

DIRECTIONS

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IN GLOBAL HEALTH

SPECIAL
ISSUE ON
**Health
technologies**

Using health technologies to meet global challenges

**PATH provides effective, affordable solutions
for those most in need**

Innovations in technology have played a critical role in improving health around the world. Important examples include vaccines that have dramatically reduced the global burden of polio and measles and eliminated smallpox.

Often developed by private firms, health technologies have generally addressed priorities of high-income nations. These products have frequently been unsuitable for use in developing countries, which typically lack the resources, infrastructure, and specialized skills needed for implementation. Also, companies have often been reluctant to invest in technologies designed specifically for low-resource settings because of perceptions of a low return on investment and a high risk of implementation challenges.

PATH recognizes both the need and untapped potential for appropriate health technologies in low-income countries. As this issue of *Directions in Global Health* shows, we facilitate work on many innovative and affordable products, often in partnership with private firms. Working across a range of health topics, we develop or tailor technologies that meet the needs, preferences, and realities of poor communities. The articles in this issue feature some of our work related to women's health, vaccine development, diarrheal disease, and nutrition—and our general approach to developing and deploying effective health solutions for vulnerable populations.



Richard Lord

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 **PATH**
A catalyst for global health

Reproductive health

Advancing low-cost tests to screen for cervical cancer

Project builds on PATH's history of solutions for reproductive health

Project name

Screening Technologies to Advance Rapid Testing for Cervical Cancer Prevention—Utility and Program Planning (START-UP)

Locations

India, Nicaragua, Uganda

Methods

Advocacy, clinical studies, demonstration projects, public-private partnerships, technical assistance, technology development

Partners

Arbor Vita Corporation, QIAGEN

Funder

Bill & Melinda Gates Foundation

For more information

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WOMEN AROUND THE WORLD

face myriad challenges to their reproductive health, from the risk of early or unwanted pregnancy to complications during childbirth to transmission of HIV. In developing countries, the risk of dying from cervical cancer remains high, despite substantial progress in preventing deaths in high-income nations.

Improving women's reproductive health is a key component of PATH's work, and we have a history of developing affordable technologies for contraception, disease prevention and detection, and safe birth. Recently, PATH has advanced new low-cost screening technologies for cervical cancer. Combined with new vaccines and proven treatments, the new screening tools will ultimately help to reduce the toll of cervical cancer among the world's poorest women.

Developing new screening tests

Low-resource countries shoulder a disproportionately high burden of cervical cancer. Among the approximately 500,000 women affected and 274,000 who die from the disease each year, about 80 percent live in the developing world.^{1,2} Although wealthy countries have successfully reduced cervical cancer incidence and mortality by screening women with Pap tests and other methods, developing countries often lack the laboratories, trained technicians, and financial resources for effective screening using these approaches.

PATH has collaborated with two private partners to develop

affordable tests that identify women at high risk for cervical cancer due to infection with human papillomavirus (HPV), the primary cause of the disease. These tests will give women accurate and affordable alternatives to Pap smears and provide rapid test results, meaning a woman could be screened and receive treatment in one or two visits to the health center. One of the tests, a rapid-strip method that detects a protein produced when precancerous changes occur in HPV-infected cells, is still in development. The other test, which detects HPV DNA, was evaluated in China and India with good results and is being produced in China this year.

PATH worked with industry partner QIAGEN to adapt the DNA test, called *careHPV*, from a more complex test geared toward high-income countries. The simpler screening method can be used with portable, battery-operable equipment, does not require refrigeration for the reagents, and produces results in two to three hours. Test results are easy to read and, unlike Pap smears or visual inspection methods, are not vulnerable to misinterpretation. To ensure acceptability of the test among women and health care providers, PATH's research partners screened more than 21,000 women in China and India and offered treatment as appropriate. Feedback from our local partners verified that women, health care providers, and other stakeholders are comfortable with the test.



Preparing for introduction of an HPV test

The project team is helping industry partners understand developing-country public health care systems so they can navigate the appropriate regulatory approval processes and forecast potential demand for the test. PATH is also working with developing countries to pave the way for test introduction once the technology is available.

