



## **Boosting the Immunization Workforce: Lessons from the Merck Vaccine Network — Africa**

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## Executive Summary

The prevention of disease through immunization is one of the most successful and cost-effective public health interventions in history. However, despite significant progress made over the last decade, global immunization rates remain low in many parts of the world. Almost one-quarter of children worldwide lack access to life-saving vaccines, and every year 2.4 million children die from vaccine-preventable diseases (VPDs).<sup>1</sup> The problem is particularly severe in sub-Saharan Africa, where each year 8.3 million children do not receive the most basic vaccines.<sup>2</sup> This region suffers one of the highest per capita burdens of VPDs in the world, with only 70 percent of children under age one receiving the diphtheria-tetanus-pertussis (DTP3) vaccine, the global standard used to measure immunization coverage.<sup>3</sup>

Critical deficiencies in the health workforce in many African countries underpin and exacerbate the challenges to vaccine delivery.<sup>4</sup> In particular, limited immunization management capacity presents an acute barrier to expanding vaccine coverage.<sup>5</sup> In many African countries, formal training for immunization managers is low quality, sporadic, or non-existent.<sup>6</sup> Tackling issues of health worker capacity and improving access to vaccination are critical if global efforts to achieve the United Nations (UN) Millennium Development Goal 4—a two-thirds reduction of mortality in children under five—are to be successful.

In response to chronic under-capacity in the immunization workforce in Africa, Merck launched the Merck Vaccine Network-Africa (MVN-A).<sup>7</sup> Funded by The Merck Company Foundation and endorsed by the GAVI Alliance (GAVI), MVN-A was a ten-year, \$4.8 million philanthropic initiative that provided customized, hands-on training to immunization managers in Kenya, Mali, Uganda, and Zambia. With the aim of enabling capacity building and two-way learning, each MVN-A program was managed and administered by two primary institutions, one in the African country and one in the United States or Europe. In turn, these institutions developed broader collaborative partnerships with other national stakeholders including ministries of health and education, non-governmental organizations (NGOs), medical and nursing schools, and multilateral organizations such as the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). Employing a train-the-trainer approach, the program focused on improving the knowledge, skills, and confidence of immunization managers, who in turn provided training and support to more junior health workers.

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<sup>1</sup> "Vaccine-Preventable Diseases Overview," Bill & Melinda Gates Foundation, <http://www.gatesfoundation.org/vaccines/pages/overview.aspx>.

<sup>2</sup> IFPMA, "Merck Vaccine Network - Africa (MVN-A)," <http://partnerships.ifpma.org/partnership/merck-vaccine-network-africa-mvn-a>.

<sup>3</sup> UNICEF and WHO, "Immunization Summary: A statistical reference containing data through 2009," (2011).

<sup>4</sup> Bernhard Liese and Gilles Dussault, "The State of the Health Workforce in Sub-Saharan Africa: Evidence of Crisis and Analysis of Contributing Factors," in *Africa Region Human Development Working Paper Series*, ed. The World Bank Africa Region (2004).

<sup>5</sup> UNICEF et al., "Mid-Level Management Training in Immunization in the African Region 2000-2004: Summative Evaluation," (2005).

<sup>6</sup> Ibid.

<sup>7</sup> Merck is known as MSD outside of the United States and Canada.

Between 2003 and 2012, MVN-A facilitators trained more than 1,600 vaccine delivery workers, including close to 150 trainer-of-trainers, nearly 1,000 immunization managers, and over 400 additional health workers. Studies of pre- and post-training test scores indicate that all four national programs were successful in improving the knowledge and skills of trainees. Furthermore, overall immunization coverage improved in areas where the MVN-A trainings were conducted. While more difficult to quantify, evidence also exists that the program improved health worker morale, a particularly valuable outcome in resource-constrained health systems suffering from low motivation and high turnover.

**Figure 1: MVN-A At a Glance**



<p><b>MALI</b></p> <p>YEARS FUNDED: <b>2003-2011</b></p> <p>TOTAL FUNDING: <b>\$1.4M</b></p> <p>TOTAL HEALTHCARE WORKERS TRAINED: <b>395</b></p>	<p><b>MVN-Mali</b></p> <p>PRIMARY PARTNERS: Centre pour le Developpement des Vaccines, Mali (Bamako, Mali) Center for Vaccine Development at the University of Maryland School of Medicine (Baltimore, Maryland, USA)</p>
<p><b>UGANDA</b></p> <p><b>2007-2012</b></p> <p><b>\$1.0M</b></p> <p><b>618</b></p>	<p><b>UITP</b></p> <p>Makerere University School of Public Health (Kampala, Uganda) Task Force for Global Health (Decatur, Georgia, USA)</p>
<p><b>KENYA</b></p> <p><b>2003-2011</b></p> <p><b>\$1.4M</b></p> <p><b>441</b></p>	<p><b>MVN-K</b></p> <p>Moi University School of Medicine (Eldoret, Kenya) University of Indiana School of Medicine (Indianapolis, Indiana, USA)</p>
<p><b>ZAMBIA</b></p> <p><b>2007-2012</b></p> <p><b>\$1.0M</b></p> <p><b>157</b></p>	<p><b>MVN-Z</b></p> <p>University Teaching Hospital of the University of Zambia School of Medicine (Lusaka, Zambia) Brighton and Sussex University Hospitals NHS Trust (Brighton, UK)</p>

As the MVN-A program comes to an end, Merck's experience designing and supporting the initiative can offer valuable lessons for other actors in the immunization and broader global health fields who are engaged in or planning similar work. Specifically, we identify seven forward-looking lessons that can increase the effectiveness and sustainability of programs to build the capacity of the vaccine workforce in developing countries:

- 1. Conduct a rigorous needs assessment** to anchor efforts in local needs and priorities;
- 2. Perform ongoing monitoring and evaluation (M&E)** to enable programs to adapt, improve, and generate evidence of impact to attract new partners and funding;
- 3. Create a sustainability plan at the outset** to ensure that program impact is maintained beyond the conclusion of initial funding;

4. **Embed programs into local health systems** to ensure that investments leverage existing infrastructure, relationships, and resources, and that impact can be sustained beyond the life of the program;
5. **Employ locally-adapted curricula and appropriate teaching techniques** to maximize transfer and retention of relevant knowledge;
6. **Incorporate supportive supervision** into programs to ensure that transferred knowledge is maintained and acted upon;
7. **Facilitate and support regular convening and communication**, enabling continuous learning for improvement.

In addition to describing the approach taken by MVN-A and the results achieved in the four focus countries, this paper provides additional detail on each lesson, supported by case studies from the MVN-A experience.

## Introduction

In 2003, Merck launched the Merck Vaccine Network – Africa (MVN-A), a multi-year, multi-country initiative designed to contribute to improving the immunization workforce in four African countries: Kenya, Mali, Uganda, and Zambia. The MVN-A program complements a number of other significant investments by The Merck Company Foundation to improve access to health in Africa and around the world, including:

- **The Merck Mectizan Donation Program:** Merck has committed to provide medicine for the treatment of onchocerciasis (or river blindness) to all who need it, for as long as needed. Established in 1987, this is the longest-running, disease-specific drug donation program and public/private partnership of its kind.
- **The African Comprehensive HIV/AIDS Partnership (ACHAP):** Since 2000, ACHAP has supported Botswana's national HIV/AIDS strategy to prevent new HIV infections and reduce morbidity and mortality associated with the disease.
- **The BroadReach Institute for Training and Education (BRITE):** Merck is supporting implementation and management of BRITE's Management and Leadership Academy (MLA) program in Zambia, which teaches critical management and leadership skills for health care professionals in order to strengthen the capacity of local health systems.
- **The Earth Institute's Millennium Villages Community Health Worker Training Program:** Merck provides support for this program, strengthening community health services for more than 400,000 people in 10 African countries.

