Is operational research delivering the goods? The journey to success in low-income countries

Rony Zachariah, Nathan Ford, Dermot Maher, Karen Bissell, Rafael Van den Bergh, Wilma van den Boogaard, Tony Reid, Kenneth G Castro, Bertrand Draguez, Johan von Schreeb, Jeremiah Chakaya, Rifat Atun, Christian Lienhardt, Don A Enarson, Anthony D Harries

Operational research in low-income countries has a key role in filling the gap between what we know from research and what we do with that knowledge—the so-called know–do gap, or implementation gap. Planned research that does not tangibly affect policies and practices is ineffective and wasteful, especially in settings where resources are scarce and disease burden is high. Clear parameters are urgently needed to measure and judge the success of operational research. We define operational research and its relation with policy and practice, identify why operational research might fail to affect policy and practice, and offer possible solutions to address these shortcomings. We also propose measures of success for operational research. Adoption and use of these measures could help to ensure that operational research better changes policy and practice and improves health-care delivery and disease programmes.

Lancet Infect Dis 2012; 12: 415–21

Published Online February 9, 2012 DOI:10.1016/S1473-3099(11)70309-7

This online publication has been corrected. The corrected version first appeared at thelancet.com/infection on March 9, 2012

Operational Centre Brussels, Medical Department, Médecins Sans Frontières, Luxembourg, Luxembourg (R Zachariah PhD, R Van den Bergh PhD, W van den Boogaard MPH, T Reid FCFP, B Draguez MD); **Access to Medicines Unit, Médecins Sans Frontières, Geneva, Switzerland** (N Ford PhD); **London School of Hygiene and Tropical Medicine, London, UK** (D Maher DM, Prof A D Harries FRCP); **International Union against Tuberculosis and Lung Disease, Centre for Operational Research, Paris, France** (K Bissell PhD, Prof D A Enarson MD, A D Harries); **Department of Molecular and Cellular Interaction, Vlaams Instituut voor Biotechnologie, Brussels, Belgium** (R Van den Bergh); **Department of Microbiology, Institute of Tropical Medicine, Antwerp, Belgium** (R Van den Bergh); **Division of Tuberculosis Elimination, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA** (K G Castro MD); **Department of Public Health, Division of Global Health (IHCAR), Karolinska Institute, Stockholm, Sweden** (J von Schreeb PhD); **Kenya Medical Research Institute, Ministry of Health, Nairobi, Kenya** (J Chakaya PhD); **Global Fund to Fight HIV, Tuberculosis and Malaria, Geneva, Switzerland** (Prof R Atun FRCP); **Imperial College London,**

Introduction

The scientific knowledge available on communicable and non-communicable diseases should, in theory, have ushered in a golden age of health care in low-income countries.[1,2] The reality, however, is different and the gap between what we know from research and what we do with this knowledge is huge. Operational research has a key role in bridging this so-called know–do[2,3] or implementation gap,[4,5] particularly in low-income countries, and is essential to ensure that scarce resources invested in research produce results that can be used to strengthen health services and benefit communities.[6]

All research starts with an appropriate research question. Clinical research often involves a journey that ends in a publication and presentation at a national or international conference. For operational research, this process is long and passes through four essential stages after completion of the research project: effective dissemination to stakeholders to ensure that findings are accepted and adopted, a peer-reviewed publication (a milestone in the dissemination process, as well as an important indicator of successful completion of a research study), changes to policy and practice, and positive effects of programme results—the most important end-measure of success.

Guidance and indicators to measure progress along this road do not exist and are needed urgently. In this Personal View article, we draw on our experience of operational research mainly in tuberculosis and HIV over many years in Malawi and other low-income countries and propose ways to redress this deficiency. We define operational research and its relation to policy and practice. We then identify why findings can fail to affect policy and practice and offer possible solutions. Finally, we propose parameters and a checklist for measuring success of operational research to assess progress along the journey.

Relation with policy and practice

Many definitions of operational research exist,[7] but from a disease-control perspective it is the search for knowledge on strategies, interventions, or technologies that can improve the results of the health programmes under investigation.[8] Thus, by this definition, operational research should affect policy and practice and improve health-care delivery systems.[9] Operational research questions should address issues that impede achievement of programme objectives and implementation of activities (eg, prevention, care, or treatment). This research should provide answers of direct, practical relevance to improvement of health-care delivery and should ensure that investments are used wisely to maximise health returns.

