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Innovation and access: medicines for the poor – the IGWG strategy and plan of action

Article by Bart Wijnberg (pictured left), Vice-Chair for the European region, WHO Inter-Governmental Working Group on Public Health, Innovation and Intellectual Property and Marleen Monster (pictured right), Senior Policy Advisor, Directorate General for International Cooperation’s Coherence Unit, Ministry of Foreign Affairs, The Netherlands

This paper will examine why it was urgent for WHO to establish an inter-governmental working group (IGWG) that could draft a multilateral strategy on public health, innovation and intellectual property rights. We will reflect on the outcome of the IGWG process and present some ideas on how best to put the strategy into practice.

Background

Today 4.8 billion people live in developing countries and 2.7 billion of them live on less than US$ 2 a day. Half of all diseases in these countries are communicable. Governments, the pharmaceutical industry, foundations, nongovernmental organizations (NGOs) and others recognize that poverty is a major factor in preventing access to medicines in the developing world and are working to encourage the development of new or adapted medicines and to improve access to them.

The urgency of a new multilateral strategy: developing countries are missing out on innovation and access

In the 20th century medicines were developed according to an established pattern: pharmaceutical companies would develop a vaccine or medicine through trial and error, investing enormous amounts of time and resources in the process. Once a vaccine or medicine had been developed, it was patented, creating a monopoly position for the developer, who could then recover high research-and-development costs by setting a high monopoly price. Provided they were applied appropriately, patents were assumed to encourage innovation. The search for the “blockbuster” – a top-selling, often one-size-fits-all medicine – has always been the basis for the big pharmaceutical companies’ R&D strategies. The innovation cycle in developed countries has to a large extent been relatively sustainable over the years.

What was this strategy’s effect on health care in developing countries? Where innovation was concerned, the traditional approach to developing medicines failed. There was no significant market demand due to a lack of (collective) purchasing power and inadequate health systems in developing countries. Pharmaceutical companies were not inclined to develop new medicines for diseases in resource-poor countries without a clear market demand that promised a reasonable return on investment. In general, both the public and private sectors lacked the resources to invest in research. As a result, the products of innovation that developing countries had to rely on were designed principally to meet the health-care needs of developed countries with well-organized health-care systems. In most developing countries, patent protection did not bring greater innovation as the market was too small, and scientific and technological capabilities were inadequate. Furthermore, the monopoly costs associated with patents impacted the affordability of patented health-care products. As a consequence, developing countries still face problems related to access – medicines are often very expensive, difficult to obtain and ineffective within the health-care systems that are in place – and to innovation: for some diseases, no treatment, vaccine or cure exist.

Over the years this traditional system to develop medicines has started to crack. Public health-care funding (including medicines) in developed countries has become an increasingly difficult issue because costs have risen due to demographic changes. What is more, climate change and globalization have altered the traditional map of diseases. Those diseases that historically occurred only in developing countries are now taking root in developed countries and vice versa: the prevalence of noncommunicable diseases such as cancer and cardiovascular disease has rapidly increased in developing countries. Drug-resistant bacteria and pandemic influenza are major threats to global public health, in both the developed and developing worlds. Until now, it has been difficult, if not impossible, for pharmaceutical companies to respond adequately to this complex situation. And the patent system has had difficulties of its own: low standards of patentability and shortcomings in patent clearance have led to patents of poor quality or dubious validity.

A new, more complex system of innovation has now emerged: active campaigns by NGOs have increased public awareness of the lack of accessible and affordable medicines in developing countries and the issue is now receiving more attention. Pharmaceutical companies have started to invest more in research on diseases that affect developing countries, setting up specific programmes to this end. Large private funds have donated resources aimed at finding cures for diseases like malaria, HIV/AIDS and tuberculosis. Some companies have introduced tier-pricing systems for
differentiating medicine prices in developing countries. Public-private partnerships have been set up to counter the market’s failure to develop sufficient products for diseases that affect the poor. And in researching and developing medicines, there is now more consideration for local circumstances and resource-poor environments. In the TRIPS Agreement, all World Trade Organization (WTO) members have adopted a framework of minimum standards for intellectual property rights protection, though Least Developed Countries have been allowed to delay implementing them until 2016 at the latest. The 2003 Doha Declaration on the TRIPS Agreement and public health was very important in balancing commercial interests against public health interests where intellectual property rights are concerned. The 2003 Declaration facilitated access to affordable medicines for developing countries by allowing flexibility on intellectual property rights. Progress was under way, but more needed to be done.

The outcome of the IGWG process
A more structured effort was needed to better understand the barriers to innovation in, and access to, medicines, and how the situation might be improved. For this reason, a WHO Commission on Intellectual Property, Innovation and Public Health was asked to draft a report with recommendations on the relationship between public health, innovation and intellectual property rights. When the report was completed, Resolution WHA 59R established an intergovernmental working group to draw up a global strategy and plan of action in order to “provide a medium-term framework based on the recommendations of the Commission and to secure, inter alia, an enhanced and sustainable basis for needs-driven, essential health research and development relevant to diseases that disproportionately affect developing countries and to propose clear objectives for research and development, and estimating funding needs in this area”.

After complex negotiations lasting two years, the Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property Rights, prepared by the Intergovernmental Working Group of Experts on Public Health, Innovation and Intellectual Property Rights (IGWG), was approved at the 61st World Health Assembly in May 2008 (see WHA 61S). The result is a broader palette of policy options, for example in terms of securing funding, stimulating new types of R&D and R&D cooperation, and implementing the TRIPS flexibilities where they relate to public health. These have been described in the strategy and fleshed out in the (partly unfinished) plan of action (PoA). Policy choices have been made more explicit and the various stakeholders identified.

The following results are especially noteworthy and will be useful for the Global Forum’s 2008 meeting in Bamako in November.

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a) The role of intellectual property rights where they relate to public health has been put into perspective

Intellectual property rights should be applied according to the multilateral agreements on TRIPS. There is now a more common understanding of the need to be careful when adopting public health-related legislation that goes beyond the TRIPS Agreement.

b) Inclusion of Type I diseases
The strategy will promote R&D focusing on Type II and Type III diseases and the specific R&D needs of developing countries in relation to Type I diseases. The strategy does not therefore place limitations on which diseases warrant most focus. The inclusion of Type I diseases in the strategy acknowledges their rapidly growing significance in developing countries. This is a positive outcome. Developing countries can prioritize Type I diseases in their health research strategies if they consider them to be a threat to public health.

c) An expert working group on financing and R&D coordination
The strategy gives developing countries an opportunity to raise the profile of alternative R&D mechanisms and, in the longer term, mobilize financial and technical support for programmes, whether existing or new. An expert WHO working group is to be established to examine current financing and coordination of research and development, as well as to propose new and innovative sources of funding.

Process

a) The inter-sectoral aspect of the negotiations
This was one of the most interesting features of the IGWG process. Because such a broad range of topics were discussed, many of the member states’ delegations were larger than usual. In the Netherlands’ case, representatives of the Ministry of Health, Welfare and Sport, the Ministry of Foreign Affairs and the Ministry of Economic Affairs formed part of the official delegation. Although we were like-minded in many areas, it took some time to achieve consensus, even at national, interministerial level. The three ministries concerned held broad national consultations with industry representatives and NGOs. This helped us to focus and reach
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a common position.

The same was true for the multilateral organizations involved in the process. The IGWG evolved in the interfaces between the mandates of the WHO, WTO and WIPO and others21. While implementing the strategy will require a greater level of coordination between these organizations, we are cautiously optimistic that this collaboration will bear fruit, given the generally positive atmosphere during the IGWG negotiations22.

The initial culture clash between health and trade/IP professionals during the negotiations eventually led to a positive outcome: there is now greater understanding and awareness on both sides of how public health relates to intellectual property rights and trade issues. Health professionals in particular can benefit further by re-examining national intellectual property rights policies and engaging actively in international trade negotiations.

These, of course, were not the only stakeholders. Companies, NGOs and PPPs all tried to influence the proceedings and the outcome. Some were better organized than others, but it was fascinating to be a part of a multi-stakeholder environment in which global interests were at stake.

b) The interplay of forces

During the negotiations we had the sense that IGWG was one of the first processes within WHO in which lower- and middle-income countries strongly voiced their opinions. The traditional North-South divide made way for a more multidimensional dynamic. The European Union partners, including the European Commission, were notable for the mediating role they played in the negotiations.

c) The duration of the process

Reaching agreement on this complex issue is quite an achievement. But to have done so in such a short time is remarkable. During the negotiations the differences between countries’ positions were clear and it sometimes felt as though a consensus would never be reached22. Everyone involved felt the urgency to act, however, and agreement was reached by all parties in a relatively short period.

d) The complexity of the strategy

The strategy identifies a complex set of actions that link public health with innovation and intellectual property rights. It also names stakeholders, and sets out the required timetable and a rudimentary budget. The principal merit of the strategy and plan of action lies in its breadth of policy choices rather than its prioritization of required actions. The budget still needs to be fleshed out – no small task!

e) The role and mandate of WHO

Much of the debate (especially during the final hours of discussion on the PoA) was devoted to the role of WHO. Where should WHO take the lead, where should it be just one of the actors, and where should it not be involved? We feel that ultimately, despite some unresolved points in the PoA, the “spirit of Geneva”23 prevailed and WHO’s role was confirmed. Director-General Margaret Chan’s personal commitment, charisma and ability to build bridges with the WTO and the World Intellectual Property Organization (WIPO) certainly contributed to this result24, but it is nonetheless a result that needs consolidating. Member states themselves have an important role to play in coordinating their WHO, WTO and WIPO policies at national level.

Putting the IGWG Strategy and Plan of Action into practice: some ideas

We left Geneva exhausted but in high spirits, with a completed strategy, and ready to embark on an urgent priority: implementing the strategy in our respective countries. So where do we go from here?

Firstly, a broad range of innovations is required. Research efforts may focus on diverse forms of creative thinking and result in equally diverse discoveries: not only new drugs, new vaccines, new diagnostics, but also new strategies for utilizing them and new social or economic policies that can reinforce their use or create a supportive environment for their application.

The IGWG process revealed the interfaces between public health, innovation and intellectual property. The actions that have been identified are all interconnected. It is important that policy-makers are aware of the links between the three areas and take a coherent approach to the issue. If the goal is to increase access to, and innovation in, medicine, it would be unwise for policy-makers to focus on only one element. Isolated policy interventions will create more, rather than fewer, problems.

The complexity of this policy area may require a networked approach in which innovators attempt to create a forum, a central network in which all the actors agree that the network is worth building and defending24. Learning capacity is crucial: policy-makers, researchers and industry which operate in the international system should learn from one another’s initiatives, ideas and achievements. The process as started in IGWG is arguably a good example of such a network. It is a hybrid structure, technical as well as social in nature, in which the interests of the stakeholders, while different, converge.

By leading the overall process, the World Health Organization played a crucial role in the IGWG. Hopefully, WHO will be equally significant in promoting the implementation of the strategy. WHO should encourage governments to act on what they have promised, stimulate the business community and NGOs to work more closely together and encourage the UN institutions and the WTO to play an active role in the network. Another important task for WHO is to promote the exchange of information and thus increase learning capacity throughout the network, and monitor the performance and the progress being made with implementation.

What next?

a) Public health and innovation: setting a decentralized agenda on innovation

It is possible that decentralizing the agenda on innovation in both developing and developed countries might offer a solution to the innovation problem. The current agenda sometimes seems too prescriptive, cumbersome and centralized to effectively tackle the problems of the poor. Too often there is a tendency to define diseases in fixed terms,
promoting public access to the results of government-sponsored research; promoting the creation and development of accessible public health libraries; encouraging the use of appropriate licensing, including but not limited to open licensing; and considering, where appropriate, the use of the "research exception" on patents for innovation purposes.

In each of these innovation mechanisms, intellectual property rights are applied in a flexible, non-traditional way. Policy-makers involved in public-private partnerships are encouraged to take a stance on IP that maximizes public availability of the results of innovation. This may mean that a public entity is obliged to become co-owner of the intervention to ensure public access. And when clinical trials are paid for with public funds, data exclusivity should ideally be reduced to a minimum.

c) Including alternative models in policy options and generating firm commitments

The results of the IGWG open the door to exploring alternative financing mechanisms. While this outcome has yet to be confirmed by an expert working group "to examine current financing and coordination of research and development, as well as proposals for new and innovative sources of funding," now is the time to act. Industry, PPPs and NGOs should seek out neutral ground and deliver common proposals to carry this forwards. Initial thoughts and ideas have been mooted from several sides and have already sparked the first concrete activities in this area.