The MVN-A program received \$4.8 million in philanthropic support from Merck over a 10-year period from 2003 to 2012.<sup>8</sup> This decade of experience provides useful insights for other organizations that are planning or implementing similar programs elsewhere.

The objective of this paper is to document the impact and share the lessons learned from MVN-A with the broader global health field. In addition to describing the approach taken by MVN-A and the results achieved in the focus countries, we identify seven key lessons for designing and implementing immunization workforce strengthening programs. Each of these lessons is grounded in Merck's experience with MVN-A, drawing from both its successes and its challenges. Together, these lessons offer a blueprint for increasing the effectiveness and sustainability of similar initiatives to build the capacity of the health workforce in developing countries.

The report draws on data and insights gathered from interviews with nearly 40 program leaders and stakeholders from across the four focus countries in Africa, the U.S., and the EU. These individuals include program directors, training officers, trainees, ministry of health (MOH) officials, multilateral partners, and members of the core Merck team who were involved in the design and administration of the

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<sup>8</sup> MVN-A was a philanthropic effort supported by The Merck Company Foundation; Merck generated no commercial benefit from the program.



program. In addition, we synthesized data from more than 50 documents provided by in-country program leadership, including grant applications, unpublished grantee progress reports and final evaluations, and published journal articles.

As Merck sunsets its decade-long investment in MVN-A, The Merck Company Foundation commissioned this paper in order to identify, document, and share the results of the MVN-A program and relevant lessons for the field.

## The Vaccine Workforce Challenge

### Vaccination Is a Highly (Cost-) Effective Public Health Intervention

The prevention of disease through immunization is one of the most successful public health interventions in history, saving three million lives annually—second in its reach only to the provision of clean drinking water.<sup>9</sup> Margaret Chan, Director General of WHO, describes vaccines as “one of the greatest success stories in global public health.”<sup>10</sup> Increases in immunization coverage can extend life expectancy, decrease health care costs, and increase productivity for both vaccinated individuals and whole communities.<sup>11</sup> Immunization also is one of the most cost-effective health interventions available today; every dollar spent on vaccines results in up to thirty dollars saved on later treatment.<sup>12</sup> New vaccines—including for rotavirus diarrhea, human papillomavirus, and pneumococcal disease—promise to extend this powerful effect to other disease burdens.

### Sub-Saharan Africa Bears a Disproportionate Burden of Vaccine-Preventable Disease

Despite ample evidence of the efficacy of vaccines, global immunization rates remain low. Almost one-quarter of children worldwide lack access to life-saving vaccines; as a result, every year, 2.4 million children die from vaccine-preventable diseases.<sup>13</sup> Sub-Saharan Africa has one of the highest per capita burdens of VPDs in the world, with only 70 percent of children under age one receiving the DTP3 vaccine, the global standard for immunization coverage.<sup>14</sup> Further improving access to immunization is critical if global efforts to achieve a two-thirds reduction of mortality in children under five by 2015 (Millennium Development Goal 4) are to be successful.<sup>15</sup>

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<sup>9</sup> “Q-Series: Global Pharmaceuticals,” in *UBS Investment Research* (UBS, 2012).

<sup>10</sup> Margaret Chan, “Saving Lives with Immunization,” (Bill & Melinda Gates Foundation, 2011).

<sup>11</sup> UNICEF, WHO, and World Bank, “State of the world's vaccines and immunization,” (Geneva: The World Bank, 2009).

<sup>12</sup> “Q-Series: Global Pharmaceuticals.”

<sup>13</sup> “Vaccine-Preventable Diseases Overview.”

<sup>14</sup> UNICEF and WHO, “Immunization Summary: A statistical reference containing data through 2009.”

<sup>15</sup> WHO, “Immunization, Vaccines and Biologicals: Millennium Development Goals,” <http://www.who.int/immunization/newsroom/mdg/en/index.html>.

In the last decade, the world has made substantial progress in tackling low immunization coverage rates. Thanks to large, sustained investment by agencies and partnerships such as the GAVI Alliance, coverage of DTP3 in low-income countries rose from 66 percent in 2000 to an all-time high of 79 percent in 2010.<sup>16</sup> Nevertheless, a significant coverage gap remains in sub-Saharan Africa and the challenges to progress are numerous. Poor distribution and delivery structures, including disruptions to the cold chain that is essential to transporting vaccines in a temperature controlled environment, have contributed to reduced vaccine potency and access. Poor surveillance and monitoring also have made it difficult to forecast demand, set priorities, and identify disease outbreaks.<sup>17</sup>

### Limited Workforce and Management Capacity in Many African Countries Hinders Progress

Critical deficiencies in the health workforce in many African countries underpin and exacerbate these challenges.<sup>18</sup> Africa has only 3 percent of the world's health workers to address 24 percent of the global disease burden; this disparity is troubling as evidence exists that the number and quality of health care workers is positively associated with vaccine coverage.<sup>19,20</sup> Too often, training for under-resourced and over-stretched health workers is low quality, sporadic, or non-existent.<sup>21,22</sup> Furthermore, health systems often suffer from high staff turnover, urban-rural imbalances, and demotivating working conditions.<sup>23</sup>

Limited immunization management capacity within health systems presents a particularly acute barrier to expanding vaccine coverage.<sup>24</sup> Moreover, efforts to address this need through training are hampered by inadequate and inconsistent financing.<sup>25</sup> In many African countries, formal training for immunization managers has not been conducted since the mid-1990s.<sup>26</sup> In 2004, WHO identified capacity building to improve managers' planning, management, monitoring, and evaluation skills as a critical strategy for improving immunization services, particularly in decentralized systems where resource allocation decisions are made at a local level.<sup>27</sup>

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<sup>16</sup> GAVI Alliance, "GAVI Helps DTP3 Coverage Rise After Stagnation,"

<http://www.gavialliance.org/library/news/roi/2010/gavi-helps-dtp3-coverage-rise-after-stagnation/>.

<sup>17</sup> UNICEF, WHO, and World Bank, "State of the world's vaccines and immunization."

<sup>18</sup> Liese and Dussault, "The State of the Health Workforce in Sub-Saharan Africa: Evidence of Crisis and Analysis of Contributing Factors."

<sup>19</sup> GAVI Alliance, "Health System Strengthening Support," <http://www.gavialliance.org/support/hss/>.

<sup>20</sup> WHO, "The World Health Report 2006: Working Together for Health," (Geneva, 2006).

<sup>21</sup> UNICEF, "Mid-Level Management Training in Immunization in the African Region 2000-2004: Summative Evaluation."

<sup>22</sup> Norad and GAVI, "Alleviating System Wide Barriers to Immunization: Issues and Conclusions from the Second GAVI Consultation with Country Representatives and Global Partners," (Oslo, Norway, 2004).

<sup>23</sup> Liese and Dussault, "The State of the Health Workforce in Sub-Saharan Africa: Evidence of Crisis and Analysis of Contributing Factors."

<sup>24</sup> UNICEF, "Mid-Level Management Training in Immunization in the African Region 2000-2004: Summative Evaluation."

<sup>25</sup> Ibid.

<sup>26</sup> Ibid.

<sup>27</sup> Ibid.