Operational research needs to demonstrate relevance and value to programme managers, health-care workers, and the community by showing that it improves policy, practice, and the results of the programme. Demonstration of success also prevents research being perceived as an unwanted and unnecessary burden on services.[10–12]

We are in an era of rapid technological innovation where new technologies such as drugs, diagnostics, and vaccines are under development with potential to change substantially the way that diseases such as HIV, tuberculosis, and malaria are managed (eg, the introduction of GeneXpert for the diagnosis of drug-resistant tuberculosis[13]). Operational research programmes are crucial to assess how new technologies can be integrated into routine health systems to improve diagnosis and treatment outcomes.

Why operational research might fail to affect policy and proposed solutions

Development of the research question

The study question must be of direct relevance to the programme, and decision makers should be involved from the start to promote a sense of ownership and responsibility. In an investigation of the burden and control of tuberculosis in a Malawi central prison by Nyangulu and colleagues,[14] the study question was formulated by senior staff from the Malawi National Tuberculosis Programme and the subject of the study was discussed thoroughly with the chief commissioner of prisons. Prior agreement was obtained from the commissioner to do the study and report back the findings when completed. The study noted a high

London, UK (R Atun)**; and Stop TB Partnership, WHO, Geneva, Switzerland** (C Lienhardt PhD)

Correspondence to:
Dr Rony Zachariah, Médecins Sans Frontières (Brussels Operational Centre), Operational research unit, 68 Rue de Gasperich, L-1617, Luxembourg, Luxembourg
zachariah@internet.lu

prevalence of tuberculosis, and many inmates seemed to develop the disease while in prison. The results also showed a strong association with HIV and that the routinely implemented passive case-finding strategy failed to detect most cases of the illness.[14] The findings were reported to the chief commissioner of prisons, permission was obtained to publish the study in a peer-reviewed medical journal, and a directive was issued from the national prison and health authorities to set up an integrated tuberculosis control programme in all prisons in Malawi. The findings also stimulated donor support for funding for a sustained prison tuberculosis control system, which still exists.[11] Similar examples of engagement of stakeholders at the outset of research include a study showing the benefits of co-trimoxazole prophylaxis for people with HIV and another noting the negative effect of user fees on patients' outcomes in HIV programmes.[15–17] The key message from these experiences is that, at the outset, the most important people needed to support and implement the study findings should be identified and engaged.

Doing the research

The main barriers to doing operational research include restricted knowledge of the necessary steps and, after implementation of the research, insufficient practical skills to write up and publish results. A high turnover of staff in country programmes and non-governmental organisations (NGOs) contributes to these issues and is one of the reasons why much internationally published research, at least that done in Africa, has been outsourced and generated by academic institutions or research institutions through parallel research systems or affiliated sites.[18–20] Many researchers are reluctant to work within disease control programmes or within the NGO sector because of a perception that these institutions do not have the intellectual rigour to design research studies, are chaotic in terms of research organisation, and have no long-term vision for research sustainability.[18] However, experience from the Malawi National Tuberculosis Programme between 1996 and 2004 showed that investment in a full-time, competent operational research officer who had programme skills and who worked alongside the programme manager led to the full integration of operational research into the programme.[8,21] This type of integration promotes the status of research and fosters long-term sustainability (appendix). Other examples include implementation experience from NGOs that do research,[22] the Indian model of WHO national consultants who are involved with operational research and are integrated into the National Tuberculosis Control Programme of India,[23] and US Centers for Disease Control and Prevention involvement in sustainable public health capacity development in Central America.[24]

See Online for appendix

Research outputs from disease control programmes, health facilities, or implementing NGOs can be improved in several other ways. Experience from Médecins Sans Frontières (an implementing NGO) showed a fivefold increase in publication outputs soon after establishment and retention of key research staff that included one full-time research coordinator with programme skills, a data manager, and a full-time medical editor (figure).[22]

Second, operational research can use a range of methods, including specialised surveys. However, if properly embedded in normal programme settings, the operational research team will mainly draw on data that are routinely collected.[25] The collection of routine data is sometimes regarded as a boring and onerous activity for programme staff, but operational research that uses, analyses, and feeds back data to the programme can provide a convincing alternative view. Use of routine data in research also increases the reliability and accuracy of the information collected, which in turn improves the validity of the operational research. Thus, an incentive exists for health workers to record and monitor data with the knowledge that the information can be used to answer important questions. Sometimes, in trying to answer such questions, researchers realise that the information is not available through routine registers and treatment cards. In such cases, the data-capturing instruments can be modified, which can lead to improved routine monitoring of programmes. Several successful operational research studies[26–29] from Malawi (a low-income country) used routine programme data and were done during routine supervisory activities (table 1). These studies needed low levels of financing because they were included with routine programme activities.