Through demonstration projects in India, Nicaragua, and Uganda, PATH has partnered with ministries of health and other key stakeholders to compare the HPV DNA test against other screening strategies and demonstrate its feasibility, effectiveness, and acceptability. The team will use lessons learned from the demonstration projects to garner support from the World Health Organization, the International Federation of Gynecology and Obstetrics, and other key agencies that can advocate for cervical cancer prevention programs—and the use of HPV tests—in developing countries.

Results of a recent clinical trial of various screening methods for cervical cancer in India have boosted chances that HPV DNA tests will soon be widely adopted.³ The eight-year study of 130,000 women found that a single round of screening for HPV dramatically reduced the incidence of advanced cervical cancer and deaths from cervical cancer. Conducted by the International Agency for Research on Cancer, the trial used a version of the HPV test more commonly used in wealthy nations.

Combining screening with vaccination to protect women's health

As PATH advances affordable cervical cancer screening methods for women in low-resource areas, we are also building evidence for

vaccinating young adolescent girls against HPV before they have a chance to contract the virus. Researchers predict that these prevention and detection methods, when used simultaneously, could drastically reduce developing-country cancer deaths to the low rates seen among women in developed countries.

All of PATH's reproductive health technologies are making it easier for women to control their own health and protect themselves from illness. As each technology reaches another health program and another home, women and communities in the

Other technologies for reproductive health

PATH has advanced multiple technologies to improve reproductive health and make birth safer. Examples include:

- The SILCS diaphragm, a "one-size-fits-most" device that does not require a doctor's fitting. PATH anticipates receiving clearance from the US Food and Drug Administration for commercial distribution by 2010 and is seeking partners for manufacturing, distribution, and introduction.
- The PATH Woman's Condom. In 2008, PATH transferred the technology and equipment to a commercial partner in China, which could have market clearance as early as 2010.
- The Uniject® device. PATH is exploring pairing the prefilled, single-use syringe with a new form of Depo-Provera® to allow health professionals to provide contraception outside of a clinic. PATH has begun work to introduce this method in up to five countries. PATH has also combined the preventive drug oxytocin with the Uniject device to allow the medicine to be delivered in emergency situations and in remote locations, potentially saving thousands of women's lives from the effects of postpartum hemorrhage.
- Clean delivery kit. Used in Bangladesh, Egypt, and Nepal, the kit includes a bar of soap for washing hands, a plastic sheet to serve as the delivery surface, clean string for tying the umbilical cord, a razor blade for cutting the cord, and pictorial instructions to illustrate the sequence of delivery events.

Uniject is a registered trademark of BD.



PATH/Glenn Austin

developing world are significantly closer to achieving health equity. ■

REFERENCES

1. World Health Organization (WHO), PATH, and United Nations Population Fund. *Cervical Cancer, Human Papillomavirus (HPV), and HPV Vaccines: Key Points for Policy-makers and Health Professionals*. WHO/RHR/08.14. Geneva: WHO; 2007. Available at: http://www.rho.org/files/WHO_PATH_UNFPA_cxca_key_points.pdf.
2. Ferlay J, Bray F, Pisani P, Parkin DM. *GLOBOCAN 2002: Cancer Incidence, Mortality, and Prevalence Worldwide*. IARC CancerBase No. 5, Version 2.0. Lyon, France: IARC Press; 2004.
3. Sankaranarayanan R, Nene BM, Shastri SS, et al. HPV screening for cervical cancer in rural India. *The New England Journal of Medicine*. 2009;360:1385–1394.

Vaccine development

Extending the reach of immunization

How the Meningitis Vaccine Project is developing a meningitis vaccine that Africa can afford

Project name

Meningitis Vaccine Project

Location

25 countries in sub-Saharan Africa

Methods

Vaccine development and introduction, clinical trials, case-based surveillance

Partners

African health ministers, Agence Africaine pour la Recherche en Santé Humaine, Association pour la Médecine Préventive, DiagnoSearch Life Sciences Pvt. Ltd., GAVI Alliance, International Coordinating Group on Vaccine Provision for Epidemic Meningitis Control, Médecins Sans Frontières, Serum Institute of India Limited, SynCo Bio Partners B.V., UK Health Protection Agency, United Nations Children's Fund (UNICEF), US Centers for Disease Control and Prevention, US Food and Drug Administration's Center for Biologics Evaluation and Research

Funders

Bill & Melinda Gates Foundation, Michael & Susan Dell Foundation, US Agency for International Development

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Visit www.meningvax.org to learn more.