**Conclusion**

The goal of the IGWG process was to increase poor people’s access to medicines by optimizing the interfaces between

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<td>The goal of the IGWG process was to increase poor people’s access to medicines by optimizing the interfaces between public health, innovation and intellectual property rights.</td>
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<td>To achieve that ambition: we needed a broader palette of policy options: on securing funding, for example, promoting new kinds of R&amp;D and R&amp;D cooperation, implementing TRIPS in a public health oriented, non-traditional, manner, and acknowledging the significance of Type I diseases for developing countries.</td>
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<td>Implementing the strategy is both important and urgent. Maintaining the strategy’s coherence and synergy will be vital.</td>
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<tr>
<td>The strategy should be implemented flexibly, using hybrid (decentralised) networks and innovation agendas. At the same time, WHO should maintain close oversight of implementation, measure progress and promote greater cooperation between stakeholders and the various networks.</td>
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public health, innovation and intellectual property rights. To achieve that ambition, we needed a broader palette of policy options for securing funding, for example, promoting new kinds of R&D and R&D cooperation, and implementing TRIPS in a public health oriented manner. A further result of the negotiations was the acknowledgement of the significance of Type I diseases for developing countries. And the IGWG process established that intellectual property rights should be applied in a flexible, non-traditional manner if we want to improve new innovation mechanisms and increase access to research data and knowledge.

Until now, many features of this broader palette are still only ideas on paper. Implementing the strategy is both important and urgent. Maintaining the strategy’s coherence and synergy will be vital.

The strategy should be implemented flexibly, using hybrid (decentralized) networks and innovation agendas. At the same time, WHO should maintain close oversight of implementation, measure progress and promote greater cooperation between stakeholders and the various networks.

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1. The authors would like to thank Ms Gerda Vrielink, at the Netherlands’ Permanent Mission to the UN in Geneva, Ms Marij Essed and Mr Theo van de Sande of the Dutch Ministry of Foreign Affairs (Development Cooperation) and Mr Frank van der Zwan of the Dutch Ministry of Economic Affairs for their valuable comments on an earlier draft of this paper.
4. www.wikipedia.org
5. OPHI report, p.193.
7. OPHI report, p.35.
8. OPHI report, p.32.
9. OPHI report, p.34.
11. OPHI report, p.34.
13. Ibid.
14. For the purpose of this strategy, the definitions of Type I, II and III diseases, are as referred to by the Commission on Macroeconomics and Health and as further elaborated in the OPHI report. Type I diseases are incident in both rich and poor countries, with large numbers of vulnerable populations in each. Type II diseases are incident in both rich and poor countries, but with a substantial proportion of the cases in poor countries. Type III diseases are those that are overwhelmingly or exclusively incident in developing countries. The prevalence of diseases and thereby their categorization in the typology can evolve over time” – Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property Rights (http://www.who.int/gb/ebwha/pdf_files/A61/A61_R21-en.pdf).
16. Notably the OECD.
17. Notwithstanding the failure of recent WTO negotiations.
18. We had the feeling that we were negotiating a treaty text, which, of course, was not the objective. Attempts to open negotiations on the content of existing IP rules further extended the process.
19. A term used frequently during the negotiating process to try and achieve a cooperative spirit. William Safire’s Political Dictionary, 2008, traces the use of this term to 1955 when President Eisenhower first used it.
20. The constant, positive presence of WTO and WIPO representatives during the IGWG and the World Health Assembly also contributed to the end result.
22. www.xplora.com
25. Differences may exist between PPPs which could make tailor-made solutions necessary.
26. WHA 61.21, paragraph 4(7).
27. One such proposal was made by Paul Herzing from Newar. Others have been put forward by James Love of Knowledge Ecology International.
Over the last century health care innovation has transformed the way medicine is practised and has brought substantial benefits in the prevention, diagnosis and treatment of diseases. But the innovation system has failed to deliver new medicines, vaccines and diagnostics to address infectious diseases that primarily affect the developing world.

Our understanding of the ecosystem for innovation, from basic research through to delivery to the patient, needs to be brought up to date and new ways of networking research and development (R&D) need to be found to:
- make the process of innovation more efficient so that more products are developed more quickly and at lower costs;
- change the incentives faced by innovators, so as to encourage more firms and researchers to become involved in R&D;
- improve the commercial viability of small market products; and,
- create more capacity, especially in disease endemic countries.

Why the OECD?

OECD countries (see Box 1) have many reasons to be involved in this issue. Besides ethical and humanitarian imperatives, there are strong economic reasons driving involvement. New and emerging infectious diseases can spread rapidly and affect health, the economy and security in all countries, including those of the OECD.

Meantime, if the productivity decline across mainstream health innovation (especially for new medicines) is to be turned around substantial efficiency gain will be necessary. Greater competition, shorter product life-cycles and shorter time to market, coupled with growing costs and risks put the traditional approach to innovation under rising pressure and with it the block-buster model of drug development we have seen in recent decades. In fact, many of the policies and practices being put in place or considered to enhance the availability of drugs, vaccines and diagnostics for neglected infectious diseases may also be relevant to markets for health innovation in advanced industrialized countries. Thus the innovation system itself needs a thorough health check and some much overdue medicines.

The Noordwijk Medicines Agenda (NMA)

This is the context for the OECD, in collaboration with the government of the Netherlands organizing a High Level Forum on Availability of Medicines for Neglected and Emerging Infectious Diseases (HLF) which took place 20–21 June 2007 in Noordwijk-aan-Zee, Netherlands. The HLF was attended by high level officials from OECD and developing countries, industry, research and funding organizations, academia, philanthropic foundations, and international and nongovernmental organizations who came together with a common goal of building a coherent open agenda for action to stimulate innovation and radically accelerate the availability of new medicines, vaccines and diagnostics for neglected infectious diseases.

The Noordwijk Medicines Agenda (NMA) represents a broad consensus reached at the HLF among the participants about the problems, goals, and work ahead in order to improve the availability of medicines for neglected infectious diseases. It sets out a number of specific actions to bring about change in the way we innovate in this area, calling for improved efficiency and coherence and strengthened collaborative efforts among innovators and other stakeholders, in particular the WHO (see Box 2).

Many of the actions contained in the NMA can only be achieved by partnerships between many players across many sectors.
Advancing the NMA at the OECD

At present, we have a wide range of work going forward across the Organisation that directly or indirectly addresses the issues raised in the NMA. The indirectly relevant work is too broad ranging to present here, but a major themes of OECD work is especially pertinent — namely our work on improving the efficiency of the system of health innovation, mainly brigaded under a major new OECD-wide project known as the Innovation Strategy.

The NMA puts forward several actions which focus on developing new models for innovation. Our newly launched OECD Innovation Strategy focuses on improving economic performance and social welfare. Its aim is to assist policy-makers in harnessing innovation to achieve sustainable growth and development in a way that takes account of the growing complexities — and some of the exciting experimentation — in the practice of innovation. In a sense, it provides the key actors with a laboratory to test out the workings and impacts of some of these new directions in innovation. The focus is broad, well beyond health innovation, but the scope and ambition of the work overlaps substantially with that of the NMA.

Box 2: The Noordwijk Medicines Agenda

Recognizing that it is important to scale up and expand new for-profit and non-profit models of innovation for tackling neglected infectious diseases in the developing world, the Noordwijk Medicines Agenda calls for several changes to the present health-innovation system (for full details, see www.oecd.org/sti/biotechnology/nma).

Innovation system efficiency
1. Prioritise research and development needs and align research to a common purpose.
2. Facilitate the development and operation of a sustainable architecture for sharing and exchange of knowledge, data and research tools.
3. Explore collaborative mechanisms for IP management.
4. Promote the transfer of technology, knowledge and technical skills to strengthen innovation systems in developing countries.
5. Support developing country led efforts to provide their own health, local production and research systems.

Changing incentives to build capacity
6. Create incentives for R&D through alternative policy mechanisms to reward innovation.
7. Explore for-profit and not-for-profit models to promote and stimulate development of drugs, vaccines and diagnostics.

What can the OECD bring to this issue?
8. Pursue the viability of a global virtual collaborative drug development network that scales up existing initiatives and is more open.
9. Identify infrastructure needs to underpin a global virtual collaborative network.

Box 3: The importance of the OECD

The added value that the OECD brings to the issue of improving the availability of medicines for neglected and emerging infectious diseases is its:

- Capacity for sound economic analysis and evidence-based policy advice on the different policy options for action, including the scale up of R&D networks and the incentives necessary for bringing new products to market;
- Understanding of the innovation system and groundbreaking work on new research models that could improve the efficiency of the discovery, development and delivery of new medicines by removing disincentives to sharing data and material and opening up innovation;
- Ability to broker whole of government buy-in and build coherent policies, by virtue of the OECD organizational structure which includes cross ministry representation (i.e. Health, Development and Aid, Finance, Innovation, Economic Development and Industry).

The concept of knowledge markets thus encompasses a number of different mechanisms or marketplaces where buyers and sellers trade a variety of knowledge intensive goods and services. Mechanisms such as intellectual property exchanges, patent pools, consortia, matching or brokering services, as well as knowledge “warehouses” are all examples of new ways of deriving value from knowledge assets. In the life sciences, examples of tradable assets could be scientific data such as outcomes of clinical trials and toxicology data. Achieving greater access and exploitation of existing knowledge, by facilitating the trading and sharing thereof, would increase the efficiency of the health innovation cycle and potentially deliver a number of positive health and economic outcomes.
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There are real challenges of course in identifying which knowledge assets it makes economic sense to trade as well as in articulating and developing the kinds of market platforms that would need to be created to support this. The first step is to understand what kind of knowledge is being underused and under-developed in the life sciences and what sorts of new institutions, organizational mechanisms and infrastructures for creating value are required to exploit this knowledge in order to improve health innovation.

- **Collaborative Intellectual Property (IP) mechanisms**
  
  One of the actions in the NMA is to explore “collaborative mechanisms” for IP management. These are mechanisms that rights holders voluntarily enter into (often, though not exclusively, explicitly for-profit) to ease access to patented inventions that allow more open innovation and collaborative research as well as more rapid and less costly (mainly through diminished transaction costs) access to knowledge. Some examples of collaborative mechanisms include clearinghouses, IP exchanges/auctions, patent pools, cross-licensing schemes, and intellectual property sharing agreements. Our focus on these collaborative mechanisms so far has been to try to document what practices are beginning to emerge, determine their impact and consider what normative action – if any – may be necessary to enable maximal positive impacts on innovation.

- **New models for pharma-business innovation**
  
  As I mentioned above, the current block-buster model for developing new medicines is creating at the seams. Many new models have been articulated in recent years, some have been tried and fewer have been successful – at least in some cases. Meantime, the advent of genomics as well as evidence-based medicines and targeted therapy has demonstrated that efficiencies in terms of the health benefits to patients from new innovations are possible – but only in smaller, more discrete markets. In many ways, this shift shares a number of similarities with the challenges facing drug discovery and delivery for infectious diseases. The key question is how innovation in drug development can continue to remain an attractive proposition for mobile capital when markets may be smaller, competition higher, and public expenditure on health care under continual pressure.

  Our focus here is on how policies around the use of pharmacogenetics and genomics, as well as biomarkers more generally, can be developed that improve innovation efficiency and that support the servicing of smaller markets. Some of the questions therefore are around what is required in terms of changes in the regulatory systems and clinical trials, and what is required in terms of drug evaluation systems.

  There needs to be more work done in this area as to how we can identify which of the proposed new models can continue to attract capital in the long term, that can meet the identified health need and that will not unnecessarily distort markets in so doing.

- **Evaluating the policy mix**

  The HLF also recognized the need to look at what the best mix of mechanisms (push and pull) might be to encourage companies and researchers to work on neglected infectious diseases. We in the OECD do substantial work on how policies (subsidies, tax breaks, orphan drug act, patents) influence firm or country innovation. For infectious diseases, and other small, uncertain markets for drugs, other policies of course have been mooted and sometimes used, such as patent extensions, AMOs, prizes, global funds etc. But we do not have the kind of analytical work for these new mechanisms that we have for more “traditional” interventions. Work therefore needs to be done to look at these specific policies in terms of identifying their strengths and limitations, evaluating their effectiveness and understanding what mix of mechanisms is necessary to address different types of disease or situations.

- **Innovative finance mechanisms**

  Finally, it has been recognized that reliance on philanthropic and public funding is not sustainable for R&D into neglected infectious diseases as these sources could be endangered by a shift in priorities. To that end, new and innovative funding mechanisms have been put forward to help generate more sustainable and longer-term resources. A Global Forum, Lessons for Development Finance from Innovative Financing in Health, was held on 7 October 2008, organized by the Development Cluster of the OECD. The Forum considered donor and recipient governments’ views on the issues and opportunities created by recent innovative financing mechanisms. In particular, the Forum looked at lessons learned from the International Finance Facility for Immunization Company (IFFIm), the costs and benefits of new approaches, how to leverage private sector investment and future developments in the innovative financing mechanisms as well as the opportunities, and adaptability of these mechanisms across sectors.

  On the face of it, pulling all these strands together into a coherent picture could be one of the greatest challenges we could face from the policy perspective. But this is where our innovation strategy approach is really different. We advocated new ways of working in the NMA. We pushed for collaboration and new ways of working. We decided that if we were asking others to work this way then we in the OECD had to show that this could be done. So that is precisely what we are doing – bringing together government actors from science, industry, competition, education, development, investment, employment and many other ministries to work together on changing the face of innovation.