Third, the establishment of collaborative research partnerships between local researchers in low-income countries and academic institutions, NGOs, and donors from developed countries is important.[19,30,31] These partnerships can provide external criticism, which is useful for programme researchers. Innovative and product-oriented training courses that can deliver results within a short timeframe are also needed, such as the Centers for Disease Control and Prevention–US Agency for International Aid and the International Union Against Tuberculosis and Lung Disease–Médecins Sans Frontières models of sustainable operational research capacity building.[32–34] These training modules focus on strict candidate selection, on-the-job mentorship, teaching of practical skills, and performance-linked support.[32,35,36] In the International Union Against Tuberculosis and Lung Disease–Médecins Sans Frontières course, operational research questions are developed from the candidates' own programmes. The first of these courses was run between August 2009 and April 2010, with 12 participants from Africa and Asia. Each participant wrote one or two papers and submitted these to peer review journals 4 weeks after the end of the course. By December 2010, 11 of the 14 submitted papers had been accepted for publication or were published.[34]

Finally, major health donors are providing new opportunities in various areas, and programmes need to

make the best use of them. Some examples include the US Government[37] and UK Department for International Development[38] commitments to operational research and health and information systems strengthening, the WHO–Tropical Diseases Research and Global Fund framework for implementation and operations research,[7] and possible opportunities in the GAVI Alliance–Global Fund–World Bank joint platform for health-systems strengthening.[39]

Dissemination of research results

Dissemination involves identification of an appropriate audience and targeting of the messages to that audience. This process should include the community where the research has been done, as well as local and international policy makers (appendix).[2] An important part of the dissemination process is publication in a peer-reviewed scientific journal.[40] Several arguments support this approach. A published paper provides a credible evidence base to advocate for policy change with local decision makers, ministries of health, and international policy makers.[41] International guidelines, such as those developed by WHO, and national guidelines, increasingly rely on published work for the evidence base, usually via systematic reviews, and this process rarely includes unpublished findings. The standard structure of a scientific report, along with the peer review process, provides an inbuilt quality control that strengthens the final article and makes it easier to read, understand, and disseminate than the original.[40] Finally, operational research that is published in a peer-reviewed journal can affect policy change outside the confines of a particular programme. For example, the study by Culbert and colleagues,[42] which provided knowledge on the feasibility of offering antiretroviral therapy during conflict in the Democratic Republic of the Congo, led to a change in the Sphere Project's humanitarian charter and the adoption of minimum standards in humanitarian responses (previously this benchmark reference for NGOs advised against offering antiretroviral therapy in such settings).[43]

Despite the importance of publication as a way to share knowledge, a substantial proportion of operational research studies in low-income and middle-income countries are never published in scientific journals.[44] Failure to publish research is not confined to low-income countries. A study of scientific abstracts from high-income countries included in conference proceedings revealed that only 49% of 79 had been written up and published in scientific journals about a decade later.[45] One of the main reasons for such research waste[46] is the difficulty that researchers have in writing reports. Writing is a skill that can be learned through specific training and mentoring, and operational research programmes and training modules should ensure that this is included. Additionally, anecdotal evidence suggests that many editors and reviewers are biased against operational research studies, deeming them of low quality. A better understanding of the relevance of operational research by journal editors is needed.

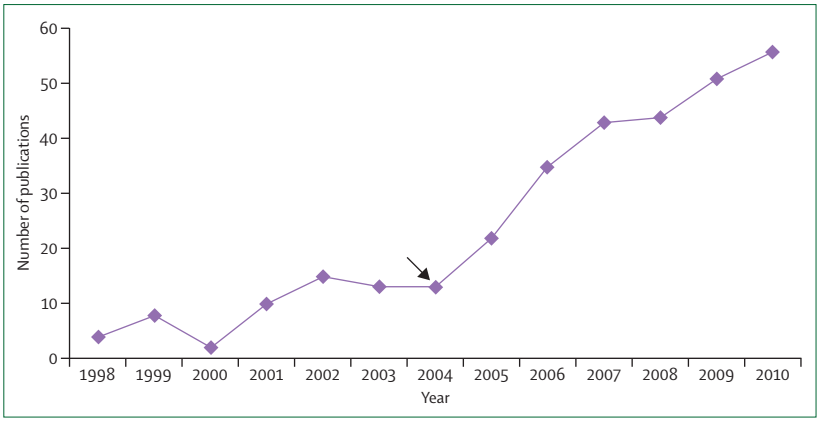

***Figure*: Trend in peer-reviewed scientific publication of operational research**
Adapted from reference 22. Publication of peer-reviewed research by Médecins Sans Frontières increased rapidly with the introduction (arrow) of a research coordinator, a data manager, and a medical editor to the Operational Centre Brussels, Belgium 1998–2010.