## The Merck Vaccine Network – Africa Was Developed to Address the Workforce Challenge

In response to chronic under-capacity in the immunization workforce in Africa, Merck launched the Merck Vaccine Network – Africa. Funded by The Merck Company Foundation and endorsed by GAVI Alliance, the program supported collaborative partnerships in the development and implementation of Expanded Program on Immunization (EPI) management training programs in Kenya, Mali, Uganda, and Zambia.

This philanthropic commitment reflects Merck's dedication to improving access to medicines, vaccines, and health care in the developing world. It built on the company's longstanding dedication to reducing the morbidity and mortality of children in low-income countries, and was specifically designed to help achieve the UN Millennium Development Goals, including reducing by two-thirds the mortality rate among children under five by 2015.

## MVN-A Program Design and Implementation

### MVN-A Sought to Build Management Capacity in Four African Immunization Programs

The approach of the MVN-A program was to provide customized training for mid- to high-level immunization managers working in sub-Saharan Africa in order to increase health worker capacity and improve vaccine delivery. The program was designed to support and build capacity for EPI, a global effort initiated by WHO in 1974 with the aim of ensuring that all children in all countries benefit from life-saving vaccines.

Merck initiated a competitive grant application process, which emphasized strength of partnerships, to select countries for program implementation. In 2003, Merck

established MVN-A training programs in Kenya and Mali. Following a second competitive grant application process in 2007, two additional programs were established in Uganda and Zambia. The Merck Company Foundation provided funding of \$200,000 annually to each program, for a total of \$4.8 million over ten years.



Each MVN-A program adapted the existing mid-level manager EPI training modules published by the WHO Regional Office for Africa. The training courses covered a wide range of topics, including storing and handling vaccines safely, forecasting community needs to ensure an adequate vaccine supply, planning and conducting disease surveillance activities, and providing on-site supportive supervision to health workers. Some programs also created new modules based on feedback gathered during a local needs assessment, which each program completed.

After conducting a series of customized training of trainers sessions, each program identified a pool of highly effective facilitators to administer training at the national, provincial, and district levels across each focus country. MVN-A training facilitators included senior Ministry of Health EPI program administrators, medical and nursing school professors, medical training college instructors, WHO EPI personnel, cold chain equipment technicians, and former MVN-A graduates with experience training health workers at the operational level.

Each MVN-A program was managed and administered by two primary institutions, one in the African country and one in the United States or Europe. The primary partnerships were as follows:

- Kenya, a collaboration between Indiana University School of Medicine (Indianapolis, Indiana, U.S.) and Moi University School of Medicine (Eldoret, Kenya);
- Mali, a collaboration between the University of Maryland School of Medicine Center for Vaccine Development (Baltimore, Maryland, U.S.) and Centre pour le Développement des Vaccins-Mali (Bamako, Mali);
- Uganda, a collaboration between The Task Force for Child Survival and Development, Emory University (Decatur, Georgia, U.S.) and Makerere University School of Public Health (Kampala, Uganda); and
- Zambia, a collaboration between Brighton and Sussex University Hospitals NHS Trust (Brighton, U.K.) and the University of Zambia School of Medicine (Lusaka, Zambia).

## The Partnership Structure Was Integral to the Program's Design

The four MVN-A programs were designed as partnerships between local African institutions and centers of expertise in the United States and Europe. This unique structure leveraged the strengths of each partner. Anchoring efforts in local institutions enabled the programs to benefit from deep in-country knowledge and existing networks. Involving global centers of excellence provided technical assistance and expertise from leading academics, building the capacity of African organizations.

The two-way learning that this model enabled was hailed by many stakeholders as a valuable aspect of the program. Professor Samba O. Sow, Program Principal Investigator for the Mali program (MVN-Mali) credits his U.S. collaborators with “strengthening our program administration, helping us write grants, and advising us on our finance and accounting systems.” Meanwhile, U.S.-based colleagues cite the knowledge and experience of their African counterparts as vital to building local relationships, informing needs assessment, and setting program priorities. Dr. Fred Wabwire-Mangen, Co-Director of the Uganda

program—known as the Uganda Immunization Training Program, or UITP in-country—reflected, “The partnership was a central piece of the program. The quality of collaboration was excellent.”

## The Primary Partnerships Were Supplemented by Robust Networks of In-Country Partners

The primary partners in each MVN-A program established a broad network of local stakeholders, including ministries of health and education, NGOs, medical and nursing schools, and multilateral organizations such as WHO and UNICEF. These important connections helped the programs establish credibility, leverage local knowledge, and ensure alignment with existing priorities for immunization delivery.

Each MVN-A program formed a Technical Advisory Group (TAG), bringing together key stakeholders to inform program strategy, provide guidance on curriculum content, and identify promising trainers and trainees. The TAG for the Zambia program (MVN-Z), for instance, included representatives from the Ministry of Health, WHO, UNICEF, The United States Agency for International Development (USAID), local nursing schools, local NGOs, and leading pediatricians. Professor Mary Shilalukey Ngoma, Co-Director for MVN-Z, describes the essential functions filled by the TAG:

It played an invaluable role in guiding the program – both in determining our overall strategy, and with the day-to-day work. We met at the beginning of each year and at regular intervals throughout, planned together and received input on what issues and activities were critical, what could wait, and what was not relevant to Zambia's EPI program.

Trainings were regularly attended or co-taught by local representatives from WHO and EPI, providing an important stamp of credibility for the program, and helping to elevate the issue of childhood immunization within the local public health agenda.

## A Train-the-Trainer Model Was Employed to Leverage Limited Resources

The MVN-A program implemented a train-the-trainer approach, focused on improving the knowledge, skills, and confidence of immunization managers, who in turn provided training and support for more junior health workers. The primary partner institutions in each country, informed by additional local stakeholders, identified a cadre of facilitators to deliver national-, provincial-, and district-level training to managers nationwide.

Dr. Fred Wabwire-Mangen, Co-Director of the Uganda program, cites the benefits of this approach:

Training of trainers was highly effective because it allowed us to implement cascade training throughout all levels of the health care system. At the national level, we worked with WHO to create a small team that facilitated the training of our larger national team of trainers. This team, in turn, trained managers throughout the country. Those district

managers then returned to their districts and trained the workers below them, both formally and in a hands-on fashion. In this way, we generated a spill-over effect.

Given finite funding, this cascade approach to training allowed the program to maximize the number of health workers reached through this investment, and allowed the facilitators to provide much-needed ongoing training in response to high turnover in the field.

## Results and Impact

### At MVN-A's Launch, National Immunization Programs Suffered from Major Deficiencies

At the outset of the MVN-A program, the need for comprehensive immunization delivery training in sub-Saharan Africa was substantial. Studies showed that past EPI training activities were infrequent, underfunded, and provided only on an ad-hoc basis, using curricula and reference materials that were incomplete or outdated.<sup>28</sup> For example, in Kenya, there had been no comprehensive training for immunization managers in over 15 years.<sup>29</sup> Given high turnover rates in the sector, most current health workers had never received immunization training at all. Partly as a result of this dearth of training, vaccination rates remained low and quality of immunization delivery was poor.

Professor Samba O. Sow of MVN-Mali describes the situation in that country before the training:

When MVN-A began, the vaccine coverage level in some of the places we worked was below 50 percent. Half of the kids who did not receive full coverage had never had a single immunization. That is a disaster. Routine EPI was supposed to have been running in Mali since 1986, but in 2003, even in Bamako, we found babies that had never been vaccinated. We also found health workers leaving vaccines on their desk all day long when it was 110 degrees outside. Even though there are monitor strips on the vaccine that show if it has been compromised by exposure to inappropriate temperatures, health workers didn't know how to read them. We would ask the EPI supervisors if they would give a baby that vaccine, and they would say, "Oh, yes, we would."