  This is the challenge for the OECD – and it remains the challenge laid at the feet of us all by the NMA.

  The effort needed to make such collaboration work is high; but the rewards are potentially much higher.
Key messages

- The way we look at innovation needs to change – from a linear model to an iterative, complex interactive cycle. In this new model there is a need for new tools, new actors and a collaborative, multidisciplinary, horizontal approach.
- There is a need for new models of innovation that are more open and global. In order to support this more open model, we need new infrastructures to support them including governance models, regulatory frameworks, guidelines and tools.
- No one can do this alone, more partnerships, networks and policy coherence are needed to drive a health innovation strategy that is more efficient and reactive to global public health needs.

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Health dynamics, innovation and the slow race to make technology work for the poor

Article by Melissa Leach (pictured), Director, Social, Technological and Environmental Pathways to Sustainability (STEPS) Centre, United Kingdom with Ian Scoones

The science, technology and development races are on. Nowhere is this clearer than in international health, where a new generation of donor, philanthropic and public-private initiatives is emerging and attracting increasing funding. These hold out promises of new drugs, vaccines and infrastructure applications, with some claiming major technological breakthroughs that could solve longstanding health problems and tackle emerging disease outbreaks in the developing world. This “race to universal fixes” for health and development problems is valuable. It is an important counter to innovation approaches aimed simply at a race to the top in the global economy, assuming that health and poverty-related problems will be solved by trickle down. Yet as this article argues, it risks missing the finishing line if a complementary — and slower — race is not pursued. This “slow race” emphasizes pathways to tackling ill-health and disease which are specific to diverse and dynamic local contexts; creates hybrids between local and external knowledge and perspectives for appropriate solutions; recognizes that technological fixes are not enough and that social, cultural and institutional dimensions are key; requiring a systems approach to health and innovation; and embraces uncertainty and unpredictable change through adaptation and learning.

In this view, innovation for health and development is part of a bottom-up, participatory process in which citizens in resource-poor settings must take centre stage. In the race to the universal fix, much current investment is justified by the prospect of “big hit” technologies with the potential for global scope and applicability, and the capacity to deliver these on a large scale. This is exemplified by the 14 “grand challenges” for research in global health identified by the Bill and Melinda Gates Foundation, which range from new and improved (e.g. needle-free, non-refrigerated) vaccines, to genetic and chemical technologies to control disease vectors, and enriched crops to improve nutrition. Another, and growing, strand of investment focuses on responses to outbreaks and pandemic threats. Here, as in the approaches of the World Health Organization and others, the focus is on universalized, generic emergency-oriented control of outbreaks at source, aimed at eradication — as for example in responses to human pandemic and avian influenza, and to haemorrhagic fevers such as Ebola. The emphasis is on a plethora of technological and infrastructural initiatives focused on early warning, risk assessment, surveillance, rapid response teams, treatment and vaccination. In both cases, the nature of the health problem is assumed to be broadly similar across vast areas, so that technological and associated institutional solutions are unproblematically transferred, and can be applied “at scale”.

Alongside the obvious merits of these approaches, however, lie many telling examples of failure. These include potentially good health technologies left sitting on laboratory benches because they failed to fit local circumstances. They include examples of disease eradication programmes thwarted by unexpected microbial resistance to the drugs involved, or by public resistance to programmes perceived as inappropriate — as in the cases of the global polio eradication initiative in Nigeria in 2003–04, or tetanus toxoid campaigns in Uganda and Cameroon. In Gabon in 1995–96, for example, American and French Ebola control measures were perceived as so inappropriate and offensive by villagers that they aroused deep suspicion, and international responses to a further outbreak there in 2001 met with fierce local armed resistance1. Avoiding such problems requires complementary approaches to understanding and policy, with four key elements contributing to the necessary slow race.

First is to recognize the diversity of interlocking dynamics that shape health problems, and must inform responses to them. Challenges to human health have always involved intimate relationships between social, political and economic processes, ecosystems and potential pathogens. The acceleration of population growth, mobility and urbanization, human-animal interactions, change in industrial, livelihood and food production systems, and technological and environmental processes has in many instances brought new challenges2, such as the emergence of new infectious diseases and zoonoses3. Yet these dynamics play out in specific ways in diverse local settings, varying across regions, localities and sometimes even within communities, producing multiple patterns and multiple needs. Thus a one-size-fits-all solution is often inappropriate. And given that problems of

1 The title, race metaphor and central arguments in this article are drawn from Leach and Scoones, 2006.
disease and ill-health are not just the result of technical matters, a focus on technology as a separate domain carries many dangers, leaving important social and political causes unaddressed. A more context-specific and integrated approach to linking technologies, health and development is therefore needed.

Second, different people and groups in society tend to understand and experience these dynamics in very different ways. The scientific perspectives of biomedical doctors or epidemiologists offer only some among multiple “framings” of health problems and possible solutions. Other framings emerge from, for instance, local cultural understandings, knowledge and experiential expertise. Such cultural framings can be crucial to understanding both why technologies work and are acceptable in particular settings – and why they are sometimes rejected. For example childhood vaccines are high on global policy agendas. In The Gambia, mothers go to great lengths to build and protect their own and their children’s strength, which they see as dependent on proper quantity and flow of blood and body fluids. They value immunizations in these terms, as introducing a powerful substance that, going into the blood, either builds its strength or builds in the blood defences against disease. “The injection strengthens the health of the child. It gives the child good body.” Within this logic, many feel that vaccinations are effective against illness in general. 29% of urban and 48% of rural mothers could name no biomedically “correct” vaccinable diseases, yet were actively seeking immunization – reflected in national coverage rates of 90% in 2003. Such ideas about strength, fluid and substance do not conform to biomedical notions of an immune system, disease-specific vaccines and strong distinctions between prevention and cure. Yet they ground strong appreciation of immunization in areas across The Gambia, Guinea, Sierra Leone and beyond. Yet the same framing can also underlie anxiety: in a social context in which mothers often miss clinic sessions due to workloads and problems at home, they often worry greatly great lengths to build and protect their own and their children’s strength, which they see as dependent on proper quantity and flow of blood and body fluids. They value immunizations in these terms, as introducing a powerful substance that, going into the blood, either builds its strength or builds in the blood defences against disease. “The injection strengthens the health of the child. It gives the child good body.” Within this logic, many feel that vaccinations are effective against illness in general. 29% of urban and 48% of rural mothers could name no biomedically “correct” vaccinable diseases, yet were actively seeking immunization – reflected in national coverage rates of 90% in 2003. Such ideas about strength, fluid and substance do not conform to biomedical notions of an immune system, disease-specific vaccines and strong distinctions between prevention and cure. Yet they ground strong appreciation of immunization in areas across The Gambia, Guinea, Sierra Leone and beyond. Yet the same framing can also underlie anxiety: in a social context in which mothers often miss clinic sessions due to workloads and problems at home, they often worry greatly about local health and circumstances. Context matters, and technologies and practices suited to one place might be rejected in another.

Third, the slow race implies a different approach to thinking about innovation. Rather than assume – as in the “universal fix” view – that technologies can be developed “upstream”, often in international centres, and then transferred in a linear way to the resource-poor settings that need them, a more participatory and systemic approach is required. This can helpfully draw lessons into the health sector from participatory technology development approaches – as pioneered in agriculture and natural resource management, for instance – that put local users at the centre of the innovation process, working in collaboration with scientists both to design new technologies and to adapt existing ones to local circumstances. These approaches recognize the value of local knowledge, moving away from the image of people as passive recipients of externally-derived health technology, to involve them as active, creative partners in technology development processes.

Yet such participatory interactions raise many questions about who controls the innovation process, and whose perspectives drive it. Too often, participation has meant simply co-option of local people into pre-set technological agendas. The huge imbalances in the power, reach and resources of people living in resource-poor settings and research agencies has contributed to this. Even where true collaborative arrangements have been established, these have often been isolated and dependent on the interest of key individuals and on temporary project funds, rather than being fully institutionalized in national and international innovation systems.

Rather than isolated project examples, an innovation systems approach emphasises the networked interaction of multiple actors, both public and private, local and national, in processes which initiate, import, modify and diffuse technologies. It emphasizes understanding these actors that enable them to operate as an effective system, involving issues of funding, marketing and the encompassing policy and legal framework. This involves not just building the “hardware” of research and development (R&D) infrastructure and capacity, but fundamentally, considering the “software” of social and political relations among the many actors that are now involved, and the question of who controls science and technology agendas in whose interests. The development of the International AIDS Vaccine Initiative (IAVI) illustrates many aspects of this approach. The initiative aims to further HIV vaccine research worldwide, including the search for candidate molecules, the funding of clinical trials, work on delivery issues and wider policy and advocacy efforts, working towards an effective and cheap vaccine for resource-poor settings. Vaccine development partnerships have been created between developing country organizations and northern research agencies, both public and private. The initiative spreads its funding across a diversity of players, and focuses on vaccine development and delivery issues rather than upstream research. It currently

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Operates in 22 countries, and is increasingly decentralized in its operation, responding to early accusations of top-down, central control. The existence of regional offices and growing links with non-governmental organizations (NGOs) and civil society means the initiative is broad based and attuned to social and political issues. Nevertheless despite its scale it still remains a small player in the overall HIV/AIDS technology innovation and delivery network, dwarfed by larger funds spent on more conventional upstream research.

Furthermore, innovation should focus not just on the technology, but also on the social, cultural and institutional relationships that make it work. There are numerous examples where technologies already exist that could have major impacts on health and poverty problems, yet they remain out of reach. To make existing technologies – sometimes everyday, old technologies – accessible to people living in poverty often means linking the technical with the social. For example in parts of South Asia, a revolution in "community-led total sanitation" has occurred as community organization, empowerment and learning has facilitated the widespread building of extremely low-tech, low-cost latrines – in contexts where adoption of existing sanitation technologies in the past had been very low. To enable people to make use of technologies that may be available, but are poorly understood often requires culturally-appropriate communication strategies, improving people's knowledgeability, capacity and power to make technology choices.

In other cases, institutional innovations – for instance in the ways that health services are financed, delivered and relationships between people and providers negotiated – can be crucial in enabling people to access technologies and their benefits, as part of building health systems that work for the poor. For example many health systems in Nigeria have become increasingly pluralistic and poor people are faced with a confusing myriad of health providers and drug sellers. Old barriers between private and public, modern and traditional, and formal and informal health providers are breaking down. In this context innovative learning and regulatory arrangements are being developed to increase the knowledge of medicine vendors and local people about appropriate drug treatment for malaria, and to address the problem of access to and use of low quality anti-malarial drugs by the poor (http://www.futurehealthsystems.org/country/nigeria.htm).

Fourth, the complex interaction of multiple dynamics involved with health issues today – biological, demographic, ecological, economic, social, political, cultural – operating at different scales and at different speeds – results in deep uncertainties – and often ignorance – about likely outcomes and their consequences. Despite this, the design of technological research and development, of health systems and of approaches to epidemics frequently proceed as if the world were stable, and as if uncertainties and possibilities of surprise could be reduced to risks which can be assessed and managed. In today's world, in which deep uncertainty and surprise are inevitable, this is, more than ever, a flawed approach. It may be time to move towards more adaptive, learning-process approaches in building pathways to health and development. This will require new institutional and administrative arrangements which can embrace surprise, deal with uncertainty and accept ignorance, along with appropriate bureaucratic and other procedures. There are as yet few examples in the health sector, but this is a frontier area for future development.

Running the slow race to make health technologies work for the poor therefore requires an embracing of dynamics and diversity, of multiple forms of knowledge and framing; of an innovation and health systems approach, and of adaptation and learning to cope with uncertainty. This in turn carries major implications for the organization of research, funding and policy.

An overarching challenge is to foster more, and more effective, interdisciplinary, user-oriented and participatory research of various kinds. This involves creating research and innovation partnerships between scientists and potential users, especially poor people themselves, remembering and recapturing longstanding experiences in participatory technology development that have been overshadowed of late by today's new global technology-transfer hype. It involves linking natural science and biomedical disciplines with the social science that can illuminate how technologies might engage with society. It involves linking different sectors – and the social and technical debates within each – so as to generate, for instance, lesson-learning from the agricultural and natural resource management fields across to health, and vice versa. This carries implications for research funding, much of which – whether from development donor agencies, foundations or research councils, is still strongly divided by natural science – social science boundaries, or split into sectoral silos. The last few years have seen the take-off of some exciting and important funding initiatives which do promise support for the kind of interdisciplinary and international partnership work which is needed, but these remain drops in the ocean of the levels of funding devoted to disciplinary, technical research. The challenge is to mainstream the social into the technical and vice versa, through genuinely trans-disciplinary openness in funding regimes focused on (health) problems and issues, not disciplines.