Although many research studies from Africa are published in high impact factor journals in high-income countries, they are often unavailable to the very communities where the research is done because of the high cost of articles or journal subscriptions. One way forward is to allow free and open access for articles of interest to low-income countries through online technology. The HINARI Access to Research in Health Programme was established by WHO with major publishers and enables developing countries to access one of the world's largest collections of biomedical and health research. More than 7000 journal titles are available to health institutions in over 100 countries.[47] This initiative, which has recently come under threat, must be fully supported.[48] Similarly, Médecins Sans Frontières has negotiated with publishers to allow open access to its publications via an online field research repository.[49] This website archives articles authored by Médecins Sans Frontières researchers that are available for free so that the communities and programmes where our organisation works can benefit from the research. The International Union Against Tuberculosis and Lung Disease has also started an online companion

	Length of research	Activity costs (US$)
A national survey of the impact of rapid scale-up of antiretroviral therapy on health-care workers in Malawi: effects on human resources and survival[26]	3 months	450
Assessing the quality of data aggregated by antiretroviral treatment clinics in Malawi[27]	3 months	450
Antiretroviral therapy in the Malawi defence force: access, treatment outcomes, and impact on mortality*[28]	3 months	600
What happens to patients on antiretroviral therapy who transfer out to another facility?[29]	6 months	1500

*This study was part of other studies done at the same time researching antiretroviral therapy in the Malawi police force and in prisoners; US$600 was the total needed to support all three studies.

***Table 1*: Examples of published studies on antiretroviral therapy based on routine programme monitoring data in Malawi**

journal to the *International Journal of Tuberculosis and Lung Disease* to provide a vehicle for broad dissemination of operational research.[50]

Translation of research results into action

Once research studies have been completed, the next step is to translate the acquired knowledge into practice, which might not happen for several reasons (appendix). Access to and understanding of the research results and their implications might be confined to academics and might not reach top level decision makers,[51] who are absent from many scientific dissemination forums. Non-medical policy makers and unspecialised medical staff often find the interpretation of technical language difficult.[25,51]

Much research is outsourced to academic or research institutions and not rooted in the programmes themselves and is done without engagement of the important decision makers. Consequently, there is little or no involvement of or ownership by the programme staff.[19,30]

	Present
Dissemination	
National	
Information circular is written in plain language	Yes/no
Information circular is disseminated to appropriate stakeholders	To who
Interviews with key decision makers to verify knowledge	Number/who
Community, district, or national dissemination workshops	Number/type
Contacts with national media and specific newspaper publications	Number/ type
International	
Oral presentations at international scientific conferences	Yes/no
Contacts with international media and news slots or blogs	Number/type
Publication	
The study has been published in a scientific journal	Yes/no
Contribution to coauthorship includes national investigators	Yes/no
Copies of published paper disseminated within the country	Number/who
Downloads of the publication from journal sites or field research websites during a specified period	Number
The study is available through an open-access source or journal	Yes/no
Changing policy and practice	
National	
Ministry of health implementation circular or rapid advice prepared	Yes/no
Rapid advice disseminated to health facilities	Yes/no
National guidelines updated with new evidence	Yes/no
National training materials based on new evidence are updated	Yes/no
Monitoring tools adapted to new evidence	Yes/no
Evidence of implementation in the field (judged during supervision or practice audits)	Yes/no
International	
Evidence included in worldwide or regional WHO guidelines or policy documents if relevant on a wide scale	Yes/no
Effect on programme performance	
Improvement in programme outcomes	Yes/no
Reduction in morbidity and mortality	Yes/no

For each of the parameter headings (dissemination, publication, changing policy and practice, and effect on programme performance), this table provides an objective checklist to measure how well these parameters have been met.