AS THE GLOBAL ERADICATION OF smallpox has shown, vaccines may be the most effective public health intervention of all time. Yet vaccines developed for industrialized nations sometimes fall short in their ability to prevent disease in poor countries, which may be affected by different strains of bacteria or simply unable to afford costly new vaccines. Even when vaccines are available and affordable, health systems in developing countries are often unable to deliver them to everyone who needs them.

PATH is working to bridge these gaps. We are currently leading partnerships to develop or advance vaccines for malaria, meningitis, Japanese encephalitis, enteric pathogens, pneumonia, and other neglected diseases. In each of these efforts, we partner with the private sector, researchers, governments, and communities to drive vaccine research, development, availability, and uptake. Our work under the Meningitis Vaccine Project—a collaboration between PATH and the World Health Organization (WHO)—illustrates how these efforts are bringing much-needed protection to vulnerable populations.

Assessing need and potential for a new meningitis vaccine

Almost all major meningitis epidemics in Africa's meningitis belt—a vast area in sub-Saharan Africa plagued by repeated epidemics of meningococcal meningitis—have been caused by group A *Neisseria meningitidis*. Over the past 25 years, control of

these epidemics has emphasized surveillance and reactive mass vaccination with meningococcal polysaccharide vaccines. Today, mass vaccination campaigns use a bivalent (A and C) and/or trivalent (A, C, and W₁₃₅) polysaccharide vaccine as soon as possible after an epidemic has been declared.

Polysaccharide vaccines have several significant disadvantages, however. Supplies are uncertain and often not well linked to epidemic areas. The vaccines do not protect very young children, do not protect unvaccinated population groups, and only provide protection for up to three years. As a result, repetitive outbreak responses deplete countries' scarce health care finances with little impact.

After the largest meningitis epidemic in history hit Africa in 1996 and 1997—more than 250,000 cases and 25,000 deaths were reported in a single epidemic season—African ministers of health turned to WHO for help. In response, WHO convened scientific meetings on the feasibility of developing a novel meningococcal conjugate vaccine that could be used preventively in the meningitis belt. The two disease-specific components for a suitable conjugate vaccine—meningococcal polysaccharide A and tetanus toxoid—had been available for many years. So had the conjugation technology. Meeting participants concluded in 2000 that development of a low-cost group A conjugate vaccine was possible, and they recommended support of efforts to eliminate meningococcal disease in Africa. Soon after, the Meningitis Vaccine Project was funded to

advance the development, production scale-up, testing, licensure, and introduction of meningococcal A conjugate vaccines for Africa.

The right targets, the right players

The Meningitis Vaccine Project first focused on understanding the constraints that had limited the introduction of new vaccines. The team consulted with African public health officials, who emphasized vaccine price as a key barrier and indicated that a cost of more than US\$0.50 per dose would be unsustainable. This ceiling price became the key driver in negotiations.

To develop the vaccine, the project brought three critical partners to the table: SynCo Bio Partners B.V., which supplied meningococcal polysaccharide A; the Serum Institute of India Limited, which supplied tetanus toxoid and scaled up the manufacturing processes; and the US Food and Drug Administration's Center for Biologics Evaluation and Research, which transferred their conjugation technology. In this new model, essential raw material came from one source, the technology from another, and the final scale-up for production from another. The model also included a north-to-south

transfer of technology and capacity. PATH and WHO jointly managed the project, identifying appropriate partners and then offering financial, management, and technical support.

Poised for introduction

The meningococcal A conjugate vaccine that resulted from these efforts—known as MenAfriVac™—is currently in phase 2 and phase 2/3 clinical trials in Africa and India; phase 3 trials are scheduled to begin in May in India. Clinical data demonstrate that the vaccine is safe and highly immunogenic, producing antibody levels almost 20 times higher than those obtained with the marketed polysaccharide vaccine. Licensure and WHO prequalification are expected by the end of 2009 for persons one year or older; an infant indication is expected by 2012. Priced at less than \$0.50 per dose, the vaccine is on track to be introduced in Burkina Faso in late 2009 or 2010 and in Mali and Niger in 2010.