At the same time, new policy approaches and institutions are needed which bring together poor people, health providers, scientists, administrators and health policy-makers in new ways that promote dialogue: about long-term futures and technology options; about health problems, about technology adaptation to local contexts; and about risks and uncertainties and ways to understand and adapt to these. Such institutions would need to enable both more open-ended dialogues which take their lead from peoples' felt health and well-being needs and debate the technological options that might help address these, and more focused dialogues around particular problem areas (e.g. how to address child deaths from diarrhoea, or an emerging zoonosis) or particular new technologies, their potentials, benefits and risks (e.g. a new vaccine). While some such institutions might operate at local scales, they would need to articulate with national, regional and global equivalents, in a
networked interaction. This slow race may be less glamourous than the technology breakthroughs that capture global headlines. It is not a substitute for these, but it is a vital complement in the ongoing, painstaking task of linking science and innovation to the complex, diverse needs of people in resource-poor settings, and in helping to ensure that, in a dynamic and uncertain world, investments in science and technology for health are firmly enmeshed with inclusive debate about the social and political values they serve.

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References
Information and communication technologies (ICTs) are increasingly being recognized as essential health technology, giving individuals at all levels of the health workforce and other stakeholders access to information that helps them protect and improve health and save lives. Radio and television are ever-present in many parts of the world, and their uses in health care, health education, and health information dissemination and access continue to be invaluable. At the clinical and laboratory level, ICTs are used to track and provide patient information, to facilitate research, diagnosis and testing, and to deliver services through telemedicine despite distance and time barriers.

Debate continues as to the roles and relative importance of ICTs in socioeconomic development including health development. Many people believe that ICTs are a necessary component of every facet of development, ranging from infrastructure projects and general economic development to community development, health care provision and education. On the other hand, there are many barriers to implementing ICTs and health technologies in developing countries (see Table 1) and many argue that clear precedence must be given to clean water, sanitation and jobs. There have been many efforts to use older ICTs for health and development in developing countries. Radio and television networks can be powerful tools for widespread health education. There have been many efforts to donate legacy systems and older computers to developing countries, although some argue that this is more a means of dumping eWaste than a philanthropic effort. MIT has recently announced it is developing a US $10 computer using the older Apple II hardware and software in parallel with the One Laptop per Child (OLPC) initiative.

The concept of leapfrogging implies that developing countries should be able to benefit from the most current technologies and bypass older legacy systems as a more efficient means of achieving technology transfer. This paper looks at leapfrogging technologies as a potential tool to address the inequalities in health care between the low- and middle-income countries (LMICs) and high-income countries. We focus here on two current examples of leapfrogging which are already being successfully implemented in many developing countries: ePublishing and mobile phones. Other leapfrog technologies and potential benefits and risks of their use for health in

Table 1: Potential barriers to implementing leapfrog technologies in developing countries

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Absorptive capacity</td>
<td>Inadequate ability to recognise, place value upon, internalize and apply new knowledge (e.g., among IT support workers and system managers in LMICs)</td>
</tr>
<tr>
<td>Attitudes and perception</td>
<td>Acceptability, perceived needs based on a needs analysis, attitudes towards technology, concepts of development and aid, and focus on the problems to be solved (i.e., being people-driven and problem-oriented not kit-driven)</td>
</tr>
<tr>
<td>Cultural and community issues</td>
<td>Language, cultural views towards technology, sharing of resources within the community, appropriateness of a specific technology within a given culture or community, literacy requirements, gender issues and access issues</td>
</tr>
<tr>
<td>Legal and ethical issues</td>
<td>Privacy, confidentiality, security, malpractice potential, insurance, jurisdiction, copyright, patents for new technologies and treatments, other intellectual property issues</td>
</tr>
<tr>
<td>Technical issues</td>
<td>Access to electricity grid and alternative power supplies, power schedules and reliability, UPS back-ups, ongoing maintenance of computer, inappropriate access devices and inappropriate Internet technologies including low bandwidth, insufficient language and cultural adaptation of content and the digital divide</td>
</tr>
<tr>
<td>Environmental issues</td>
<td>Effects of weather, temperature, humidity and dust on equipment, security and accessibility of equipment, Isolation, transport issues</td>
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<tr>
<td>Sustainability issues</td>
<td>Degrading upgrades of technology, ongoing costs, cost-effectiveness</td>
</tr>
<tr>
<td>Practical issues of working internationally</td>
<td>Corruption, borders and customs in equipment transport, nationally-imposed barriers to information access or dissemination or to information privacy, donor-imposed barriers, time zones and communication issues of working in remote geographical areas</td>
</tr>
<tr>
<td>Health care infrastructure</td>
<td>In health, insufficient means to implement health care and take full advantage of leapfrog ICT technologies, e.g. lack of treatment facilities, drug delivery systems, inadequate cold chain facilities for vaccines</td>
</tr>
<tr>
<td>Technology</td>
<td>Examples of potential applications in developing countries</td>
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<tr>
<td>----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Telemedicine technologies</td>
<td>eRadiology, ePathology, teleSurgery, Store and Forward Telemedicine can enable access to necessary expertise and help in overcoming the “brain drain” of medical personnel in developing countries</td>
</tr>
<tr>
<td>Open access technologies</td>
<td>Technologies such as Web Bibliometrics, Web 2.0 and wiki are making it possible to realize the principles of The Budapest Open Access Initiative, The Berlin Declaration, The Open Source Initiative and Gnu License, as well as The Copy Left Movement. Projects such as The Public Library of Science, Biomedcentral are revolutionizing medical publishing with Open Peer Review and Commentary and free access to publications. This has resulted in a paradigm shift in why and how we publish scientific research</td>
</tr>
<tr>
<td>Collaborative technologies and social networking</td>
<td>Advances such as Web 2.0 and wiki will mean that health professionals and patients in developing countries can effectively network with each other and with the industrialized world and actively participate in knowledge development through projects such as medical wikis. This will also lead to patient empowerment and to better informed health care particularly for those suffering from chronic illness and disabilities</td>
</tr>
<tr>
<td>GRID technologies</td>
<td>May deliver greater power at less cost by harnessing the capacity of many computers and increasing collaboration efforts</td>
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<tr>
<td>Internet2</td>
<td>Internet2 allows advanced centres of medicine to provide health education to hospitals and universities in developing countries through increased bandwidth, improved security and collaboration potential</td>
</tr>
<tr>
<td>eLearning technologies and virtual patient simulation</td>
<td>The creation of these new resources is both exciting and precarious as they can offer limitless possibilities to advance in areas like distance learning and interdisciplinary development. Facilitates capacity building and collaboration with other institutions through both real time and asynchronous delivery methods</td>
</tr>
<tr>
<td>Bioinformatics</td>
<td>Identification of drug targets and understanding pathogen-host interactions</td>
</tr>
<tr>
<td>Alternative network technology</td>
<td>3G, 4G mobile phone networks and digital satellite radio offer the potential for access in remote areas</td>
</tr>
<tr>
<td>Eco-technologies</td>
<td>Environmental sustainability, sanitation, clean water, bioremediation</td>
</tr>
<tr>
<td>Solar technology</td>
<td>Power for computers, phones. A lesser known health sector application for solar technology vs the application of solar ovens to dispose of hazardous medical waste</td>
</tr>
<tr>
<td>Genomics and recombinant technologies</td>
<td>Sequencing pathogen genomes to assist in development of antimicrobials; decreased costs of vaccine development; development of less expensive and more field-useable vaccines Reduced costs of drug development; development of more-effective and appropriate and less expensive drugs for priority problems in LMICs</td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>Nanomedicine offers new methods of diagnostics and could completely dispel certain classes of drugs and change the ways diseases like HIV, malaria and TB are treated</td>
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<tr>
<td>Genetically modified crops</td>
<td>Increased nutrients to counter specific deficiencies Cross-contamination with other crops, international regulation issues</td>
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<tr>
<td>Combinatorial chemistry</td>
<td>New drug discovery</td>
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<tr>
<td>Molecular technologies</td>
<td>Affordable diagnosis of infectious disease</td>
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Table 2: Examples of leaping technologies
Technological innovations

developing LMIC countries are outlined in Table 2. Case studies have recently been published outlining eHealth activities and results in Peru, South Africa, Turkey, Vietnam and Rwanda. The South African case study confirmed that the needs of developing countries differ from those of the developed world in some areas. Issues of interoperability, human resource development, broadband penetration and high cost of bandwidth are worth noting. Although several e-Governance projects have been implemented in South Africa and a draft eHealth White Paper Discussion Document has been developed, the implementation of eHealth policy remains a concern.

The training of the workforce needed for successful eHealth implementation is globally a common focus. Apart from residential degree courses, online training opportunities are now also offered, such as Drexel University’s Certificate in Healthcare Informatics and Certificate in Medical Billing and Coding. An important part of eHealth, albeit sometimes viewed as on the periphery, is consumer health sites. Such sites should preferably be accredited by the Health On the Net Foundation (HON), whose mission is to guide Internet users to reliable understandable accessible and trustworthy sources of medical and health information. However, the apparent success of consumer health sites can result in – or unveil – another problem for health-care consumers and providers. A recent survey in the USA commissioned by Envision Solutions found that more than 85 million adults in the USA – almost 40% – have doubted their health-care providers’ opinions when the information did not match what they found online.

A good example of technology leapfrogging is mobile phones, which have enabled low- and middle-income countries to overcome the barriers of poor or insufficient telecom infrastructure and leapfrog into 21st century mobile technology. ICT leapfrogging also applies to digital technologies whereby many low- and middle-income countries have been able to leapfrog to the digital age without going through the analogue era technologies. This possibility to leapfrog extends to eLearning and eHealth as well. Currently, most of the popular eLearning and eHealth programs and applications require sophisticated hardware and software, and in many cases access to high-speed Internet. As a result, countries that need eLearning and eHealth services the most are also the ones least able to access and use them. With the introduction of mobile technologies and devices, it is possible to provide eLearning and eCapacity building programmes to public health providers, even in remote and isolated areas. By 2010, the total number of mobile phone users is expected to grow to 3.3 billion globally, or approximately half the world’s population. Although the more affordable mobile phones in developing countries may not yet have sophisticated features found in Smart Phones, mobile phones are becoming ubiquitous in Asia, Africa and Latin America. This is expected to result in an increase in mobile-enabled health systems and services throughout the world. The recent development of “mobile web” is already turning web browsing into an “any time, any place” phenomenon. The mobile web will essentially function as “personal computers”. If at least one doctor and one nurse in every hospital in developing countries, especially those in rural and peripheral areas, were to have access to (and effectively use) a mobile “smart” phone with web capability, it could have a major impact on provision of health care.

The UN Millennium Villages Program has initiated a plan in which some of the world’s poorest people in several African countries will be connected to cellular networks and be able to use mobile phones. This is expected to have a significant impact on health care and education. They will not have access to mobile web browsing yet, but that could be available to them within a few years. The UN hopes that if the very poor in Africa have mobile phones they will be able to use them effectively in medical emergencies and also to access appropriate and useful health information. A rural hospital would be able to make a call to the nearest specialty hospital or specialist and thus help save lives during emergencies.

Mobile web browsing, at the very least, could provide instant access to the most relevant and up-to-date health information to health practitioners, especially if the most relevant and appropriate information were available in easily accessible forms, and it would offer a private and personal form of learning experience. The mobile web can be a “knowledge repository” for both providers and consumers of health care. Other mobile devices such as patient monitoring devices, PDAs and wireless radios can all be used in public health education, training and eHealth. For example, they can be used in real-time monitoring of patient vital signs and in accessing important and useful health information.

One of the main constraints that prevents developing countries from being fully part of the emerging global ICT infrastructure is the lack of resources, both financial and human, to acquire and apply the technologies. The latter is true, especially in public health. Even if the government or donor agencies are prepared to invest in the required infrastructure, at present there are not enough skilled people within the health sector, especially in the rural areas, who are able or willing to use most ICTs effectively. Mobile phones and some other hand-held wireless devices, however, do not seem to pose too much of a challenge to the users. Medical record-keeping is an area which begs for leapfrogging. In the tsunami-hit hospitals in Sri Lanka and other countries, for example, paper-based health records and patient records were washed away or destroyed. Having one’s medical records available on a mobile phone would also help doctors, nurses and pharmacists make the right decisions,
form of eLearning. They keep readers up-to-date on new
developments in public health research. In many parts of the
developing world, unlimited Internet access is now available
on a monthly rate basis. Health personnel with such access
can easily have individualized professional
development by just going through these online
journals. Many medical schools and colleges have
computer centres that allow students free time on the
Internet. Many journals are available on a fully open-
access basis, e.g., *BioMedCentral* and *PLOS Medicine*, and
in developing countries many journals are
available through HINARI and even some evidence-
based medicine websites such as
dynamicalmedical.com are available free of charge to
health professionals in many developing countries.
Electronic journals also offer the convenience of taking
part in blogs, debates, webchats, and other forms of
eLearning and electronic participation. This has the
added advantage of peer learning and of being part of
communities of practice on a global scale. ePublishing
also stands to make major changes in the way we
disseminate information. Success will be measured by
web bibliometrics analysing one’s contribution to
making a real impact, rather than merely by
counting peer review publications and citations. These
bibliometrics have the potential to replace the current
system of publish or perish merit system measured by
citations. The new system will allow an
unprecedented transparency in research, making
fraudulent research very difficult. Open access, open
archives, open editorial review and open peer review
will make possible access to original data and
collaboration in ways not yet envisioned. An open
source approach to research dissemination will ensure
true advancement in scientific acknowledge through
real paradigm shifts and important innovative
advances.