***Table 2*: Checklist for measuring the success of operational research studies in low-income countries**

Because academic and research institutions are rarely involved in the translation of evidence into practice, research findings could be perceived as being dumped on busy programme managers with little support for implementation. Finally, the research question or generated evidence might be irrelevant to the programme, or high implementation costs could prevent uptake of the evidence. For example, although five in-vivo studies provided evidence for changing antimalarial policy in Sierra Leone, restricted domestic and donor financing meant that the decision to replace the first-line antimalarial drug chloroquine with more effective but higher-cost artemisinin-based therapy was substantially delayed.[52]

To address these issues, short and clear summaries of the research in plain language are useful to explain the meaning and practical implications of the findings for busy programme managers and decision makers.[51] Efforts should be made to identify and include knowledge brokers or policy entrepreneurs who bridge the gap between the producers and users of knowledge.[2,51,53,54] These people work within the programme management team and must be trusted by decision makers in ministries of health. The role would include raising awareness of decision makers to important findings and bringing stakeholders together to begin the decision-making process. For example, after the national policy development on co-trimoxazole prophylaxis for HIV-positive individuals in Malawi, Uganda, and Zambia,[16] a policy entrepreneur was used in Malawi to help bridge the gap between operational research and policy networks. In Malawi, research evidence was swiftly translated into policy and practice,[53] whereas in the other two countries this translation was slow.

Much energy and time are spent updating and publishing national guidelines with new research findings. This process is expensive and often subject to unforeseen delays. By contrast, a quick and efficient way of overcoming these obstacles is to issue a ministry of health circular or rapid advice to implementers soon after research is completed. For example, the results of operational research into recurrent tuberculosis management in Malawi were disseminated first to all district tuberculosis officers at a national seminar, and then a rapid circular on how to diagnose and manage recurrent tuberculosis was distributed to all other tuberculosis officers.[55] At a later date the National Tuberculosis Manual was changed to incorporate the new advice. International organisations have also used this approach—eg, WHO released rapid advice on antiretroviral delivery in November 2009, and then translated the information into revised international guidelines in July 2010.[56,57] Turning guidelines into living documents on the internet can also help with dissemination.

The role of implementing partners, such as NGOs, in operational research needs to be recognised and improved. As implementers with fewer bureaucratic obstacles than governments, NGOs can rapidly apply research knowledge and adopt it into practice.[8] NGOs

***Panel*: Monitoring operational research outputs at nine consecutive programme levels:**

1 Operational studies approved by ethics group or committee during the year
2 Operational studies being done
3 Operational studies completed
4 Official and local or national reports of study findings
5 Operational studies submitted to peer-reviewed journals
6 Operational studies published in peer-reviewed journals
7 Operational studies meet criteria for successful dissemination
8 Operational studies meet criteria for affecting policy and practice
9 Key programmatic outputs

Focal operational research officer monitors cohorts of studies on an annual basis. Success is calculated as the proportion of operational research studies approved by the ethics group or ethics committee (level 1) that reach levels 2–9. See table 2 for criteria for successful dissemination (level 7). The effect on policy and practice (level 8) and programme performance (level 9) might need to be assessed over several years.

can also bring useful additional human, financial, and logistical resources to the programme. Importantly, NGO advocacy can exert effective pressure on policy makers to act on the evidence quickly.[15,58–60]

Health outcomes are often dependent on community-based support systems, particularly for diseases such as tuberculosis and HIV. Thus, engaging with communities, including civil society organisations,[61] and where possible establishing community advisory boards to provide a link between researchers and the community, will probably help with research implementation as well as adoption of the results.[62] Finally, short courses targeting senior policy makers might help them to understand the relevance and value of operational research to policy and practice. This approach needs to be assessed.

Measurement of success

In practice, improvement in disease control and health systems through operational research is an iterative process—in seeking answers to one question, other questions will probably arise. However, each study should be assessed independently.

We propose the following four steps to success for operational research (table 2): effective dissemination (so that the research knowledge is shared with appropriate audiences);[40,63] publication in a peer-reviewed journal (a milestone in the dissemination process as well as an important indicator of successful completion of a research study); changes to policy and practice; and effects on programme performance—the ultimate end-measure of success on the ground.[30,64,65] Systematic annual assessment of the successive steps in implementation of operational research and promotion of its effects on policy and practice would enable programmes in low-income countries to monitor the outputs of operational research agendas and projects (panel). The denominator is the number of studies approved by relevant ethics committees. With time and experience such parameters could be used to develop a scoring system to assess objectively the journey to success. This system could be validated at field level.

Eventually, a national reporting and surveillance system is needed to monitor the effect of improved policy and practice on disease control programmes. The World Health Report for 2012 will be based on the theme of "no health without research".[66] We have addressed issues central to some of the main aims of this forthcoming report such as the importance of operational research for meeting health needs and improving health outcomes, the need for countries to invest more in strengthening their research systems at the programme level, and the monitoring of research outputs.