Building on the 2008 Yaoundé Declaration, in which African health ministers committed to introduce

the vaccine, the Meningitis Vaccine Project is actively preparing for MenAfriVac™ introduction. Key components of this effort include enhanced surveillance and a carriage study in Burkina Faso. The team has also developed a vaccine introduction plan and a corresponding communication plan that includes an Advanced Immunization Management e-Learning module in French and English (available at <http://aim.path.org>).

A ceiling price of US\$0.50 per dose became the key driver in negotiations.

Ultimately, the new vaccine should eliminate meningitis A epidemics in 25 African countries that are home to an estimated 95 percent of the world's meningococcal meningitis disease burden. Preventive mass vaccination campaigns and routine immunization strategies are expected to have an enormous public health impact: long-term direct protection for approximately 272 million people, prevention of 149,000 deaths and 347,000 disabilities, and herd immunity for an estimated 638 million people throughout the meningitis belt. ■

Protecting vaccines from freeze damage

PATH has developed a breakthrough formulation method that protects common vaccines from the effects of accidental freezing. The method adds freeze-protection stabilizers, such as glycerin, polyethylene glycol 300, or propylene glycol, to a number of vaccines containing aluminum adjuvants. These stabilizers all have a long history of use in many other human medications with excellent safety records.

Study results published by PATH and colleagues from the University of Colorado in the January 1 issue of *Vaccine* demonstrate that even a small amount of stabilizers can protect vaccines—including hepatitis B, diphtheria, tetanus toxoid, and pertussis vaccines—from the damaging effects of repeated freezing. In addition to ensuring vaccine

effectiveness, the prevention of freeze damage also reduces vaccine wastage, which occurs when health workers dispose of vaccines suspected to have been exposed to freezing.

PATH has placed the technology in the public domain so that vaccine manufacturers around the world can access the approach. To date, the technology has been transferred to vaccine producers for use in two childhood vaccines.



Unit Kartoglu

Diarrheal disease

Project names

Safe Water Project, Enhanced Diarrheal Disease Control Initiative

Location

Global

Methods

Advocacy, communication, formative research, market development, public-private partnerships, surveys, technology development and introduction, technology transfer, vaccine development

Selected partners

Safe Water Project: Abt Associates Inc., Cascade Designs Inc., Centre for Social Communication Programs, Emory University, Intellectap, Johns Hopkins University, MART, Massachusetts Institute of Technology, MBAs Without Borders, Monitor Company Group LP, RTI International, Sustainable Business Development LLC

Enhanced Diarrheal Disease Control Initiative: Merck & Co., ministries of health, NicaSalud, UNICEF, US Centers for Disease Control and Prevention, World Health Organization

Funders

Safe Water Project: Bill & Melinda Gates Foundation

Enhanced Diarrheal Disease Control Initiative: Bill & Melinda Gates Foundation, National Institutes of Health, US Agency for International Development, World Bank

For more information

Safe Water Project: Contact Glenn Austin, project director, at gaustin@path.org.

Enhanced Diarrheal Disease Control Initiative: Contact Evan Simpson, program officer, at esimpson@path.org.



Visit www.eddcontrol.org to learn more.

Stopping diarrheal disease

A comprehensive approach using market-based technology solutions and other interventions

A PROTOTYPE WATER-TREATMENT system in Nairobi, Kenya, is helping a small community prevent diarrheal disease caused by waterborne pathogens. Vaccines against rotavirus, a primary cause of severe diarrhea, are protecting an increasing number of children around the world. And new, low-cost, easy-to-use diagnostic tools are improving identification of diarrhea-causing pathogens in developing countries. These are a few examples of how PATH and other groups are successfully using technologies in the global campaign against diarrheal disease.