This year’s *Global Economic Prospects* focuses on
technology diffusion in developing countries and
states that even the introduction of relatively simple
technologies can have far-reaching development
impacts. “Technological advances do not need to be
extraordinarily complex or reliant on the most
sophisticated technology to have important
development impacts”. This holds true for health ICTs.
With the convergence of mobile phones and the web,
we expect major impacts on the way health
information is used and processed. More and more
health workers will be able to access web-based
health and hospital information using their mobile
phones rather than their desktop or laptop computers,
which usually do not exist in many health care
facilities. Ubiquitous, portable and personal
computing via affordable mobile phones will lead the
way in leapfrogging ICTs in many parts of the
developing world. ePublishing and Open Access make
it possible to access essential health information at
the point of care on these devices, and this is already
occurring in many areas.

<table>
<thead>
<tr>
<th>Initiative/organization</th>
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<tbody>
<tr>
<td>AED Satellite</td>
<td>Uses ICTs, especially PDAs, in health and development. <a href="http://www.healthnet.org/whatwedo.php">http://www.healthnet.org/whatwedo.php</a></td>
</tr>
<tr>
<td>Development Gateway</td>
<td>World Bank Initiative. Portal for development partners and member countries. <a href="http://www.developmentgateway.org">www.developmentgateway.org</a></td>
</tr>
<tr>
<td>Health InterNetwork for Developing Nations (HINARI)</td>
<td>Biomedical publishers, working closely with the World Health Organization (WHO), allowing free or very low priced online access to more than 4500 biomedical research and healthcare journals. <a href="http://cat.inist.fr/?aModele=afficheN&amp;pid=1446758">http://cat.inist.fr/?aModele=afficheN&amp;pid=1446758</a></td>
</tr>
<tr>
<td>Health on the Net Foundation (HON)</td>
<td>Sets code of practice for health Internet sites to guide Internet users to reliable, understandable, accessible and trustworthy sources of medical and health information. <a href="http://www.hon.ch">www.hon.ch</a></td>
</tr>
<tr>
<td>Interactive Health Network and Academy for Health Equity and Disability</td>
<td>Nonprofit organizations dedicated to using online technologies to combat health inequities through stimulating discussion regarding effective policies for public and private health programmes and practices affecting those most marginalized in society. Works in Africa and Asia-Pacific predominately on elearning and ePolicy initiatives. Uses ICTs for eCapacity Building of health-care workers and for effective national and international policy development. <a href="http://www.infohealth.org">www.infohealth.org</a></td>
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<tr>
<td>IRC Asia Initiative</td>
<td>Works in Africa with a focus on appropriate applications and technologies, infrastructure, policy and governance. <a href="http://www.idrc.ca/ircasia">www.idrc.ca/ircasia</a></td>
</tr>
<tr>
<td>PATH</td>
<td>Nonprofit organization using health technologies designed for low-resource settings, by the people who will use them, promoting health equity for women, among the world’s most vulnerable and influential – populations and vaccine programmes. <a href="http://www.path.org">www.path.org</a></td>
</tr>
<tr>
<td>Rockefeller Foundation and the global coalition for eHealth in developing countries</td>
<td>Sponsors think tank meetings on eHealth aimed at improving health systems in the developing world. Includes BIRDIE (PAHO/ WHO Latin American and Caribbean Center on Health Sciences Information), the American Medical Informatics Association (AMIA), International Medical Informatics Association (IMIA), Health Level Seven (HL7), Health Metrics Network (HMN), Partners in Health (PIH), Regenstrief Institute, Telemedicine Society of India, United Nations Foundation (UNF) and Vodafone Group Foundation Technology Partnership. <a href="http://www.healthnet.org">www.healthnet.org</a></td>
</tr>
<tr>
<td>WHO Essential Technologies Programme</td>
<td>Has eHealth branch focusing on applications in developing countries; collaborates with NGOs on programmes; sponsors many conferences on technology and health. <a href="http://www.who.int">www.who.int</a></td>
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*Table 4: Examples of international initiatives promoting ICTs for health and development (modified from McConnell 2004, 2006)*
Technological innovations

Table 3 shows some examples of international efforts to implement Leapfrog technologies in developing countries for health care.

Conclusion

In public health practice, ICTs enable the identification of disease and risk factor trends, analysis of social and demographic data, and increase access to publications and databases. As free and open source software continues to evolve, the uses of ICTs for health will expand exponentially. ICTs can be used by medical professionals and community health workers to improve not only health services but also entire health-care systems, while beneficiaries can use ICTs to access health information and make well-informed decisions regarding their own health. However, not all members of the health workforce or the public have equal access to ICTs. The digital divide—the gap between those with effective access to ICTs and those without it—contributes directly to the persistent health inequality both between and within countries. In health, lacking or limited access to ICTs impedes the provision of health care and the effectiveness of public health work. Efforts to bridge the gap in access to ICTs have varied dramatically in their effectiveness and their usefulness. Beyond the creation of systems for cell phone and Internet use, we need to ensure that access to ICTs for health will link individuals to the health information and modes of communication that are most useful to them, and that the most necessary, valid and useful information is available in the most acceptable and useable forms.

Thomas Kuhn in The Structure of Scientific Revolutions in 1962 put forward that true scientific knowledge does not advance as a linear increase in understanding based on logical models. He proposed that true advances occur naturally as a series of revolutions, replacing the old paradigms and resulting in a “paradigm shift,” a new way of thinking about a problem. Thus, to advance development, the use of leapfrog technologies must extend this process to include ecologically, financially and socially sustainable means of tackling poverty and health inequalities. Examples of such paradigm shifts include very recently the effect of the Internet on information retrieval, and earlier the discovery of penicillin and vaccines for combating infectious diseases. ICTs are already having an impact in health in developing countries through the rapidly growing use of mobiles and ICTs are already having an impact in health in developing countries through the rapidly growing use of mobiles and

He has a keen interest in Open Access and innovative use of IT to make scientific publishing more available in developing countries. Professor McConnell has worked extensively with the WHO, World Bank and other international agencies on the implementation of eHealth programmes in developing countries. He trained in the USA, Canada, New Zealand and the UK. Professor McConnell also has a keen interest in evidence-based policies for disability services and in health and disability in developing countries. He is a Consultant Psychiatrist and Professor of Neuropsychiatry at Griffith University School of Medicine.

Prita Chathoth PhD has more than 20 years of international experience in health, eHealth and ICTs for development. She worked at the World Bank in Washington, DC, from 1993 to 2007. During this time, for more than seven years, she served as senior operations officer in the Global Development Learning Network (GDLN), as Task Manager of the GDLN Global Dialogues Program, Dr Chathoth worked extensively with all regions of the world. From July 2005 to December 2006, Dr Chathoth was on assignment at the WHO Office in Sri Lanka as eCapacity Building Coordinator and Project Manager of the Sri Lanka eHealth Project. Prior to joining the World Bank, she worked at INTELSAT, in Washington, DC, as a training specialist. In 2007, Dr Chathoth worked as a consultant at the Pan American Health Organization (PAHO). She has researched, written and produced more than 15 broadcast quality documentaries. Dr. Chathoth currently works as an independent eLearning/eHealth Consultant.

Ashley Pardy is the co-director of the Interactive Health Network (IHN) and project manager of the Academy for Sustainable Health Equity and Development (AHEAD). Both are nongovernmental organizations dedicated to improving health and disability services in developing countries through the use of information communication technologies. Now a full-time PhD student at Griffith University in Australia, Ashley started her university education at Queens University in Canada, where she completed her BA and then continued on to Australia to do her masters in International Relations. She is currently focussing her PhD research in Ethiopia and is actively involved in development projects in the Asia pacific region. Ashley has worked as a volunteer in Asia, Africa and South America.

Camille Bossstrom is a PhD candidate in public health at Griffith University, Australia. Her research analyses the sector-wide approach in Mozambique’s health sector and its impacts on the country’s HIV/AIDS prevention efforts, specifically on the negotiation and dissemination of HIV/AIDS communications. Camille is also a Research Associate with the Georgetown University Medical Center.

Eugene Bossstrom MD, DrPH is a public health specialist with more than 30 years’ experience in the development of health systems and health personnel. He has worked in Africa, Latin America and the Caribbean, the Middle East and South Asia with bilateral and multilateral agencies, universities, foundations and the private sector. He retired from the World Bank as Senior Public Health Specialist in 2002 and now lives in Okinawa, Japan, where he is a Visiting Researcher at Meio University Research Institute. He also teaches public health, epidemiology, health project and human
resources planning and management, and sustainable development related topics for the Japan International Cooperation Agency (JICA), Japan’s National Institute of Public Health, and Hokkaido University Medical School.

Ross Leue is an eHealth consultant living in Cape Town, South Africa. He served for many years in the top management of the South African Medical Research Council as Executive Director: Informatics and Knowledge Management. He is an acclaimed role player in the area of health informatics and knowledge management nationally and internationally, and has a track record of various successful large multi-institutional eHealth projects. He holds a PhD from Stellenbosch University, South Africa. This university appointed him in the honorary position of Visiting Professor: Information Science (Knowledge Management) and as an Associate of its Centre for Knowledge Dynamics and Decision Making.

Luis Gabriel Cuervo is a Medical Doctor with an MSc in Clinical Epidemiology & Biostatistics from the Universidad Javeriana, and qualified as a Specialist in Family Medicine at the Universidad del Valle, Colombia. He brings first hand experience as producer and user of evidence for health care in the clinical, academic, and research fields working in various communities in rural and urban environments in Colombia. He has developed a career around knowledge management including summarizing evidence and developing strategies to systematically inform policy and practice with research evidence. From his position as Clinical Editor at BMJ Clinical Evidence he emphasized evidence-based programmes and access to developing countries and worked closely with the World Health Organization and International NGOs including the Cochrane Collaboration and INClEN. More recently he has coordinated the response of the Pan American Health Organization (PAHO/WHO) to the 2004 Mucoviscidosis Declaration on Health Research.

Sumiko Ogawa, MS in Medical Sciences, MPH, PhD, is Associate Professor at Meio University, Okinawa, Japan, where she teaches Public Health. Her successful work with WHO and JICA in developing Primary Health Care and Village Drug Revolving Funds and improving water supplies in the Lao PDR’s remote Khamsouane Province from 1992 to 1996 led the Government of Laos to award her its Labor Medal, and the Japan Chamber of Commerce named her Japan’s Outstanding Young Person of 1997. With support from Japan’s Ministry of Education and JICA, she documented the post-World War Two recovery and development of health systems and human resources for health in war-ravaged Okinawa. She is President of Okinawa’s Association of Former Overseas JICA Experts and a member of the board of Japan’s Association for Overseas Volunteer Studies. She continues her work with the Lao PDR MOH and also teaches and consults for JICA.

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6. Refer: www.nroc.org/ 
9. http://www.worldbank.org/WH/IT/EXTERNAL/EXTERNAL EXTECONPROFILES/EPET%2EGET%2EPHP%2E0086%2E0%3Ft=PC%26K%3D4503385%26page PK%3D641677102%26p%26K%3D64167676%26theSite%26K%3D4503324%260.html

Furthur reading

The IVI’s innovative approach to closing the gap between vaccines for industrialized and developing countries

Article by Denise DeRoeck (pictured), Coordinator, Social Science Research and Institutional Development, International Vaccine Institution, South Korea with Anna Lena Lopez, Rodney Carbis and John D Clemens

Experience in the past three decades has shown that getting a new childhood vaccine introduced into a developing country is more than simply a matter of obtaining good results from clinical trials, getting it licensed and introduced into immunization programmes in industrialized countries, and expecting developing countries to follow suit. A large number of obstacles stand in the way. First, country policy-makers, as well as donors, may consider the new vaccine unaffordable, especially compared to the pennies-per-dose basic childhood vaccines, such as DPT and oral polio. Second, a number of countries, especially large Asian countries, such as China, Vietnam, India and Indonesia, have a policy of self-reliance in vaccine production, requiring them to produce or at least fill/finish and package locally any vaccine used by the national immunization programme. The new vaccine may be patented, too complex or too expensive to produce locally. One way to deal with both of these issues is to develop technologies for vaccine manufacture and testing that can be transferred to qualified vaccine producers in developing countries so that they can manufacture high quality vaccines at affordable prices.