Contributors
RZ and ADH wrote the first draft and revisions of the paper, which was improved substantially by all coauthors. All authors were involved with the writing of the final version, which has been seen and approved by all.

Conflicts of interest
We declare that we have no conflicts of interest.

Acknowledgments
We are grateful to our many donors who encourage and support operational research and the related training and capacity-building efforts in low-income countries.

References

1 WHO. World health report 2004: changing history. http://www.who.int/whr/2004/en/int/whr/2004/en (accessed Jan 6, 2011).
2 Graham ID, Tetroe JM. Getting evidence into policy and practice: perspective of a health research funder. *J Can Acad Child Adolesc Psychiatry* 2009; **18:** 46–50.
3 Tetroe JM, Graham ID, Foy R, et al. Health research funding agencies' support and promotion of knowledge translation: an international study. *Milbank Q* 2008; **86:** 125–55.
4 Fox W. Realistic chemotherapeutic policies for tuberculosis in the developing countries. *BMJ* 1964; **1:** 135–42.
5 Fendall NR. Auxiliaries and primary medical care. *Bull N Y Acad Med* 1972; **48:** 1291–300.
6 Parkhurst J, Weller I, Kemp J. Getting research into policy, or out of practice, in HIV? *Lancet* 2010; **375:** 1414–15.
7 WHO-TDR. Framework for operations and Implementation research in health and disease control programs. http://apps.who.int/tdr/publications/training-guideline-publications/framework-operation-research/pdf/framework-operation-research.pdf (accessed Aug 20, 2011).
8 Zachariah R, Harries AD, Ishikawa N, et al. Operational research in low-income countries: what, why, and how? *Lancet Infect Dis* 2009; **9:** 711–17.
9 Lienhardt C, Cobelens FG. Operational research for improved TB control: the scope, the needs and the way forward. *Int J Tuberc Lung Dis* 2011; **15:** 6–13.
10 Harries AD. Integration of operational research into National Tuberculosis Control Programmes. *Tuberculosis (Edinb)* 2003; **83:** 143–47.
11 Harries AD, Nyirenda TE, Yadidi AE, Gondwe MK, Kwanjana JH, Salaniponi FM. Tuberculosis control in Malawian prisons: from research to policy and practice. *Int J Tuberc Lung Dis* 2004; **8:** 614–17.
12 Salaniponi FM, Gausi F, Mphasa N, Nyirenda TE, Kwanjana JH, Harries AD. Decentralisation of treatment for patients with tuberculosis in Malawi: moving from research to policy and practice. *Int J Tuberc Lung Dis* 2003; **7** (suppl 1): S38–47.

13 Boehme CC, Nabeta P, Hillemann D, et al. Rapid molecular detection of tuberculosis and rifampin resistance. *N Engl J Med* 2010; **363:** 1005–15.

14 Nyangulu DS, Harries AD, Kang'ombe C, et al. Tuberculosis in a prison population in Malawi. *Lancet* 1997; **350:** 1284–87.

15 Zachariah R, Van Engelgem I, Massaquoi M, et al. Payment for antiretroviral drugs is associated with a higher rate of patients lost to follow-up than those offered free-of-charge therapy in Nairobi, Kenya. *Trans R Soc Trop Med Hyg* 2008; **102:** 288–93.

16 Hutchinson EPJ, Gibb Di M, Hoskins S, Droti B, Phiri S, Chishingha N. National policy development for cotrimoxazole prophylaxis in Malawi,Uganda and Zambia: the relationship between context, evidence and links. http://www.evidence4action.org/images/stories/documents/cotrimoxazolecasestudy.pdf (accessed Jan 6, 2010).

17 Zachariah R, Spielmann MP, Chinji C, et al. Voluntary counselling, HIV testing and adjunctive cotrimoxazole reduces mortality in tuberculosis patients in Thyolo, Malawi. *AIDS* 2003; **17:** 1053–61.

18 Wolffers I, Adjei S, van der Drift R. Health research in the tropics. *Lancet* 1998; **351:** 1652–54.

19 Costello A, Zumla A. Moving to research partnerships in developing countries. *BMJ* 2000; **321:** 827–29.

20 Mgone C, Volmink J, Coles D, Makanga M, Jaffar S, Sewankambo N. Linking research and development to strengthen health systems in Africa. *Trop Med Int Health* 2010; **15:** 1404–06.