### MVN-A Contributed to Significant Improvements in Quality and Reach of Vaccination Programs

Although the use of different monitoring and evaluation approaches in each MVN-A focus country makes it impossible to draw direct comparisons across programs, there is evidence that MVN-A effectively

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<sup>28</sup> D. Nshimirimana et al., "EPI Training Needs Assessment in 12 African Countries (2002-2004)," *Communicable Diseases Bulletin* 3 (2005).

<sup>29</sup> S.O. Ayaya et al., "Training Needs for Mid-Level Managers and Immunisation Coverage in Western Kenya," *East African Medical Journal* 84, no. 7 (July 2007).

increased the skills and knowledge of EPI workers and contributed to improved immunization rates in the geographies where it was implemented (see Figure 2). Over the course of the program, MVN-A facilitators trained more than 1,600 EPI workers, including over 150 trainer-of-trainers, over 1,000 immunization managers, and over 200 additional health workers.

All four national programs demonstrated success in improving the knowledge and skills of trainees. The Zambia program demonstrated statistically significant increases (P-value of less than .001) in pre- and post-training test scores in almost every area tested.<sup>30</sup> The Kenya (MVN-K), Mali, and Uganda programs also reported substantial improvements in test scores, of between 5 and 15 percentage points, following training.<sup>31,32,33</sup> These improvements were seen over a wide range of different subject modules, ranging from immunization safety to planning and budgeting. Moreover, the participants themselves saw the training as valuable and effective. For example, in Uganda, some 99 percent of program graduates indicated that they had a better understanding of how to deliver immunization services, while 96 percent felt better equipped to provide high-quality programs.<sup>34</sup>

Although likely attributable to a number of factors, overall immunization coverage improved in areas where the MVN-A trainings were conducted. In Uganda and Kenya, national coverage improved by 7 and 17 percentage points, respectively.<sup>35,36</sup> Likewise, a study of a village in Mali where the program was implemented revealed a 13 percentage point increase in DTP3 and an 18 percentage point increase in measles vaccine coverage.<sup>37</sup> In Zambia, among previously poor-performing districts (defined as having coverage of less than 60 percent), 83 percent improved coverage to above 70 percent, and an additional 13 percent improved coverage to between 60 and 70 percent.<sup>38</sup> Kenya and Mali also saw a reduction in the dropout rate from a regularly administered course of pentavalent-1 and measles vaccination; the dropout rate declined by 6 percentage points in Kenya and fell to 5 percent or less in all centers receiving supportive supervision in Mali.<sup>39,40</sup>

Although more difficult to measure, there is also evidence that the MVN-A Program improved health worker morale, a particularly valuable outcome in resource-constrained health systems suffering from low motivation and high turnover. Dr. James Conway, Co-Director of MVN-K, explains:

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<sup>30</sup> G. Phiri et al., "Merck Vaccine Network Zambia 2011 Annual Progress Report," Unpublished MVN-A Document (2012).

<sup>31</sup> The Uganda Immunization Training Program, "Uganda Immunization Training Program Annual Progress Report Year 4, November 2010-October 2011," Unpublished MVN-A Document (2011).

<sup>32</sup> J.B. Milstien et al., "Strengthening Immunization in a West African Country: Mali," *Education for Health* 20, no. 3 (November 2007).

<sup>33</sup> MVN-K, "Merck Vaccine Network-Africa Additional Information," Unpublished MVN-A Document (2007).

<sup>34</sup> Margaret Kemigisa, "The Uganda Immunization Training Program Final Evaluation Report," Unpublished MVN-A Document (February 2012).

<sup>35</sup> Ibid.

<sup>36</sup> E.A. Liechty et al., "Final Report-Merck Vaccine Network-Africa: Kenya Collaboration," Unpublished MVN-A Document (2012).

<sup>37</sup> Milstien, "Strengthening Immunization in a West African Country: Mali."





<sup>38</sup> Merck Vaccine Network-Zambia, "Merck Vaccine Network Zambia: A Summary Report of Achievements (2007-2012)," Unpublished MVN-A Document (2012).

<sup>39</sup> MVN-K, "Merck Vaccine Network-Africa Additional Information."

<sup>40</sup> Julie Milstien et al., "Supportive Supervision Activities in Mali Improve the Quality of Immunization Services," Unpublished MVN-A Document (2011-2012).



**Figure 2: Evidence of MVN-A Program Impact<sup>41</sup>**

	HEALTH WORKFORCE REACHED	INCREASE IN KNOWLEDGE	EFFECT ON VACCINE COVERAGE
<b>MALI</b> (MVN-Mali) 	<b>395 people trained</b> <ul style="list-style-type: none"> <li>• 69 Trainers-of-trainers (TOTs)</li> <li>• 194 managers</li> <li>• 132 health center staff</li> </ul>	<b>7.5-14 percentage point increase</b> in test scores Most marked improvements in competencies tested were vaccine safety, community participation, and vaccine management <sup>42</sup>	In one village, DTP3 coverage <b>increased by 13 percentage points</b> and measles vaccine coverage <b>increased by 18 percentage points</b> In a second village, high DTP3 coverage was sustained ( <b>90%</b> ) and measles vaccine coverage <b>increased by 10 percentage points</b>
<b>UGANDA</b> (UITP) 	<b>618 people trained</b> <ul style="list-style-type: none"> <li>• 30 TOTs</li> <li>• 331 managers</li> <li>• 177 operations staff</li> <li>• 80 cold chain staff</li> </ul>	<b>9.5 percentage point increase</b> in test scores <sup>43</sup> <b>99%</b> of graduates reported better understanding of immunization service delivery <b>96%</b> of graduates reported being able to provide higher-quality immunization services	National immunization coverage <b>increased to 44%</b> from 37% <sup>44</sup> 70% of graduates associated the increases in coverage with the training
<b>KENYA</b> (MVN-K) 	<b>441 people trained</b> <ul style="list-style-type: none"> <li>• 32 TOTs</li> <li>• 409 managers (at least 3 from each district)</li> </ul>	<b>5 percentage point increase</b> in test scores <sup>45</sup>	National immunization coverage <b>increased to 77%</b> from 60% <sup>46</sup> Dropout rate <b>decreased to 15.5%</b> from 21.5% <sup>47</sup> Overall pentavalent-1 coverage <b>increased to 85%</b> from ~82%
<b>ZAMBIA</b> (MVN-Z) 	<b>157 people trained</b> <ul style="list-style-type: none"> <li>• 20 TOTs</li> <li>• 108 managers</li> <li>• 29 nursing school tutors</li> </ul>	<b>Statistically significant increase</b> ( $p < .001$ ) in test scores for modules on: <ul style="list-style-type: none"> <li>• cold chain</li> <li>• partnering with communities</li> <li>• immunization safety</li> <li>• supportive supervision</li> <li>• monitoring, annual planning/budgeting</li> <li>• EPI survey</li> </ul>	Of previously poor-performing districts (defined as having coverage rates below 60%): <ul style="list-style-type: none"> <li>• 19 of 23 <b>increased coverage to &gt;70%</b></li> <li>• 3 of 23 <b>increased coverage to 60-70%</b><sup>48</sup></li> </ul>

41. Sources: Documents provided by The Merck Company Foundation, including unpublished grant applications and grantee reports.