Development and implementation of affordable, culturally appropriate technologies is only part of PATH's response, however. Also vital are efforts to improve health behaviors and systems to reduce the burden of diarrheal disease, which kills an estimated 5,000 young children daily and leaves millions more each year with stunted growth and reduced intellectual development.^{1,2}

Increasing access to safe water

Nearly 1 billion people worldwide lack access to safe drinking water. Waterborne pathogens in lakes, rivers, and other water sources cause diarrheal disease and lead to illness or death among millions, with the most vulnerable being children less than five years old.³ Previous efforts to provide safe water have often been either too small for widespread benefit or too expensive to sustain.

Because private-sector marketing mechanisms, industrial capacity, and sales-and-service networks have

enabled many people in developing nations to purchase household goods such as soap, PATH is exploring whether and how these same commercial approaches might be effective for providing safe water. In December 2006, PATH began researching the global water market, reviewing the available scientific literature, and studying more than 150 existing safe water products, such as filters and chemical treatments. In 2008, formative research in India evaluated consumers' perceptions, attitudes, knowledge, and practices related to water storage, treatment, and use. The research included a survey of 1,000 households in 50 communities. In Cambodia and Vietnam, PATH conducted a scan of local markets and products.

In 2009, PATH is supporting pilot projects in India to extend the availability of existing household water storage and treatment products to low-income consumers. Based on the results of our formative research and market analysis, we are testing a model of bicycle-based sales via entrepreneurs and another model that incorporates support from microfinance institutions. These tests also involve advertising and promotional campaigns. In Cambodia and Vietnam, we are completing consumer research. Long-term success in both regions may hinge on finding innovative ways to further reduce prices, improve products, and generate demand.

For the poorest of the poor, who have household incomes of less than \$1 per day, community-level

water treatment may be a better option. To explore this possibility, PATH partnered in 2008 with the Redeemed Gospel Church in Nairobi, Kenya, and a Seattle firm with expertise in water treatment to set up a low-cost, community-level system using electro-chlorination technology. Implemented with support from the Laird Norton Family Foundation, the system not only provides a reliable source of safe water for a Nairobi slum called Korogocho but also generates a small income for community members operating the system and selling the water for a modest price.

Advancing other technologies

Providing safe water is only one example of how PATH is advancing technology to curb diarrheal disease. Other examples include:

- Accelerating the availability of current rotavirus vaccines in developing countries and supporting clinical trials to evaluate their performance in Africa and Asia.
- Working with companies in China, India, and other countries to develop new rotavirus vaccines that are safe, effective, and affordable.
- Teaming with private- and public-sector partners to develop vaccines against the main bacterial causes of diarrhea, *Shigella* and enterotoxigenic *Escherichia coli*.
- Assisting in the commercialization of an inexpensive handheld device for quick and easy testing of water quality.
- Working with partners to develop a disposable “lab-on-a-card” diagnostic device as a rapid, easy-to-use, and low-cost tool for detecting diarrhea-causing pathogens.

Putting it all together

PATH's Enhanced Diarrheal Disease Control Initiative takes

a comprehensive approach to addressing the problem, integrating technology solutions with helpful changes in health behaviors and systems. The initiative's website (www.eddcontrol.org) provides resources to help countries increase uptake of effective interventions, such as improved oral rehydration solution, zinc treatment, exclusive breastfeeding, hand-washing practices, and vaccination. It also provides advocates with tools they need to help raise awareness about these solutions and influence the policies that can make them more accessible.

The initiative includes increasing the knowledge base on diarrheal disease as well as coordinating with the public and private sectors. The comprehensive approach is being successfully implemented in Africa, Asia, Eastern Europe, and Latin America.

Looking ahead

Although a variety of technologies have been effectively introduced on a limited scale to curb diarrheal disease, we are now challenged to expand their use to spare millions more children from severe diarrhea. In some circumstances, market-based approaches to distribution and use of technology appear promising.