Another common obstacle to introducing a new or underutilized vaccine into developing countries is that local policy-makers may not be convinced of the need for the vaccine in their country. This may be because the disease is part of a syndrome or group of diseases and not recognized as a distinct disease (e.g., diarrhoea caused by rotavirus virus other enteric pathogens); the disease is not well diagnosed, due in part to a lack of specific, accurate or low-cost diagnostic tests, and thus is under-reported (e.g., typhoid fever); or the disease mainly affects poor, marginalized or rural populations and is therefore not on the radar screen in urban areas where policy-makers and the media are concentrated (e.g., cholera, Japanese encephalitis). Estimates of the burden of the specific disease are therefore required, which may include conducting prospective disease surveillance studies. The vaccine’s effectiveness in local populations may also be questioned, especially when the trials for licensure have been conducted solely in industrialized countries or only in certain parts of the world. Because populations can differ in their immune response to a particular vaccine, national policy-makers are increasingly demanding local or at least regional data on a vaccine’s efficacy or field effectiveness.

Finally, country policy-makers may be uncertain of their population’s demand for or acceptance of the new vaccine. This is perhaps less of an issue for vaccines introduced into the infant immunization schedule, such as the new rotavirus and pneumococcal conjugate vaccines, since children are simply given the additional vaccine during their regular immunization sessions. However, it can be an important issue for vaccines provided outside of the infant schedule, such as the new human papillomavirus (HPV) vaccine (given to pre-adolescent girls), and vaccines against cholera and typhoid fever – which are not licensed for use in children under the age of one or two years. These vaccines require special efforts to administer – such as school- or community-based vaccination campaigns – thus increasing the potential for resistance or disinterest on the part of health authorities and the community. Conducting sociobehavioural studies and private demand surveys concerning the particular disease and vaccine in target populations can help predict demand for the vaccine, as well as preempt possible negative reactions or lack of interest (e.g., by using commonly-held beliefs or attitudes to inform social mobilization activities and messages), and inform the design of effective vaccination strategies.

A number of product development partnerships (PDPs) have been established in recent years – primarily with funding from the Bill & Melinda Gates Foundation – to undertake the complex, multi-faceted and coordinated set of activities that are required to address the above issues in order to accelerate the development and introduction of specific vaccines into developing countries. Examples are the Malaria Vaccine Initiative, the International AIDS Vaccine Initiative (IAVI), the Rotavirus Vaccine Project, the Aeras Global TB Vaccine Foundation and the PneuMAIP. While most PDPs use a model that combines in-house activities and expertise with those that are out-sourced to diverse partner organizations, the approach of the International Vaccine Institute, an independent international organization founded in 1997 and based in Seoul, Korea, has been to build...
findings greatly complicate the commonly believed. These country was greater than from year to year within the same from country to country and even diversity in the distribution of countries, revealed that the Research Division in six Asian shigellosis (bacterial dysentery) prospective surveillance of bureaucracy. For example, involving multiple layers of gears and move into the direction allowing the researchers to switch by more easily and rapidly costs. It also enhances flexibility, administrative fees and overhead subcontractors with additional reducing the need to hire progression, as well as save costs by getting a vaccine introduced into developing countries has a number of advantages. Conducting most of the activities and research in-house can quicken the pace of progress, as well as save costs by reducing the need to hire subcontractors with additional scientific challenges and the development of such a vaccine circulating serotypes, making the ultimate production logistically complex and expensive. These findings from the field led the IVI’s laboratory scientists to go back to the drawing board and to use an innovative genomic search strategy to analyze whole genome sequences from the four Shigella species, using specimens obtained from the field surveillance studies.

Having in-house capacities in all or most of the areas required for getting a vaccine introduced into developing countries. These activities are depicted in Figure 2.

In the remainder of this paper, we describe how the IVI’s in-house capabilities have been put to work to accelerate the use of new-generation cholera vaccines in cholera-endemic countries. These activities are depicted in Figure 2.

Figure 1: In-house capabilities and activities of the IVI along the vaccine continuum

Vaccine discovery and design:
- Genotyping (pathogen detection)
- Novel antigens
- New routes of administration (e.g., sublingual)
- Reformulation and improvement of existing or prototype vaccines

Vaccine development:
- Laboratory process development
- Assays development (immuno-monitoring)
- Technology transfer for large-scale production
- Clinical trials

Research for vaccine introduction:
- Collection of epidemiological, economic and socio-behavioral data
- Studies of vaccine feasibility, acceptability and field effectiveness
- Data synthesis (cost-effectiveness and impact analyses) and dissemination

Figure 2: The IVI’s Cholera Vaccine Programme to accelerate the use of low-cost oral cholera vaccines for endemic populations

Vaccine development:
- Refinement and improvement in IVI’s laboratories of a low-cost oral killed whole-cell (WC) cholera vaccine produced in Vietnam
- Testing of the safety and immunogenicity of the improved oral killed WC vaccine for licensure in Vietnam and India
- Technology transfer of improved WC vaccine to high-quality developing country producers
- Development of new immuno-assays for cholera
- Field testing of a low oral, single-dose Peru-15 vaccine in Bangladesh and India

Research to vaccine introduction:
- Prospective disease surveillance studies in several sites
- Cost-of-illness and vaccine demand surveys
- Socio-behavioral surveys
- Demonstration of mass vaccination using Dukoral in Mozambique and assessment of its protective impact
- Analysis of herd effects and overall impact of oral killed WC-based vaccines
- Site-specific impact and cost-effectiveness analysis of different cholera vaccination program options
- Analysis, synthesis and dissemination of global and country-specific data to inform decisions about use of cholera vaccines

Global Forum Update on Research for Health Volume 5 © 139
The IVI’s programme to accelerate the use of new-generation oral cholera vaccines in endemic populations

At the time the IVI began its Cholera Vaccine Program in 2000, there were two internationally licensed new-generation oral cholera vaccines. One was Dukoral™, produced by Swedish Bacteriology Laboratories (SBL), and consisting of killed whole cells *Vibrio cholerae* O1 strains with a purified recombinant B-subunit of cholera toxin (rBS-WC). The vaccine, which requires the administration of two doses given one to six weeks apart, was found in field trials in Bangladesh to confer around 50% protection after three years. It is licensed for persons two years and older, costs several dollars per dose, and thus its use has been largely limited to travellers from industrialized countries traveling to cholera-endemic areas. The second was a live, attenuated vaccine (CVD 103HgR or Orochol™), manufactured by Berna Biotech of Switzerland. This vaccine had been licensed for travellers in several industrialized countries, but was not found to be protective in cholera-endemic populations and is no longer being produced.

Despite recommendations from the World Health Organization (WHO) for the use of new-generation cholera vaccines in 1999, no country has yet introduced cholera vaccines into its immunization programme, with the exception of Vietnam. As a result of technology transfer from Sweden, Vietnam manufactures an oral killed whole-cell (WC) vaccine, which does not contain the purified B-subunit of the cholera toxin and is consequently less expensive to produce (<$0.50/dose). The vaccine was found in field trials in Vietnam to provide 66% efficacy during a cholera outbreak 8–10 months after vaccination in a trial in Hue, Vietnam. After reports of cholera epidemics caused by the O139 strain occurring in South Asia, this strain was added to make a bivalent (O1/O139) vaccine. Long-term effectiveness studies showed that the bivalent vaccine conferred similar protection as Dukoral™ (~50% protection 3–5 years after vaccination). The vaccine is used in Vietnam by the national immunization programme in high-risk areas of the Mekong Delta, central coastal areas and some provinces in Northern Vietnam, especially during floods.

This vaccine could not be used outside of Vietnam, however, because the country’s national regulatory authority (NRA) does not meet WHO requirements. The vaccine also did not conform to the WHO guidelines for the production of killed oral cholera vaccines – specifically, in the way the antigen content was determined and in the presence of low but detectable levels of cholera toxin.

Therefore, at the inception of the IVI’s Cholera Vaccine Program there was the need for a low-cost, safe and effective cholera vaccine for use in endemic countries and the only available new-generation vaccines were either ineffective in endemic populations, too expensive for public sector use in developing countries, or did not meet international standards. There was also a need to demonstrate to the global health community and to skeptical policy-makers in cholera-endemic countries the need for, feasibility and effectiveness of vaccination to prevent cholera using new-generation vaccines.

The first challenge that the programme undertook was to develop a source of low-cost cholera vaccine that met WHO requirements for safety and quality for use in public health programmes throughout the cholera-endemic world. The Product Development and Technology Transfer unit of the IVI worked with the local Vietnamese producer, VaBiotech, to improve the Vietnamese WC vaccine so that it complied with WHO guidelines. This involved reformulating the vaccine by replacing a high toxin-producing strain with a low toxin-producing strain, changing the antigen content of other strains, and developing new lot release assays that both provide greater consistency in the formulation of the product and that better detect the removal of cholera toxin. These efforts resulted in a vaccine that meets quality standards, is safe and yet remains affordable in cholera-endemic settings.

The next challenge was to achieve licensure of this improved cholera vaccine in Vietnam, as well as in other potential countries of manufacture. The IVI’s Translational Research Division conducted Phase II clinical trials, with the National Institute of Hygiene and Epidemiology (NIHE), among adults in Sonla, Vietnam and found a greater increase in serum vibriocidal antibodies and higher rates of seroconversion than those seen after receipt of the original Vietnamese vaccine. The improved WC vaccine is in the process of being licensed in Vietnam, based on these results.

Internationalising the use of this vaccine required that it be produced by vaccine manufacturers in countries with NRAs approved by WHO. Following a due diligence process, the IVI chose Shantha Biotechnics of Hyderabad, India, as the first company to receive the production technology for the new WC vaccine. Before the vaccine could be licensed and produced in India, a series of clinical trials was also required in that country. First, the Translational Research Division, in collaboration with the National Institute for Cholera and Enteric Diseases (NICED), conducted Phase II trials first among adults and then children in Kolkata, India. More than half of adults and 80% of children developed four-fold or greater increases in serum vibriocidal antibodies to *V. cholerae* O1, indicating a strong immune response in this cholera-endemic population. Next, bulk vaccine from VaBiotech in Vietnam was shipped to Shantha, where it was filled and finished for use in a Phase III randomized, placebo-controlled trial involving more than 67 000 children and adults. This trial, conducted jointly by NICED and the IVI, began in 2006 and will continue with disease surveillance for three years following vaccination to estimate the new vaccine’s efficacy.

At the same time, the IVI’s Product Development and Technology Transfer unit completed the development of quality control assays and showed that the new process worked at laboratory scale. The production technology for this vaccine will be transferred to Shantha, which will enable the company to produce the vaccine from scratch under strict good manufacturing practice (GMP) conditions. Licensure in India and the subsequent production of the vaccine by Shantha can begin after the Phase III clinical trial in Kolkata is completed, if the results are shown to be favourable. The ultimate goal is for this vaccine to be pre-qualified by WHO to
enable its use by UN agencies and by the GAVI Alliance, if and when the alliance decides to support the introduction of cholera vaccines into GAVI-eligible countries where cholera still poses a public health threat.

Seeing the need for additional oral cholera vaccines, especially ones that require only a single dose and could therefore be used to control currently-occurring outbreaks, the Cholera Vaccine Program has also worked on the clinical development of a promising live attenuated oral vaccine (Peru-10), developed at Harvard University and licensed to Avant Immunotherapeutics in the United States. The vaccine also has the promise of being effective in infants. The IVI’s Translational Research Division collaborated with the ICDDR,B in Bangladesh to evaluate the safety and immunoreactivity of Peru-15 in adults, toddlers and infants. The trial results were positive and have led to plans for further Phase II and Phase III trials of the vaccine in Bangladesh and India. As with the oral killed WC vaccine, the aim is to have the vaccine produced by a qualified vaccine manufacturer in a cholera-endemic country – following technology transfer from Avant – and for its pre-qualification by WHO, so that it can be an important, affordable tool for the control of both epidemic and endemic cholera throughout the cholera-endemic world.

In parallel with these efforts in the laboratory and in the field to develop and test low-cost new-generation cholera vaccines for global use, the Cholera Vaccine Program embarked on a comprehensive research programme to build the case for cholera vaccination where it is needed for both the global health community and for individual cholera-endemic countries. This programme of translational research began with prospective laboratory-confirmed cholera surveillance studies in two field sites in Asia (slum areas in North Jakarta, Indonesia and Kolkata, India) and one in Africa (Beira, Mozambique). Nested into these studies were studies of the cost-of-illness from cholera, conducted in collaboration with the University of North Carolina (UNC) School of Public Health, which tracked the treatment and other costs of cases identified by the disease surveillance studies. Sociobehavioural surveys to determine the beliefs, knowledge, attitudes and practices of these cholera-plagued communities regarding the disease and preventive measures were also conducted at these field sites, as were household surveys to estimate private demand for new-generation cholera vaccines, both in these impoverished communities and in nearby middle-class neighborhoods.

To provide additional information on the population demand, feasibility and effectiveness of mass cholera vaccination, the Translational Research Division conducted a demonstration of the Dukoral™ vaccine in Beira, Mozambique in collaboration with the Ministry of Health in 2003/4, in which more than 11,000 children and adults received the full two doses of the vaccine. A case-control study conducted during a subsequent cholera outbreak provided further data on the vaccine’s effectiveness – found to be 78-84% over at least five months – in a population with a high prevalence of HIV infection.