42. Evaluation based on two trainings. Actual increases in test scores were: 82 to 94% and 19 to 43% in vaccine safety, 62 to 97% and 7 to 18% in community participation, and 71 to 90% and 30 to 58% in vaccine management.

43. Average test scores improved from 62 to 71.5%.

44. Increase measured as fully immunized children during the training period from 2001 to 2006.

45. Actual increases in test scores across the four trainings were: 70 to 75%, 69 to 72%, 69 to 73%, and 66 to 75%.

46. Increase measured as fully immunized children during the training period from 2003 to 2009.

47. Dropout rate is defined as those receiving pentavalent-1 and not measles. This result is statistically significant.

48. Measles coverage was used as a proxy for a fully immunized child. Increases are from 2007 to 2009-2010.



It was difficult to quantify but there was clearly confidence and pride in being associated with the program. Trainees felt that they were part of something important. It was palpable to me how people participating in these training seemed to feel empowered and proud to be an immunization manager responsible for the health of people in Kenya.

## Lessons for Future Programs

### Seven Key Lessons for Improved Program Effectiveness and Sustainability

Merck's experience designing and supporting the MVN-A program offers valuable lessons for other actors in the immunization and broader global health fields who are engaged in or planning future, similar work. Specifically, we identify seven key lessons, which can help ensure that immunization delivery training programs are effective and that the impact achieved is sustainable:

1. **Conduct a rigorous needs assessment** to anchor efforts in local needs and priorities;
2. **Plan for and perform ongoing monitoring and evaluation (M&E)** to enable programs to adapt and improve, and generate evidence of impact to attract new partners and funding;
3. **Create a sustainability plan at the outset** to ensure that program impact is maintained beyond the conclusion of initial funding;
4. **Embed programs into local health systems** to ensure that investments leverage existing infrastructure, relationships, and resources, and that impact can be sustained beyond the life of the program;
5. **Employ locally-adapted curricula and appropriate teaching techniques** to maximize transfer and retention of relevant knowledge;
6. **Incorporate supportive supervision** into programs to ensure that transferred knowledge is maintained and acted upon;
7. **Facilitate and support regular convening and communication**, enabling continuous learning for improvement.

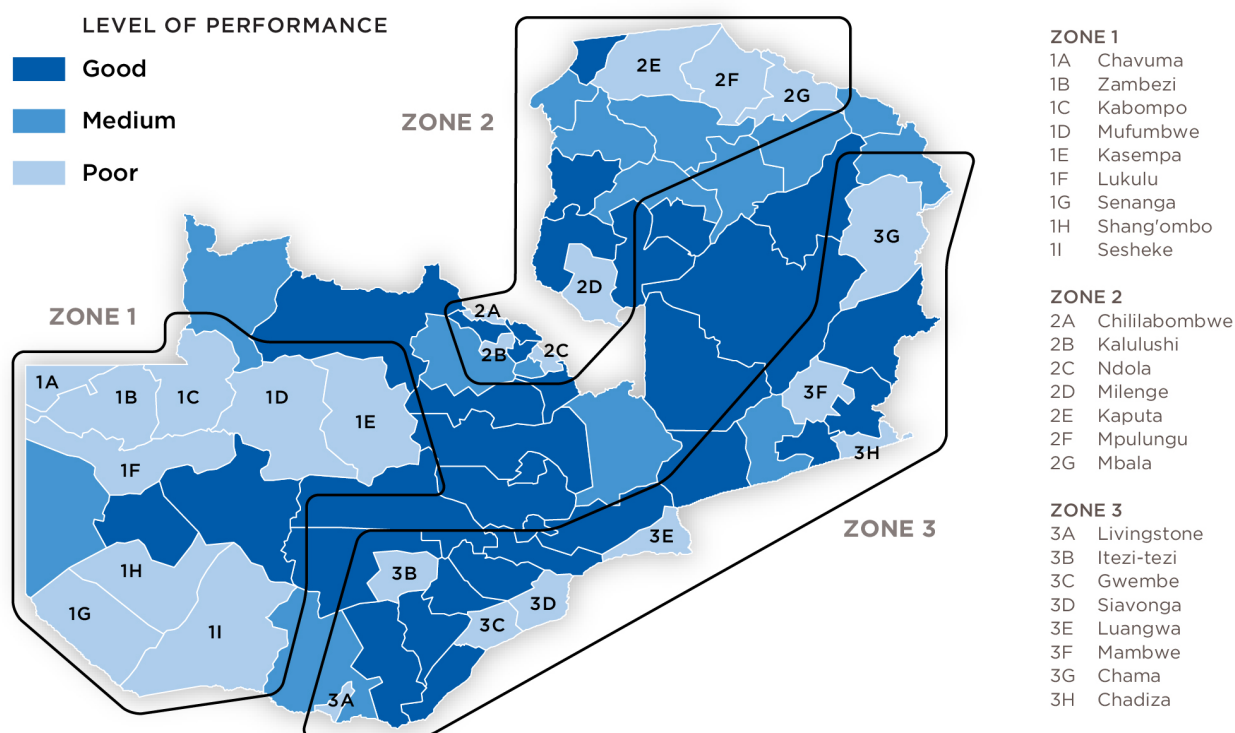
Below, we discuss each of these key lessons in greater depth and illustrate them with relevant examples from the MVN-A program.

#### 1. Conduct a Rigorous Needs Assessment

A robust needs assessment, anchored in data and input from local stakeholders, is essential to ensure that program activities and resources are deployed wisely. The MVN-A programs in Kenya, Mali, Uganda, and Zambia all conducted needs assessments prior to program implementation to inform strategic foci by identifying the most pressing gaps in immunization training and coverage.

MVN-Z, for example, used the results of its needs assessment to prioritize districts for training. The program ranked each district in Zambia according to coverage trends over an eight-year period for four critical antigens: BCG, OPV3, DPT3, and measles (see Figure 3).<sup>49</sup> MVN-Z then selected for training those districts with the lowest immunization coverage rates, with 36 of 72 districts ultimately included. The program also paired high-performing and low-performing districts for the purpose of peer learning, providing support for ongoing “supportive visits” between districts.

**Figure 3: MVN-Z’s Needs Assessment Was Used to Prioritize Districts for Training**



The Kenya program conducted a needs assessment to identify the most critical gaps in immunization knowledge, then customized program curriculum based on the results. MVN-K surveyed 83 immunization managers about their perceptions of the strengths, weaknesses, and areas for improvement in the Kenya Expanded Programme on Immunization (KEPI). The respondents frequently cited knowledge of cold chain maintenance as a critical gap that needed to be addressed. Professor Edward A. Liechty, Co-Director of MVN-K, explains:

The needs assessment revealed very clear demand for better understanding of the cold chain system. When a refrigerator would break down, the immunization workers would

<sup>49</sup> Needs assessment coverage survey included years 2000-2007.

have to ship it several hundred kilometers for repair, which would take weeks, only to find out the cause was something minor that they could have repaired themselves if they'd had the training.

In response to the data gathered in the needs assessment, MVN-K developed a supplemental training module focused specifically on cold chain maintenance, a subject not covered in standard WHO training materials. The module also included hands-on training on simple refrigerator repairs, which was identified by managers as a significant need.<sup>50</sup>

## 2. Plan for and Perform Ongoing Monitoring and Evaluation (M&E)

In addition to conducting an initial needs assessment, planning for and implementing ongoing monitoring and evaluation is also critical to program success: by systematically tracking and reviewing progress, programs can adapt and improve in response to new insights, as well as demonstrate success and positively position the program for potential future funding. M&E contributed to the success of the MVN-A program in both ways.