Attaining the highest levels of success will require ongoing innovation and collaboration with private partners to create solutions that are affordable for the poorest of the poor. It will also require

a comprehensive approach that integrates technology solutions with other effective interventions to prevent needless suffering from diarrheal disease. ■

REFERENCES

1. Boschi-Pinto C, Velebit L, Shibuya K. Estimating child mortality due to diarrhoea in developing countries. *Bulletin of the World Health Organization*. 2008;86(9):710–717.
2. Berkman DS, Lescano AG, Gilman RH, Lopez SL, Black MM. Effects of stunting, diarrhoeal disease, and parasitic infection during infancy on cognition in late childhood: a follow-up study. *The Lancet*. 2002;359:564–571.
3. Quick RE, Kimura A, Thevos A, et al. Diarrhea prevention through household-level water disinfection and safe storage in Zambia. *American Journal of Tropical Medicine and Hygiene*. 2002;66(5):584–589.



Nutrition

Responding to the need for nutrients

Food fortification technology offers an affordable, culturally appropriate solution

Project name

Ultra Rice® technology

Location

Global

Methods

Efficacy trials, market development, public-private partnerships, technology development and introduction, technology transfer

Partners

Adorella Alimentos Ltda; Center for Public Nutrition and Development, Government of China; Global Alliance for Improved Nutrition; Indian Institute of Crop Processing Technology; Ministry of Science and Technology, Government of India; Naandi Foundation; Swagat Food Products (P) Ltd.; Union de Arroceros, S.A.; University of Toronto

Funder

Bill & Melinda Gates Foundation

For more information

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Satvir Malhotra

Young children in India may benefit from use of food fortification technology to increase dietary iron.

A YOUNG CHILD IN INDIA HAS A 70 percent or greater chance of developing iron-deficiency anemia.¹ Thousands of children in India and other high-risk countries die each year from lack of dietary iron, and many more suffer physical and cognitive impairment.^{2,3} The most common and debilitating nutritional disorder in the world, iron deficiency also affects a high proportion of pregnant women, leading to many thousands of maternal deaths.⁴

Fortunately, fortification of rice and other staple foods is proving effective for addressing deficiencies in iron and other micronutrients. Ultra Rice® fortification technology may play an especially important role in many resource-poor countries. This unique, low-cost approach to fortification protects nutrients during storage, rinsing,

and cooking of rice, which is the staple food for two of three people worldwide.

Ultra Rice production and distribution

Ultra Rice consists of rice flour fortified with iron or other micronutrients—such as zinc, folic acid, and thiamin—and natural stabilizing ingredients. Dough created from this mixture is extruded through pasta-making equipment and cut into rice-shaped grains before drying. The fortified grains are then blended with locally obtained, traditional rice for purchase and use.

Cost-effective and culturally appropriate, Ultra Rice can be tailored to local needs because its micronutrient content and blend

Ultra Rice is a registered trademark in the United States of Bon Dente International, Inc.

ratio can be customized. This is particularly important for public-sector buyers seeking to meet the varying nutritional needs of people who access government food programs.

Product validation and commercialization

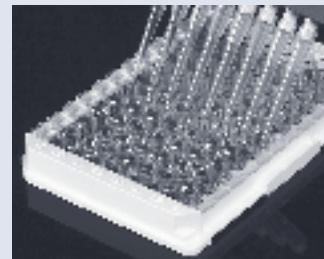
Research in multiple locations and demographic groups has confirmed the safety, efficacy, stability, and sensory acceptability of Ultra Rice,⁵⁻⁷ produced with technology developed by Bon Dente International and then transferred to PATH in 1997. A recent Ultra Rice study involving children in Andhra Pradesh, India, paved the way for a partnership between PATH and a local pasta manufacturer, Swagat Food Products.

The production of Ultra Rice complements Swagat's product portfolio and has enabled the company to enter new markets with limited investment. To ensure affordability and sustainability, PATH helped Swagat identify local sources of iron (ferric pyrophosphate) and other key ingredients as substitutes for high-cost imports. PATH also negotiated caps on Swagat's profit margin for public-sector sales.

The arrangement with Swagat exemplifies PATH's global commercialization strategy for Ultra Rice, which seeks to establish supply by transferring technology to manufacturing partners around the world. To grow the supply base, PATH intends to establish regional technology transfer centers in both India and Brazil, which will then license the technology to additional qualified producers according to PATH's established principles for price, supply, and quality. The regional centers will also provide technical support to pasta manufacturers producing Ultra Rice and millers blending it into traditional rice supplies.