As one step in determining the overall potential impact of cholera vaccination, the Translational Research Division, in collaboration with the University of Washington, performed analyses of the herd effects of killed WC-based oral cholera vaccines (both Dukoral™ and the WC vaccine without the B-subunit), using surveillance data from the original clinical trials of these vaccines in Bangladesh conducted in the mid-1980s. The herd effects of these vaccines were found to be substantial; stochastic (probability) modelling estimated that vaccinating only 50% of the population in a cholera-endemic area would result in an estimated 93% overall reduction of disease incidence in the entire population. These herd effects, along with country-specific incidence rates, cost-of-illness and private demand results from the cholera field studies were incorporated into a model, developed by UNC and the IVI, to estimate the impact and cost-effectiveness of different programme options for cholera vaccination in four cholera-endemic settings (Mattal, Bangladesh; Kolkata, India; North Jakarta, Indonesia and Beira, Mozambique).

Using these and further analyses of the global impact and cost-effectiveness of cholera vaccination, the IVI will work with policy-makers at the country and international levels to inform decisions about whether to invest in cholera vaccine introduction in endemic countries. Already, the IVI’s research has had an impact on global vaccine policy, as the Board of the GAVI Alliance recently prioritized cholera vaccines for future support.

Key messages

- The development and introduction of a new vaccine in developing countries requires a complex and coordinated set of activities encompassing vaccine discovery and design, vaccine development and testing, and research to inform decisions regarding vaccine introduction.
- The IVI’s in-house capabilities in all three areas creates synergies between its laboratory, translational research and product development sections and enhances flexibility to resolve problems and change direction in response to research findings.
- Using its in-house capabilities, the IVI’s Cholera Vaccine Program has developed a new low-cost oral cholera vaccine, coordinated the technology transfer and clinical testing of this vaccine for production by a high-quality developing country producer, coordinated field trials of an oral live attenuated vaccine candidate, and generated multi-faceted data to inform decisions to introduce cholera vaccines in affected countries.

Denise DeRoeck serves as the Coordinator for Social Science Research and Institutional Development at the International Vaccine Institute, based in Seoul, Korea. She has a Masters in Public Health degree and more than 10 years of experience in the areas of immunization financing, policy analysis and data synthesis regarding the introduction of new vaccines in developing
countries, as well as 20 years of experience overall in the field of global public health.

Anna Lena Lopez, MD, is a paediatric infectious diseases specialist by training. She is presently a senior scientist and epidemiologist at the IVI where she heads the Cholera Vaccine Program.

Rodney Carbí worked at CSL in Australia, where he was responsible for developing and implementing changes in the manufacturing process of influenza vaccines as well as developing high yielding influenza seed lots. He then joined Sartorius (Australia) and assisted pharmaceutical companies in developing downstream processes and optimizing filtration systems. He joined the IVI in 2003, where he leads a team involved in vaccine process development and technology transfer, with a focus on vaccines against cholera and typhoid fever.

John D Clemens, MD, Director-General of the International Vaccine Institute, is an international expert on the evaluation of vaccines in developing countries. He served as Chief of the Epidemiology Branch of the National Institute of Child Health and Human Development, US National Institutes of Health (NIH) and as Director of the first WHO Collaborating Centre for Vaccine Evaluation in Developing Countries. His research has focused on innovative methodological approaches to evaluating vaccines in developing country populations. He has conducted clinical studies of vaccines against cholera, enterotoxigenic Escherichia coli, typhoid fever, pneumococcus, tuberculosis, Neisseria influenzae type b, measles and Japanese encephalitis.

Technological Innovations

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<td>1</td>
<td>This has been the case of new oral rotavirus vaccines, which, because they had only been tested in the Americas and Europe, have not yet been recommended by WHO for use in Africa or Asia.</td>
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<td>3</td>
<td>Cite Jakarta study paper.</td>
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Commercializing African health research: building life science convergence platforms

A to Z Textile Mills, a company in Arusha, Tanzania, in a joint venture with the Japanese company Sumitomo, is the largest manufacturer of long-lasting insecticide impregnated bednets in Africa. Pellets containing insecticide are shipped from Japan to Arusha, where they are melted, turned into long strings, which are rolled onto spools, and then formed into nets, cut, packaged and shipped using company owned trucks to points of distribution in many African countries particularly in East and Central Africa. A to Z currently manufactures about 12 million bednets a year, which are WHO-certified and reasonably priced. Moreover, A to Z has created more than 5000 jobs for Tanzanians, supporting at least 20,000 people. As an example of manufacturing a science-based health product for one of Africa’s most burdensome diseases, A to Z is a huge success.

Now imagine a company like A to Z that relied not on imported technology but on domestic African health research. Over the same time period that A to Z was manufacturing malaria bednets, distinguished East African researchers like Wen Kilama of the National Institute for Medical Research in Tanzania and Onesmo Ole Moi Yoi of ICIPE in Kenya were studying and publishing on the malaria parasite and mosquito vector. Imagine if this domestic East African research was the source of the technology for innovations in long lasting insecticide-treated bednets! Unfortunately, the linkages between African researchers and research institutions, and companies – even those that are domestically based – historically has been weak.

In this article, we propose that African innovation – and in particular African life sciences innovation – could and should become a prime driver for health and economic development on the continent. We consider a model to catalyze life sciences innovation and commercialization in Africa through “convergence innovation”, which overcomes the problem of missing links between science, business and capital, and provides a specific focus on product development. Our main focus is life sciences innovation for health but with an understanding that applications in agriculture and energy could also benefit from convergence innovation. In a previous essay Accelerating health product innovation in sub-Saharan Africa we set out our initial ideas.

In this article, we review the concept of convergence innovation, elaborate on our real-world experiences in three African countries, and set out opportunities and proposals for the future. While our initial focus has been on Ghana, Rwanda and Tanzania, our vision is a continent where many countries are capturing the health and economic benefits of their own domestic health research.
Technological Innovations

Box 1: Stagnant technologies

Schistosomiasis dipstick test
Professor Kwabena Bosompem of the Noguchi Memorial Institute for Medical Research, Ghana, has developed a dipstick assay for schistosomiasis disease, an endemic problem in Ghana caused by parasites which are present in infected water. Although it has a low mortality rate, schistosomiasis often is a chronic illness that can damage internal organs and, in children, impair growth and cognitive development. Schistosomiasis is the second-most socioeconomically devastating disease after malaria (Danso-Appiah et al, 2008). Despite having developed a prototype test for the disease several years ago, the commercial potential of the test has not been exploited due to a lack of technology transfer capacity or support for product development, field trials or market assessment.

Artemisia annua
Artemisia annua grows in the highlands in Arusha, Tanzania, with 2–10 times higher yield than anywhere else in the world (transcripts from participant interviews, Tanzania). At the National Institute for Medical Research, scientists developed an innovative process to enhance the production of Artemisia, which is not being locally applied. Once grown, however, all Tanzanian Artemisia is farmed, dried and exported to Kenya, where extraction occurs, before being shipped to Switzerland where it is further processed for use in the antimalarial Coartem® produced by Novartis. Little commercial value is captured locally, and though there are efforts to commercialize Artemisia locally using innovative processes these remain uncoordinated across the private sector, government and universities.

Agricultural research
This included a fertilizer formulated at the Institute of Research into Science and Technology in Rwanda by a scientist who refused to disclose its formula. Due to lack of awareness of the innovation process and support structures to protect inventions, the potential value of this discovery was untapped. In another example, seed varieties developed at Rwanda’s Institute of Agriculture and Scientific Research are being marketed in Malawi – no royalties are flowing back to the Institute, hence no local value has been captured.

agriculture and environment – have found special attention from national governments and policy-making bodies such as the African Union and United Nations. Countries are being encouraged by pan-African and multilateral bodies to see life sciences as a route through which innovative, entrepreneurial activity can be channelled to produce local solutions to local problems, in time helping to diversify economies, capitalise on local talent and reduce dependency on outside sources for needed technologies.

Realizing this goal will require not only increased investment in R&D, but also in the tools, skills and infrastructure to commercialize R&D, turning it into products and services for local benefit and, ultimately, regional and global export. Included under this umbrella are a vibrant private sector, flexible financing mechanisms for small businesses, support structures for small business development and expertise in management, technology transfer, intellectual property and regulation. Most importantly, as we shall argue below, the disparate elements of science, business and capital need to be brought together and collectively energized.

Other developing countries, now known as “emerging economies” – with India and China as leading examples – are beginning to commercialize innovative health products. Will African countries also begin to turn their domestic health research into products and services that address their local health problems?

MRC research in Ghana, Tanzania and Rwanda
The McLaughlin-Rotman Centre for Global Health (MRC), based at the University Health Network and University of Toronto, Canada, has built expertise in the use of life sciences in the developing world, with an emphasis on health technologies. In 2002, we published our study on the Top Ten Biotechnologies for improving health in developing countries within the next 5 to 10 years conducted in partnership with scientists from around the world. In 2004, we published a series of seven case studies which explored the national health biotechnology innovation systems in the developing world, primarily in emerging economies, and set out policy recommendations. Current activities include a project on biotechnology firms in a number of emerging economies, including India, China, Brazil and South Africa, which seeks to raise the profile of indigenous innovation and understand the challenges and opportunities facing these firms.

MRC is also involved in technology-specific projects, such as the role of human genomic variation projects and regenerative medicine technologies in improving public health in developing countries.

Since early 2007, we have been working with three African governments to explore ways to strengthen their life sciences innovation, and accelerate the commercialization of science-based health products based on domestic African health research. So far more than 100 stakeholders from academia, private sector, government and civil society have been interviewed face-to-face in Ghana, Tanzania and Rwanda, with the aim of gaining understanding of the obstacles to innovation and product development and commercialization and exploring potential solutions. Several hundred stakeholders have been engaged through workshops where we reported back results and discussed health product commercialization in these countries. In each country, we have sought to identify the areas of local strength which offer the greatest promise of commercialization and ways in which this process could be catalysed through “convergence innovation”.

The first country we began working in was Ghana, where we were hosted by the Ministry of Health and Honourable...
Minister Courage Quashigah. Through our interviews, we found many of the key elements of innovation to be in place – a strong regulatory body for food and drug products; pockets of innovative research; a relatively strong pharmaceutical sector accounting for the production of 30% of Ghana’s health products (including La Gray Pharmaceuticals, a facility focusing on the production of Active Pharmaceutical Ingredients); the existence of financing mechanisms for science-based businesses (for example the Government’s Venture Capital Trust Fund); and an entrepreneurial mindset among Ghanaians, reflected in the number of business schools and the growing success of the IT industry. Particular knowledge areas that were considered to be of most promise were traditional medicine and tools for diagnosis of local diseases. Some elements of innovation policy and practice, such as technology transfer and intellectual property protection, were found to require attention, however the key limitation in the product development pathway was the lack of inter-sectoral linkages. Connections between researchers and the private sector, between government and end users, and between all other entities in the innovation system, need to be built.

In Tanzania, we conducted a case study at the invitation of the Minister of Communications, Science and Technology. Here, we found a strong research and tertiary education base both in the private and public sector, with a number of universities running biotechnology programmes. Again, the regulatory system is strong and there is government commitment to building innovative economic sectors and diversifying Tanzania’s economy. As in Ghana, traditional medicine and diagnostics were the leading contenders for commercialization, given the right support, but the...
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entrepreneurial mindset was not evident among the research community. A number of institutes for traditional medicine are producing products for local consumption; however, these could be significantly improved with the application of business rigour. There were some very interesting efforts to create clusters and SME clubs, but these were relatively small-scale in any particular focus area. Again, there was enormous scope for increasing linkages between researchers and entrepreneurs.

In Rwanda, our host was the Minister in the President’s Office in Charge of Science, Technology, Scientific Research, and Information Communication Technologies. The Rwandan case presents a different though exciting model since, compared to the other two countries, the life sciences research base is less well developed and, sadly, there is a smaller base of highly trained science professionals. The government is actively seeking to build capacity with a view to transforming its current agriculture-based economy to a knowledge-based economy by year 2020, and to use science, technology and ICT as a key enabler of this transformation. An important building block, in the shape of the Science and Technology master plan, is already in place16. As yet there is no framework to harness health and biotechnology inventions but the government is keen to develop one – for example, the Pharmacy Task Force in the Ministry of Health is working with Tanzania to establish a food and drugs regulatory agency; a patent office is being formed in the Ministry of Commerce and a recent patent law has been passed. There are no major links between scientists in Rwanda and Rwandan scientists abroad and little awareness of scientific investment opportunities by Rwandan entrepreneurs.

One phenomenon that we came across in all three countries was “stagnant technologies”: technologies at early stages of development, in need of product development support and expertise, but lacking the means (both resources and experience) to realize their true value (see Box 1).

The main finding from our research in all three countries was a need for improved linkages among different elements in the innovation system – science, business, and capital – to enhance knowledge flow and to stimulate the “innovation culture” necessary to underpin future growth of a knowledge-based economy. Currently, limited contact between sectors and a lack of awareness of the tools to stimulate innovative performance is resulting in the failure to harness the creativity of African scientists, as illustrated by stagnant technologies and an overall lack of examples of locally-driven innovative activity coming from these three countries. In short, Africa is more successful at health research than at commercializing that research into health products aimed at local and regional health problems.