For example, an interim impact assessment conducted by MVN-Mali identified key deficiencies in information transfer from the national and regional levels to the peripheral health workers who were responsible for the administration of most vaccines.<sup>51</sup> This finding informed the program's decision to employ additional training techniques to reinforce learnings and improve performance through guided observation and feedback (see section "Incorporate Supportive Supervision," below, for additional detail).

MVN-K provides an example of using M&E both to make real-time programmatic adjustments and to attract partners and funding. After each training session, the program directors and all trainers gathered to discuss what worked well, what did not, and ideas for improvement. The suggestions from these in-depth conversations, along with feedback gathered via survey from all training participants, were immediately incorporated into future training sessions. As Dr. James Conway, Co-Director of MVN-K, explains, "We were constantly gathering and using data to tweak and improve the program."

Furthermore, MVN-K shared with key stakeholders evidence collected on the success of the program, including pre- and post-training survey data and annual reports. This evidence of success was critical to building relationships with a number of important organizations. Based on the strength of these relationships and the demonstrated impact of the program, three stakeholders—KEPI, WHO, and USAID—have committed to the continued funding and implementation of training sessions after the completion of the MVN-A program.

A substantial weakness in MVN-A's implementation of M&E, however, was the lack of consistent data gathering and reporting across the four countries. By design, Merck did not prescribe an evaluation methodology or standardized metrics, allowing each country program to assess impact as it saw fit. While this approach had the advantage of maximizing flexibility and allowing for customization to the local

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<sup>50</sup>Ayaya, "Training Needs for Mid-Level Managers and Immunisation Coverage in Western Kenya."

<sup>51</sup>Milstien, "Strengthening Immunization in a West African Country: Mali."

contexts, it also resulted in an inability to determine standard benchmarks for success or directly compare progress across countries.

### 3. Create a Sustainability Plan at Program Outset

As with any externally funded program, it is essential to develop a long-term plan for sustainability in order to ensure that progress and impact are maintained once initial funding has been concluded. As Merck's decade-long commitment to MVN-A draws to an end, Dr. Adel A.F. Mahmoud, former President of Merck Vaccines, who was instrumental in the program's design, reflects upon an important lesson learned: "If the path to sustainability isn't clear, there is a risk that progress will backslide once initial funding concludes."

Without clear sustainability plans in place from the start, the four MVN-A country programs now face varying challenges in maintaining the impact achieved to-date. Given the high rate of turnover among health care workers in sub-Saharan Africa, training sessions must continue to be held regularly, which of course requires commitment of ongoing funding. The MVN-A program in Kenya has been most successful in obtaining additional resources, and continues to conduct training sessions after the conclusion of funding from The Merck Company Foundation, with trainees nominated and fully financially supported by the Ministry of Health Division of Immunization and Vaccines. Other country programs are in the process of securing additional funding to continue training efforts.

From the outset, Merck intended to provide multi-year seed funding for MVN-A, launching and growing the program, demonstrating impact, and "priming the pump" for additional funders to support the initiative as it gained momentum and scale. As Brenda D. Colatrella, Executive Director of Merck's Office of Corporate Responsibility, points out, however, "You can't just put off addressing sustainability. You have to define it early and take responsibility for it. You cannot expect the program to automatically continue if you haven't planned appropriately for sustainability."

From the earliest stages of program design, it is essential to develop a sustainability plan that clearly articulates the transition of funding responsibility and serves as a road map for the cultivation of relationships with in-country and global stakeholders that may eventually take ownership for the program's long-term success. The complementary implementation of other lessons provided in this paper



A UITP-trained health worker immunizes a child

– including performing ongoing M&E (see above) and embedding programs into local health systems (see below) – also helps position programs to attract resources and achieve long-term sustainability.

#### 4. Embed Programs into Local Health Systems

A common mistake made by many development initiatives is to establish independent programs rather than integrating new efforts into existing systems and processes. This approach poses two important risks that ultimately limit program effectiveness and sustainability. First, the approach fails to leverage the substantial accumulated knowledge and experience that resides in existing health systems. Second, it makes it difficult to maintain impact beyond the life of the initiative: parallel structures require ongoing funding which may not be available in resource-constrained environments, even in the presence of evidence of success. MVN-A took steps to avoid both of these risks. Dr. Conway explains:

The biggest mistake that has been made in global health, and especially in vaccines, is thinking that outsiders have the answers. True integration with local partners is critical. In the case of MVN-A, these were true partnerships, not just a U.S. program going in to implement something.

For instance, implementation of MVN-K was deeply integrated within the MOH and the existing KEPI program. By design, the program targeted the most critical three to five vaccine managers in each district, not only positioning them to train others and thus magnifying country-wide impact, but also ensuring buy-in from key government representatives. KEPI officials not only attended and participated in every training session, but also identified promising trainees and flagged ongoing training needs. As further evidence of its commitment to the program, the MOH's Division of Vaccines and Immunizations nominated and financially supported fully two-thirds of the most recent train-the-trainers during Merck's sponsorship of the program, and has continued to conduct additional trainings after the conclusion of funding from Merck. Professor Liechty explained the importance of this relationship:

The most critical success factor for the program was that it was completely intertwined with KEPI. If we had developed an independent training program, I don't think it would have been as effective or had any chance of being sustained. But since the government had contributed substantial resources, they felt ownership and wanted to see it carried on.

Embedding training curriculum into existing medical and nursing schools can also improve the sustainability of program impact. For instance, although not initially a focus of MVN-A, the Zambia program identified a critical need for pre-service training on vaccine delivery for nurses. As Dr. Paul Seddon, Co-Director of MVN-Z, describes:

One of the lessons we learned early on was that updating the training modules wasn't enough; it was a matter of health care workers not being adequately prepared by their undergraduate education. We needed to go back and strengthen pre-service training.

Prior to conducting the training, MVN-Z completed a comprehensive needs assessment to adapt existing curriculum for the nursing audience. The first training, in 2011, was attended by nineteen nursing tutors and clinical instructors from sixteen different nursing schools, who proceeded to train other nursing tutors at their respective schools. Professor Mary Shilalukey Ngoma, Co-Director of the program, describes the impact: “When the nursing tutors were trained, we immediately saw the value of peer support. The nurses very naturally, spontaneously, and extensively trained others, and the hands-on instruction was hugely effective.” Building upon this initial success, MVN-Z plans to train individuals at the country’s remaining twenty-three nursing schools in 2012.

## 5. Use Locally-Adapted Curricula and Teaching Techniques

All four MVN-A programs grounded their trainings in context-appropriate and locally adapted curricula. The existing standard at the outset of the program was the EPI Mid-Level Manager course, which was originally developed by WHO in 1991 and later adapted by the WHO Regional Office in Africa. Although built on rigorous and credible content, the materials were comprised of 24 dense modules, making them difficult for immunization managers to digest, and required far more instruction time than was feasible for busy health care workers to spend away from the hospital or clinic.<sup>52</sup>



Group discussions during a 2009 MVN-Z training

Recognizing these limitations, the Kenya program used its pool of trainer-of-trainers (TOTs) to condense the WHO modules and adapt them to the Kenyan context, focusing on priorities identified by the needs assessment. The group of TOTs selected 13 of the WHO modules for inclusion and condensed them into shorter presentations. They also developed new materials on specific local needs not addressed by the WHO curriculum, such as disease surveillance and cold chain maintenance (see section “Conduct a Rigorous Needs Assessment and Ongoing M&E,” above, for additional detail). The programs in Uganda and Zambia undertook a similar process of condensing and adapting the modules, incorporating consultation with a range of stakeholders, including local ministries of health, WHO, and UNICEF.

