor countries. Major international funders, such as the Fogarty International Center of the US National Institutes of Health, are currently making large investments in South-South and South-North partnerships for implementation science training [103]. Several universities in the Global South have recently started to offer master and doctoral degrees in implementation science, such as the University of Nairobi (Kenya), University of Ghana, University of Zambia, University of the Witwatersrand (South Africa), BRAC University (Bangladesh), Universidad de Antioquia (Colombia), Universitas Gajdah Mada (Indonesia), and the University of Beirut (Lebanon) [104]. Another important opportunity to increase capacity for implementation science are massive open online courses (MOOCs), which provide (free or inexpensive) training in implementation science through online learning platforms (see Table 2 for two examples). Reflecting the reality of implementation science projects in resource-poor countries, these research programs include training in theory and formative research for intervention design;
process, impact, and economic evaluation methods; and approaches for knowledge dissemination and policy translation. Despite these promising initiatives, the availability of researchers in resource-poor countries who have been rigorously trained in quantitative, qualitative, and mixed methods for implementation research remains low [105].

Science for policy
An important counterpoint to the triad of high need, high potential, and low capacity for implementation science in resource-poor countries and communities is the powerful opportunities for policy impact that engagement with policy makers offer. In many resource-poor countries, policy makers and stakeholders are closely involved in implementation research, ranging from the conception of research ideas to the interpretation of findings and from leading research agenda setting exercises with scientists [106, 107] to principal investigator roles in scientific studies [87]. Close collaboration between implementation scientists and policy makers is not constrained to resource-poor settings [108], but it is likely particularly strong in those settings because of the higher need for implementation evidence when the capacity to deliver interventions is extremely scarce as well as a culture of testing the delivery of scientific innovations in “demonstration projects” to guide policy decisions and the design for long-term routine practice. For instance, many African countries are currently considering adopting HIV pre-exposure prophylaxis (PrEP) as routine health policy but are unsure which delivery models work best in their specific contexts. To fill this knowledge gap, more than 50 PrEP demonstration projects in Africa are currently experimenting with alternative delivery models [109, 110].

Conclusion
In any setting, the results of implementation science can lead to improved routine healthcare practice. In resource-poor countries and communities, however, the need for such results is arguably higher than in resource-rich countries, while the capacity to carry out implementation research is lower. Despite this “inverse care law of implementation science,” several specific opportunities for implementation science in resource-poor settings exist. First, intervention and methods innovations thrive under constraints. Second, reverse innovation transferring novel approaches from resource-poor to research-rich settings will gain in importance. Third, policy makers in resource-poor countries tend to be interested in collaborating closely with scientists on implementation research projects aimed at informing national and local policy. To realize these opportunities, several actions are needed. Funders need to increase their commitments to implementation science in resource-poor settings [111]. Funders and universities need to increase their investment in training the next-generation of implementation scientists who devote their careers to discovering and testing novel approaches to create and influence healthcare resources where they lack most. Finally, journal editors need to signal strongly that they are interested in featuring results from rigorous implementation science originating in resource-poor settings, to ensure that some of the brightest graduate students can be recruited into this field. The results of such actions will likely lead to a double benefit—generating major scientific advances and contributing to improved health among the world’s poor.

Table 2
Massive open online courses in implementation science

| Course                          | Organization                  | Duration | Content                                                                 |
|---------------------------------|-------------------------------|----------|-------------------------------------------------------------------------|
| Fundamentals of Implementation  | University of Washington, USA | 11 weeks | • Relevance of implementation science to global health                 |
| Science                         |                               |          | • Impact evaluation methods                                             |
|                                 |                               |          | • Economic analysis methods                                             |
|                                 |                               |          | • Stakeholder and policy analysis                                       |
|                                 |                               |          | • Qualitative health systems research                                   |
|                                 |                               |          | • Quality improvement as a management tool                             |
|                                 |                               |          | • Disseminating research findings                                       |
| Specialist Certificate in       | University of Melbourne, Australia | 6 months | • Conceptual models and frameworks                                       |
| Implementation Science          |                               |          | • Role of data in driving implementation success                         |
|                                 |                               |          | • Different approaches to implementation                                |
|                                 |                               |          | • Process evaluation                                                    |
|                                 |                               |          | • Formative research                                                    |
|                                 |                               |          | • Outputs and outcomes                                                  |
|                                 |                               |          | • Impact evaluation                                                     |

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HMY and TB jointly conceived and wrote the manuscript. TB edited the manuscript for intellectual content and provided supervision. Both authors read and approved the final manuscript.

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