Convergence innovation and convergence platforms

Having seen that little African health research is translated into health products, what can be done about this? What approach to innovation can help catalyze new approaches that are more socially and economically productive?

The traditional view of innovation has seen it as a linear process, starting with investment in fundamental science, then seeking capital to further develop applications, leading to the formation of a business or uptake of the technology by the private sector and then to distribution (see Figure 1). This is a slow process, often not directed by market and consumer need, and as such subject to increased risk and uncertainty.

“Convergence innovation” embodies a new approach to innovation, and involves the bringing together of science, business and capital – three key elements of innovation – to create a dynamic environment where scientific knowledge, the demands of the marketplace and the realities of funders exist together. This model aims to increase speed of product development and relevance of products to the population, and reduce risk to investors.

Support structures are needed to create this type of environment including both virtual and physical platforms for stimulating innovation, encouraging cross-sectoral learning and nurturing technologies. Examples of such structures include science parks, technopoles and clusters, each of which differ slightly in approach but for our purposes will be treated as variations on the theme of convergence innovation. Our model is of a “convergence platform” that offers services necessary to grow nascent scientific and entrepreneurial capacity into an organized and fully realized cluster. Acting as the focal point for science, business and capital stakeholders, the platform will provide a forum to effectively integrate diverse expertise and interests and facilitate partnerships. Additionally, a convergence platform will be involved in public advocacy, provide training and offer entrepreneurial support and awareness, providing a balanced approach to bridging business and science. We define a convergence platform as a physical or virtual place that:

- attracts a breadth of talent and resources from science, business, and capital communities across the innovation value-chain to a single point;
- offers entrepreneurial support and services to facilitate business planning, business development and partnership formation;
- provides opportunities for knowledge exchange and shared learning opportunities – entrepreneurial training, special programmes and events, mentorship and peer-to-peer learning;
- provides a focal point for the attraction of risk capital;
- is adaptable to local circumstances and markets – one size does not fit all;
- facilitates connections to related platforms and other institutions locally and internationally.

A concrete example of a convergence platform is the MaRS Centre in Toronto, created with the explicit goal of realizing benefits from the wealth of life sciences research in the Toronto region. By mingling talent across the functional innovation system – from basic scientists to venture capitalists – MaRS provides research and business incubation facilities, co-located with professional services firms and investors, technology transfer offices and venture capital groups. MaRS has connected science, technology and
entrepreneurs with business skills, networks and capital to stimulate innovation and accelerate the creation and growth of successful Canadian enterprises by building a community in which innovators, entrepreneurs, scientists, professionals and investors can meet to establish linkages and exchange knowledge.

Key elements of the proposed convergence platforms in Africa

Ghana, Tanzania and Rwanda are three African countries seeking to capture the value of local life sciences research. MRC has been working with these countries, and with SHI Consulting, a strategy consulting firm based in Canada which serves the innovative life sciences sector, to develop business plans for convergence platforms which will enable accelerated health product commercialization and improve innovation capacity. Though each platform has subtly different features, in essence they all consist of three main elements which, together, create a dynamic environment for product commercialization:

Physical centre: this is a physical building which co-locates tenant space for research, companies of all sizes, business advisors, investors, office space and professional services. The aim of the physical centre is both to provide physical infrastructure (Internet access, laboratory services, conferencing facilities, scientific equipment) and to house activities for networking, entrepreneurial services and training which would lead to increased local product development. Activities that would occur in the centre include hands-on advisory services in commercialization and business development, entrepreneurial programming and networking sessions. The location of the physical centre must be well-chosen, ideally within a major city as the "hub" of networking, entrepreneurial services and training which would lead to increased local product development. Activities that would occur in the centre include hands-on advisory services in commercialization and business development, entrepreneurial programming and training which would lead to increased local product development.

Virtual network: the virtual network links together higher education institutions, government and other stakeholders, through, for example, events, email listings and site visits. It also manages the pre-incubation and development of promising technologies to support the technology transfer process. Examples of activities include a "technology audit" to identify promising technologies in each country ripe for commercialization, and an annual Venture Forum which will draw out innovative ideas from the research community for further business support and development. The virtual network helps to ensure a national effort – and serves the crucial function of scoping promising technologies, which could later represent "deal flow", as widely as possible. The virtual network also enhances various functions of the physical centre by supporting formation of linkages, deal flow between partners, inter-sector and cross-institutional communication and collaboration, and entrepreneurship/commercialization training.

Product development programme: the product development programme (PDP) acts as a specialized "technology development accelerator programme" to develop pre-commercial technologies identified locally to the point of market readiness. Technologies or ideas selected for the PDP are co-developed with the platform’s expert team and given initial seed funding to take them past the proof-of-concept stage and make them attractive to risk capital investors – thus taking technologies across the so-called "valley of death". The PDP will therefore play a key role in facilitating partnerships with local and global risk capital investors and receptors capable of taking the technology to a viable commercial stage. Initially, the PDP will develop pilot projects, focused on areas with potential to realize short-term gains to generate revenue. Anchored by rigorous scientific and business criteria that select only the most promising pre-commercial technologies for further development, the PDP will build a reputation as a consolidator of investor-grade life sciences assets.

Over time, each convergence platform will be networked into its counterparts in other countries, leveraging experience, skills and lessons learned across the continent. Some of these platforms are in the same African region (e.g. Tanzania and Rwanda), in which case the platforms could work together to become hubs for regional innovative activity and attract promising projects from the entire region. Other regional and international incubators and science park networks and associations such as the Africa Incubator Network (AIN), as well as convergence platforms outside Africa, will also be potential partners for collaboration.

Financing convergence platforms and resulting companies

The convergence platforms (consisting of physical, virtual and product development elements) are structured as not-for-profit entities with an independent board of directors. The platforms have the opportunity to become sustainable in the mid-term through fees for services or rent. Reaching sustainability, however, requires an infusion of start-up capital in the millions of dollars, for which several potential funding sources exist. General to all financial models, the platforms should break even within five years, although they will continue to pay off debt resulting from the initial capital investment for a longer period of time.

Initial funding for the platforms could come from a range of public sources, structured as loans or grants. African governments themselves could be direct funders of convergence platforms, seeing them as promising mechanisms to address a number of economic, health and wider societal goals and to leverage the benefit of R&D investments already being made.

The public sector window of the African Development Bank (AfDB), with its mandate to promote economic and social development through loans, equity investments and technical assistance, is another potential sponsor. Indeed, a recent ADB High Level Panel Report, Investing in Africa’s Future – the AfDB in the 21st century outlines a new role and strategic plan for the AfDB. It highlights the need to foster innovation in Africa and recommends that “the Bank support the development of national and regional centres of excellence in the health sciences and in energy and
environmental technologies. There are significant potential benefits from linkages between life science and the private sector. Like the traditional infrastructure investment of a bridge joining two sides of a river, a convergence platform is an infrastructure investment for joining science and capital for social and economic benefits to the host country and its people.

The World Bank, with its interest in capacity-building in the crucial areas of science, technology and innovation, is another potential sponsor for the virtual component of these platforms, as are a wide variety of donor agencies for whom science, technology and innovation play a central role in future economic development.

By contrast to the platforms themselves, financing for the technologies which have reached the point of proof of principle or market readiness should come from private investments in the form of equity or debt. In terms of private capital providers for technologies and spin-out companies, there are a number of entities with potential interest in making investments in Africa, including the private sector window of the ADB and the International Finance Corporation (IFC), the private sector arm of the World Bank. In December 2007, the IFC, with support from the Bill & Melinda Gates Foundation, released a report entitled The Business of Health in Africa, on opportunities for private-sector approaches to health in sub-Saharan Africa. The report covers health services provision, medical and nursing education, risk pooling arrangements, distribution and retail of health products, and also life sciences manufacturing and innovation. In a promising development, the accompanying announcement states that there are plans to mobilize up to US$1 billion in investment and advisory services support over the 2008–2012 time frame, including an equity investment vehicle starting with US$100 million (growing to up to US$300–350 million over this time frame).

Venture capital firms both within and outside Africa are another potential source of risk funding. Two examples are South-African Bioventures, the only wholly life sciences-focused VC firm in sub-Saharan Africa, which has made a number of successful investments in that country, particularly in the medical device area, and Bridgeworks, a Kenya-based VC, which also has a special focus on health technologies and over the last few years has gained extensive experience in the requisite measures to identify, develop, support and finance small science-based ventures in Africa. These investments would also be appealing for social investors, who will tolerate lower returns in exchange for social benefits.

Lessons learned and next steps

Having begun to operationalize convergence innovation on the ground through working with local governments and other stakeholders, including writing business plans and sourcing potential funders, a number of lessons have been learned which will improve the likelihood of success.

First, flexibility is key. One size does not fit all across Africa and each platform is being developed with sensitivity to local circumstances, goals and capacities. In Ghana, for example, emphasis is being placed on a virtual model that links together stakeholders through events, activities and other virtual means; a central secretariat will coordinate this approach but, at this stage, no physical centre is being proposed. In contrast, the Tanzanian stakeholders are pursuing an integrated physical and virtual model to better leverage local capacities and existing institutions. In Rwanda, again there is likely to be a physical and virtual component, with emphasis on both scientific and entrepreneurial capacity building, and a focus on both health and agriculture.

Second, local champions to spearhead these platforms are vital. Throughout our work in Africa, we have encountered a good deal of local enthusiasm for the convergence innovation concept from those eager to capitalize on the opportunity and catalyze a different approach to health and economic development. Involvement of local partners is the only way to ensure that these platforms are realistic in scope, responsive to local needs and financially sustainable. This is occurring in Ghana, where a Task Force on Life Science Commercialization and Convergence was established by the Honourable Minister of Health and mandated to advise him on next steps. Led by an eminent academic Professor Francis Nkumah, the task force meets on a monthly basis and is in the process of further developing a business plan for the platform, appointing a secretariat and sourcing funding for the first one or two years of operations. In Tanzania the business plan for its convergence platform has been presented to the Minister and the next step is to appoint a local steering committee to develop and deliver the plan. In Rwanda, the business plan has been presented to the Minister and local champions are being identified.

Third, the role of the local private sector is critical. Ultimately, it is the private sector which has the skills and expertise to commercialize technologies. Prominently included in the local champions mentioned above must be leading entrepreneurs.

The potential benefits, and metrics of success, of a convergence platform include: increased product commercialization in Africa; increased formation of life science enterprises and growth of support industries and therefore increased high value employment; enhanced life science-based entrepreneurial culture; increased formation of sustainable public-private partnerships, linkages and knowledge flow among science, business and capital stakeholders in Africa; increased inward investment and risk capital; increased exports, initially regionally but ultimately globally, of health products; and, lastly, and most importantly, improved health, social and economic outcomes for Africa.

Of course, there are also risks. Convergence platforms are complex endeavours highly dependent on the mobilization of sufficient critical mass. Commercialization of innovation is a high-stakes game that fails much of the time. Innovation requires a long-term commitment. To be successful, governments must also simultaneously address gaps across the functional innovation system.

How can this model of convergence innovation, facilitated through convergence platforms, be extended to other countries in Africa and suitably networked so as to gain maximum leverage within and across regions? The first step...
is to engage the wider audience of African Health Ministers, both to raise the profile of what has been done so far and to consider how this model of innovation might help them to achieve their public health goals by enabling the growth of indigenous health innovation. Ministers of Science and Technology and of Finance should be interested in these initiatives for what convergence innovation can mean for their countries’ social and economic development. A few examples of successfully commercialized products based on African health research will go a long way to building the confidence of African and international investors. If one were a private investor, one would have no idea how to scope promising technologies against health, agricultural, environmental or energy problems in Africa. The convergence platform provides one-stop shopping for investors, greatly decreasing the complexity and cost of identifying promising technologies.

Given the ingenuity, creativity and entrepreneurialism in Africa, it is inevitable that the continent will move towards a more diversified economy through increased knowledge-based activities. What is not at all inevitable is that this process will be as quick and efficient as possible. Failures of both individual technologies and models will pave the path to ultimate success, and mechanisms to leverage learning will be highly desirable. By focusing explicitly on commercialization of domestic African health research, and learning how best to translate this research into commercial products and services, convergence platforms pave a path for African countries towards accelerating social and economic development. As noted by President Kagame, the alternative paths are much less desirable.

Acknowledgments

Helpful comments and suggestions were received from Hassan Masum. This study was funded by Genome Canada through the Ontario Genomics Institute and the Canadian Institutes of Health Research through a Michael Smith award to Dr. Singer. The McLaughlin-Rotman Centre for Global Health, Program on Life Sciences, Ethics and Policy is also supported by the Bill & Melinda Gates Foundation and other partners listed at www.mrglobal.org. ASD and PAS are supported by the McLaughlin Centre for Molecular Medicine.

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