21 Harries AD, Hargreaves NJ, Banda HT, Zachariah R, Spielmann MP, Salaniponi FML. Tuberculosis research in Malawi: making it count. *Rec Adv Res Updates* 2001; **2:** 103–18.

22 Zachariah RNF, Draguez B, Yun O, Reid T. Conducting operational research within a non-governmental organisation: the example of Médecins Sans Frontières. *Int Health* 2010; **2:** 1–8.

23 Sahu S, Chauhan LS. The role of WHO in the successful implementation and expansion of the DOTS programme in India. http://www.tbcindia.org/pdfs/Tuberculosis%20Control%20in%20India20.pdf (accessed April 10, 2011).

24 Lopez A, Caceres VM. Central America Field Epidemiology Training Program (CA FETP): a pathway to sustainable public health capacity development. *Hum Resour Health* 2008; **6:** 27.

25 Clarkson JE. Getting research into clinical practice—barriers and solutions. *Caries Res* 2004; **38:** 321–24.

26 Makombe SD, Jahn A, Tweya H, et al. A national survey of the impact of rapid scale-up of antiretroviral therapy on health-care workers in Malawi: effects on human resources and survival. *Bull World Health Organ* 2007; **85:** 851–57.

27 Makombe SD, Hochgesang M, Jahn A, et al. Assessing the quality of data aggregated by antiretroviral treatment clinics in Malawi. *Bull World Health Organ* 2008; **86:** 310–14.

28 Banda AC, Makombe SD, Jahn A, et al. Antiretroviral therapy in the Malawi defence force: access, treatment outcomes and impact on mortality. *PLoS One* 2008; **3:** e1445.

29 Yu JK, Tok TS, Tsai JJ, et al. What happens to patients on antiretroviral therapy who transfer out to another facility? *PLoS One* 2008; **3:** e2065.

30 Walley J, Khan MA, Shah SK, Witter S, Wei X. How to get research into practice: first get practice into research. *Bull World Health Organ* 2007; **85:** 424.

31 Pappaioanou M, Malison M, Wilkins K, et al. Strengthening capacity in developing countries for evidence-based public health: the data for decision-making project. *Soc Sci Med* 2003; **57:** 1925–37.

32 Laserson KF, Binkin NJ, Thorpe LE, et al. Capacity building for international tuberculosis control through operations research training. *Int J Tuberc Lung Dis* 2005; **9:** 145–50.

33 The Union. The Union–Médecins Sans Frontières training course for sustainable operational research. http://www.theunion.org/fr/news/operational-research-training-programmes-launched.html (accessed Jan 6, 2010).

34 Harries AD, Rusen ID, Reid T, et al. The Union and Médecins Sans Frontières approach to operational research. *Int J Tuberc Lung Dis* 2011; **15:** 144–54.

35 Thacker SB, Dannenberg AL, Hamilton DH. Epidemic intelligence service of the Centers for Disease Control and Prevention: 50 years of training and service in applied epidemiology. *Am J Epidemiol* 2001; **154:** 985–92.

36 Centers for Disease Control, R.O.C. (Taiwan). Field Epidemiology Training Programme (FETP). http://www.cdc.gov.tw/ct.asp?xItem=7726&CtNode=2488&mp=5 (accessed Jan 20, 2011).

37 Global Health Initiative. US Global Health Initiative Strategy. http://www.ghi.gov/resources/strategies/159150.htm (accessed Aug 20, 2011).

38 UK Parliament. DFID funding for health system strengthening. http://www.publications.parliament.uk/pa/cm200809/cmselect/cmintdev/235/23504.htm (accessed Aug 20, 2011).

39 World Bank. The health systems funding platform. http://siteresources.worldbank.org/INTHSD/Resources/topics/415176-1251914777461/HealthSystemFundingPlatform_BackgroundUNSGGlobalStrategy_10Sept2010.pdf (accessed Jan 20, 2011).

40 Zachariah R, Tayler-Smith K, Ngamvithayapong-Yana J, et al. The published research paper: is it an important indicator of successful operational research at programme level? *Trop Med Int Health* 2010; **15:** 1274–77.

41 Haines A, Donald A. Making better use of research findings. *BMJ* 1998; **317:** 72–75.

42 Culbert H, Tu D, O'Brien DP, et al. HIV treatment in a conflict setting: outcomes and experiences from Bukavu, Democratic Republic of the Congo. *PLoS Med* 2007; **4:** e129.