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<sup>52</sup> Although WHO updated the course in 2008, and also condensed it into eight modules, this was too late for the programs to use these materials at the start of their trainings.



In order to improve learning and knowledge retention, several programs utilized adult learning techniques, including active participation, group discussions, role playing, and hands-on practice. In partnership with The University of Zambia School of Education, MVN-Z incorporated learning techniques such as brainstorming, role-playing exercises, and cooperative problem solving. The trainers worked to refine these facilitation methods over time by engaging an outside consultant to assess strengths, weaknesses, and areas of improvement. An evaluation of the program demonstrated that the trainings were successful in increasing the knowledge and skills of the participants in multiple key areas, including ability to apply problem solving approaches, plan immunization services, and monitor immunization activities.<sup>53</sup> Similarly, the MVN-K program used a range of adult learning techniques in its courses, and even created a new module on the pedagogical concepts in EPI training to educate participants on how they might apply the same techniques while supervising others.

## 6. Incorporate Supportive Supervision

Continuous supportive supervision following initial training is part of a comprehensive long-term capacity building process.<sup>54</sup> Supportive supervision is on-site training that utilizes a series of short, objective checklists to structure targeted sessions of observation and feedback. The on-site nature of the training both serves as a regular touch point to identify structural issues early and allows staff to remain at their posts and attend to the management of their local immunization centers. Ideally, the process also should include management training on strategic planning and effective monitoring of progress against goals at the local level.

MVN-Mali piloted a supportive supervision program after an interim evaluation revealed deficiencies in information transfer from those trained at the district level to the health center-level workers.<sup>55,56</sup> The aim was to ensure that knowledge and practice were actually improving at all levels. Dr. Fanta Niare Dembele, Program Coordinator, explained the rationale behind this approach:

There can be a big gap between what you learn during training and the implementation of that learning in reality. It is impossible to gauge from a distance if the training is having an effect; you need to be there with the health workers when they administer vaccines and correct them if it is not done correctly.

MVN-Mali's supportive supervision program was launched in 2008 and carried out in eight community health centers every three months. The program design favored a focused and participatory approach and covered four supervisory tools, including injection safety, techniques and communications for immunization, program management, and surveillance. Final coverage surveys indicated that supportive

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<sup>53</sup> Anitha Menon, "Overall Effectiveness of the Mid-Level Management Course for EPI Managers," Unpublished MVN-A Document.

<sup>54</sup> Children's Vaccine Program at PATH, "Guidelines for Implementing Supportive Supervision: A step-by-step guide with tools to support immunization," (Seattle: PATH, 2003).

<sup>55</sup> Interim assessment revealed higher performance at the regional and district levels and insufficient knowledge among those conducting supervisory training.

<sup>56</sup> Milstien, "Strengthening Immunization in a West African Country: Mali."

supervision was effective after just one year of implementation. Immunization coverage rates increased by almost 14 percentage points, resulting in an overall coverage rate of 90 percent.<sup>57,58</sup> There were also large decreases in drop-out rates – which declined to 5% or less at all centers – as well as reductions in stock-outs and the percentage of children vaccinated outside of scheduled intervals.<sup>59</sup>

Both MVN-Mali and UITP in Uganda have recommended that supportive supervision be adopted by national EPI programs in the future. The Mali program’s directors and TAG agreed that “supportive supervision has the potential to greatly improve immunization training activities through a simple and inexpensive approach.”<sup>60</sup> Similarly, the UITP final evaluation highlighted that supportive supervision was a powerful tool to ensure that knowledge acquired in the trainings was being successfully translated into practice and retained over time.

## 7. Facilitate and Support Regular Convening and Communication

When administering a multi-country immunization program, the facilitation of regular learning and communication between sites can be a powerful tool for improving program effectiveness. This orientation toward learning for improvement was reflected in MVN-A, as program leadership universally agreed that one of the most valuable components of the program was convening to share learning and experiences across countries. The Merck Company Foundation supported three such meetings over the life of MVN-A, bringing together key program leadership in Paris, France, in 2005; Haarlem, Netherlands, in 2008; and Washington, D.C., in 2011.

The value of these peer learning meetings was undisputed, providing program leadership the opportunity to share different approaches to the work and collaborate on potential solutions to common challenges. In fact, program leaders across Africa, the U.S., and the EU all expressed a strong desire for more regular, real-time opportunities for cross-country communication. Dr. Fred Wabwire-Mangen, Co-Director of the Uganda program, explains:

We really would have benefited from more collaboration between the partner countries. It would have been particularly helpful to learn from the experiences of Kenya and Mali, who had been operating longer than we had. More country visits, network meetings, and conference calls would have helped quite a bit, as I’m sure the different country programs were experiencing similar challenges.

Reflecting upon this desire for additional facilitation of cross-program communication, leaders from Merck learned a valuable lesson about the importance of consistently enabling meaningful sharing of experiences. Brenda D. Colatrella, Executive Director of Merck’s Office of Corporate Responsibility, points out that it is essential to plan and earmark funds for these valuable activities:

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<sup>57</sup> MVN-Mali data were analyzed for coverage of DTP1, DTP3, yellow fever, and measles vaccines by 12 months of age. Coverage increased nationwide due to several initiatives, but not to the same degree as in the test centers. Controls centers experienced an increase of coverage of 4.5 percentage points, resulting in coverage of 78.5%.

<sup>58</sup> Milstien, “Supportive Supervision Activities in Mali Improve the Quality of Immunization Services.”

<sup>59</sup> Ibid.

<sup>60</sup> Ibid.



While there was sufficient funding for the program, there was less funding available for operational support. We fell short in terms of projecting needs of the operational budget to facilitate activities such as summits and convenings of the program partners. We learned that, going forward, it's important to make those commitments explicit and plan for them accordingly.

## Conclusion

Over the past ten years, the MVN-A program trained more than 1,600 immunization managers, significantly building the capacity of vaccine delivery systems in Kenya, Mali, Uganda, and Zambia. As The Merck Company Foundation concludes its decade-long support of MVN-A, it hopes that this experience provides lessons that may be helpful to other funders, governments, and NGOs designing or implementing vaccine delivery training programs around the world. In particular, the MVN-A experience surfaced seven key lessons that, when applied together, can increase both program effectiveness and sustainability.

Comprehensive immunization manager training programs can powerfully improve the skills and confidence of the health care workers responsible for day-to-day administration of vaccines. Going forward, it is critical that immunization training be elevated as a priority on the global health agenda, ensuring that adequate funding and attention are committed to this important global health intervention. Immunization delivery training, especially when combined with other essential capacity building efforts, has the potential to save the lives of millions of children each year.

## Appendix: Stakeholders Interviewed

Pamela Achieng  
Trainer, MVN-K  
Training Manager, Kenya Expanded Program on Immunization

Nicholas Ayebazibwe  
Project Officer, UITP  
Professor, Makerere University Institute of Public Health, Uganda

Jhilmil Bahl  
Capacity Building Specialist, World Health Organization Regional Office for Africa

Alain Barry  
Manager for Mali and other West African countries, Institutional Business Africa, Merck & Company

David Chemirmir  
Country Sales Manager, Kenya, Merck & Company

Michael Chimbipa  
Facilitator, MVN-Z  
Provincial Expanded Program on Immunization Officer, Solwezi, Zambia

Brenda D. Colatrella  
Executive Director, Office of Corporate Responsibility, Merck & Company

James Conway  
Co-Director, MVN-K  
Associate Professor of Pediatrics, University of Wisconsin School of Medicine

Fanta Niare Dembele  
Program Coordinator, MVN-Mali  
District Manager, Expanded Program on Immunization, Mali

Bany Diaby  
Facilitator, MVN-Mali  
Supervisor, Expanded Program on Immunization, Mali

Niraj Doshi  
Manager, HIV Access Program, East & Southern Africa, Merck and Company

Laura Efros  
Senior Director, Vaccine Public Policy, Merck & Company

Fabian Esamai  
Co-Director, MVN-K  
Professor of Child Health and Pediatrics, Moi University School of Medicine

Mark Feinberg  
Vice President, Medical Affairs and Policy, Merck & Company

Alan Hinman  
Co-Director, UITP  
Director for Programs, Center for Vaccine Equity, Task Force for Global Health

Annet Kisakye  
EPI Team Leader, WHO Country Office Uganda  
Surveillance Officer, World Health Organization

Nouhoum Kone  
Technical Advisory Committee Member, MVN-Mali  
Assistant Director of Health, Ministry of Health, Mali

Karen Kotloff  
Co-Director, MVN-Mali  
Professor of Pediatrics, University of Maryland Medical Center

Edward A. Liechty  
Co-Director, MVN-K  
Professor of Pediatrics, Indiana University School of Medicine

Adel A. F. Mahmoud  
Former President, Merck Vaccines, Merck & Company  
Lecturer with the rank of Professor in Molecular Biology and Public Policy, Woodrow Wilson School

Julie Milstien  
Program Staff, MVN-Mali  
Adjunct Associate Professor of Medicine, University of Maryland School of Medicine

Evans Mpabalwani  
Course Director, MVN-Z  
Pediatrician and Virologist, Department of Pediatrics and Child Health, University Teaching Hospital, Lusaka, Zambia

David Mukanga  
Executive Director, African Field Epidemiology Network

Kris Natarajan  
Former Director, Global Health Partnerships and Global Vaccine Initiatives, Merck & Company  
Senior Technical Advisor to the CEO, Center for Health Sciences Training, Research and Development

Mary Shilalukey Ngoma  
Co-Director, MVN-Z  
Associate Professor of Pediatrics and Child Health, University Teaching Hospital, Lusaka, Zambia

Godfrey Phiri  
Director of Organization, MVN-Z  
Postgraduate Student in Orthopedic Surgery, University Teaching Hospital, Lusaka, Zambia

Melanie Ribeiro  
Vaccine Manager, Kenya, Merck & Company

Victor Sakala  
HIV/AIDS Specialist, Zambia, Merck & Company

Paul Seddon  
Co-Director, MVN-Z  
Professor of Pediatrics, Brighton Sussex Hospital

Josephine Simwanga  
Chief EPI Officer, Ministry of Community Development and Social Services

Samba O. Sow  
Program Principal Investigator, MVN-Mali  
Coordinator, Center for Vaccine Development-Mali and Associate Professor of Medicine, University of Maryland School of Medicine

Steve Stewart  
Health Educator, Global Immunization Division, Center for Disease Control

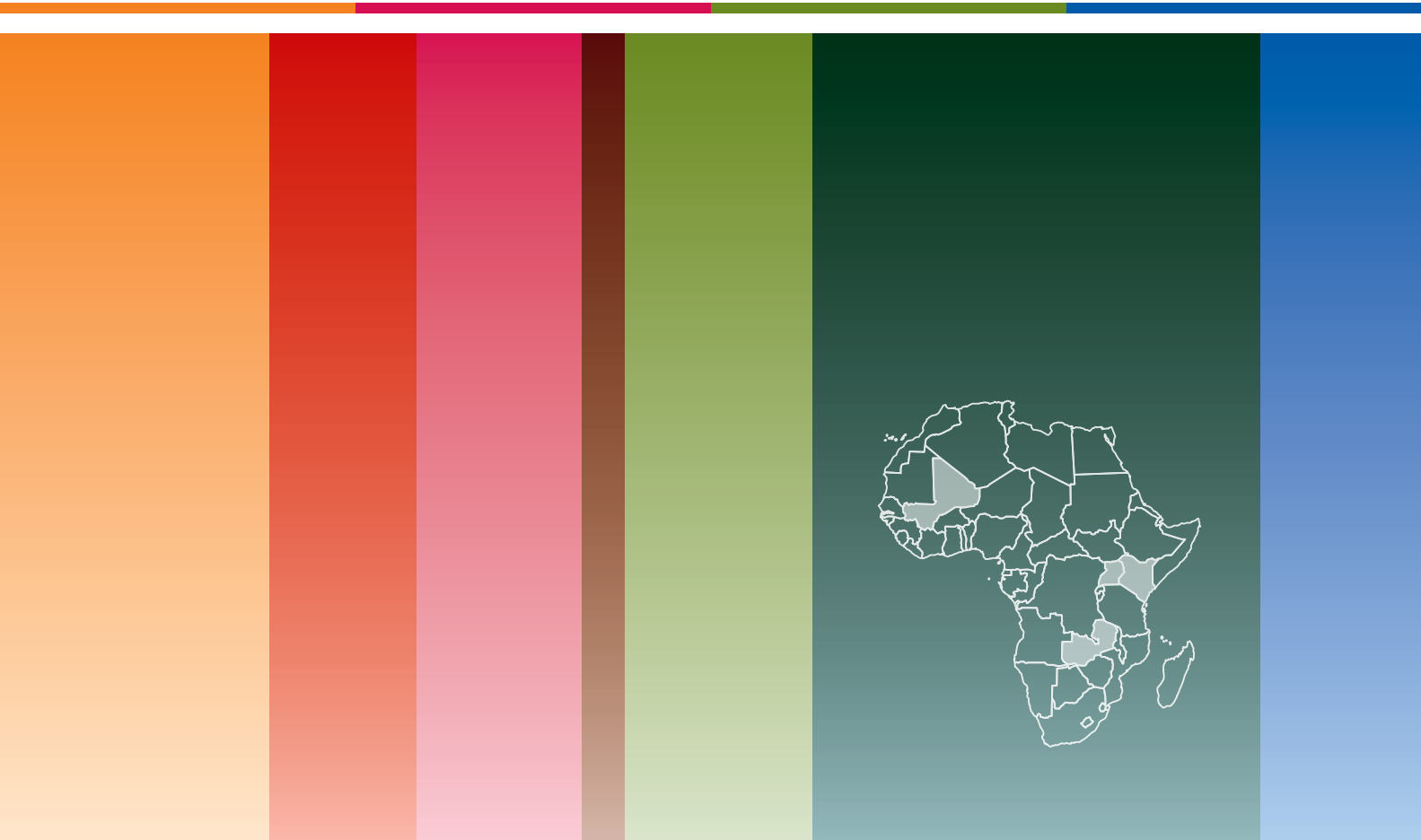
Walter Straus  
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Winifred Tabaaro  
Trainer, UITP  
Training Officer, Ugandan National Expanded Program on Immunization, Ministry of Health, Uganda

Fred Wabwire-Mangen  
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Collin West  
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Karen A. Wilkins  
Former MVN-A Advisory Board Member  
Deputy Branch Chief, Strengthening Immunization Systems, Center for Disease Control



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