43 Adam-Bradford A. The Sphere Project Guidelines. http://www.adambradford.eu/Article/UAM21.p.31.pdf (accessed Jan 6, 2011).

44 Ohkado A, Pevzner E, Sugiyama T, et al. Evaluation of an international training course to build programmatic capacity for tuberculosis control. *Int J Tuberc Lung Dis* 2010; **14:** 371–73.

45 Scherer RW, Langenberg P, von Elm E. Full publication of results initially presented in abstracts. *Cochrane Database Syst Rev* 2007; **2:** MR000005.

46 Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. *Obstet Gynecol* 2009; **114:** 1341–45.

47 HINARI. The Hinari initiative. http://www.who.int/hinari/en/ (accessed Jan 6, 2011).

48 Koehlmoos TP, Smith R. Big publishers cut access to journals in poor countries. *Lancet* 2011; **377:** 273–76.

49 Médecins Sans Frontières. The MSF field research website. http://fieldresearch.msf.org/msf/ (accessed Jan 6, 2010).

50 Yew WW, Borgdorff MW, Enarson D. The next five years of the journal: wider scope and increased access. *Int J Tuberc Lung Dis* 2011; **15:** 1–2.

51 Armstrong R, Waters E, Crockett B, Keleher H. The nature of evidence resources and knowledge translation for health promotion practitioners. *Health Promot Int* 2007; **22:** 254–60.

52 Checchi F, Roddy P, Kamara S, et al. Evidence basis for antimalarial policy change in Sierra Leone: five in-vivo efficacy studies of chloroquine, sulphadoxine-pyrimethamine and amodiaquine. *Trop Med Int Health* 2005; **10:** 146–53.

53 Harries AD, Zachariah R, Chimzizi R, et al. Operational research in Malawi: making a difference with cotrimoxazole preventive therapy in patients with tuberculosis and HIV. *BMC Public Health* 2011; **11:** 593.

54 Sin CH. The role of intermediaries in getting evidence into policy and practice: some useful lessons from examining consultancy-client relationships. *Evidence & Policy* 2008; **4:** 85–103.

55 Harries AD, Salaniponi FM. Recurrent tuberculosis in Malawi: improved diagnosis and management following operational research. *Trans R Soc Trop Med Hyg* 2001; **95:** 503–04.

56 WHO. Rapid advice: antiretroviral therapy for HIV infection in adults and adolsecents. http://www.who.int/hiv/pub/arv/advice/en/index.html (accessed Nov 30, 2011).

57 WHO. Antiretroviral therapy for HIV infection in adults and adolescents: recommendations for a public health approach (2010 version). http://www.who.int/hiv/pub/arv/adult2010/en/index.html (accessed Jan 6, 2011).

58 Guthmann JP, Checchi F, van den Broek I, et al. Assessing antimalarial efficacy in a time of change to artemisinin-based combination therapies: the role of Médecins Sans Frontières. *PLoS Med* 2008; **5:** e169.

59 O'Brien DP, Sauvageot D, Zachariah R, Humblet P. In resource-limited settings good early outcomes can be achieved in children using adult fixed-dose combination antiretroviral therapy. *AIDS* 2006; **20:** 1955–60.

60 Lowrance DW, Makombe S, Harries AD, et al. A public health approach to rapid scale-up of antiretroviral treatment in Malawi during 2004–2006. *J Acquir Immune Defic Syndr* 2008; **49:** 287–93.

61 Getahun H, Raviglione M. Transforming the global tuberculosis response through effective engagement of civil society organizations: the role of the World Health Organization. *Bull World Health Organ* 2011; **89:** 616–18.

62 Médecins Sans Frontières. Providing HIV/TB care at the primary health care level: Khayelitsha Annual Activity Report 2008–2009. http://www.health-e.org.za/documents/c110af046ff02d6d4d032755b5ca7e06.pdf (accessed Jan 20, 2011).

63 National Academies Press. On being a scientist: a guide to responsible conduct in research. http://www.nap.edu/openbook.php?record_id=12192&page=29 (accessed Jan 7, 2011).

64 Global Health Council. Getting research into policy and practice (GRIPP). http://www.globalhealth.org/news/article/4803 (accessed Jan 6, 2011).

65 Garner P, Kale R, Dickson R, Dans T, Salinas R. Getting research findings into practice: implementing research findings in developing countries. *BMJ* 1998; **317:** 531–35.

66 Pang T, Terry RF, the PLoS Medicine editors. WHO/PLoS collection "no health without research": a call for papers. *PLoS Med* 2011; **8:** e1001008.