New tests for nutrient deficiencies

Along with using technology to improve nutrition, PATH has advanced technologies to evaluate micronutrient deficiencies in developing-country populations. For example, PATH developed a new rapid, low-cost test for vitamin A status that was licensed in 2003 to Scimedx, a US diagnostics company, for introduction to commercial markets. Successful use in Uganda and other countries has paved the way for wider implementation. PATH is also exploring new tools to evaluate levels of multiple micronutrients, including iron and zinc.



PATH/Glenn Austin

Market development

By establishing a robust supply with Swagat, PATH is moving forward with plans to introduce Ultra Rice grains into midday meal programs and other key outlets for nutritionally vulnerable communities that regularly consume rice in Andhra Pradesh. At the same time, PATH is studying ways to keep costs low and preserve the grains' micronutrient content under different scenarios of transportation, storage, and food preparation. PATH is also evaluating blending accuracy with different methods: wet blending of Ultra Rice with traditional rice at the point of cooking or dry blending at rice millers' facilities.

Soon, PATH will present data to state-level decision-makers to encourage integration of Ultra Rice into existing midday meal programs throughout India. Using Ultra Rice to provide children with half of their recommended daily iron allowance will bolster their chances for healthy cognitive and physical development.

Expansion to global scale

PATH's manufacturing partner in Brazil is poised to start Ultra Rice production in 2009 to serve public-sector programs in the region. Planning for pilot introduction of Ultra Rice is under way with several municipalities in Brazil, as well as with other countries in the region, such as Nicaragua. Efforts are also

under way to export Swagat's grains to neighboring countries in Asia.

Successful introduction of Ultra Rice into school lunch programs around the world is expected to catalyze development of the overall market for fortified rice, estimated at 200 to 500 million metric tons annually. This market expansion will create additional opportunities for PATH and our partners to help improve the micronutrient status of millions worldwide. ■

REFERENCES

1. International Institute for Population Sciences (IIPS) and Macro International. *National Family Health Survey, 2005–2006*. Mumbai, India: IIPS; 2007. Available at: www.nfhsindia.org.
2. Caulfield LE, Richard SA, Rivera JA, Musgrove P, Black RE. Stunting, wasting, and micronutrient deficiency disorders. In: *Disease Control Priorities in Developing Countries*, 2nd ed. New York: Oxford University Press; 2006:551–568. Available at: www.dcp2.org/pubs/DCP/28/.
3. World Health Organization (WHO). *Iron Deficiency Anemia: Assessment, Prevention, and Control. A Guide for Program Managers*. Geneva: WHO; 2001.
4. Scholl TO, Hediger ML. Anemia and iron-deficiency anemia: compilation of data on pregnancy outcome. *American Journal of Clinical Nutrition*. 1994;59:492S–500S.
5. Hotz C, Porcayo M, Onofre G, et al. Efficacy of iron-fortified Ultra Rice in improving the iron status of women in Mexico. *Food and Nutrition Bulletin*. 2008; 29(2):140–149.
6. Beinrer MA, Jansen AK, Meléndez JGV, Pessoa M, Paintal K, Greiner T. *Sensory Evaluation of Rice Fortified with Iron*. Recife, Brazil: Department of Nutrition, Center of Health Sciences, Federal University of Pernambuco; 2008.
7. Indian Market Research Bureau International (IMRB). *Potential Introduction of Ultra Rice in India: Complete Market Assessment*. New Delhi, India: IMRB; 2003.

Technologies

Developing and introducing health technologies

PATH's approach highlights partnerships with private firms

Primary project name

Technology development and deployment

Location

Global

Methods

Advocacy, behavior change communication, clinical trials, formative research, monitoring and evaluation, needs assessment, public-private partnerships, operations research, surveillance, systems strengthening, technical assistance, vaccine development and introduction

Partners

Multiple public and private organizations

Primary funders

Bill & Melinda Gates Foundation, US Agency for International Development

For more information

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ADDRESSING GLOBAL HEALTH NEEDS by developing and deploying innovative health technologies is a central element of PATH's work. Since 1977, we have adapted, developed, or co-developed more than 85 technologies for use in developing countries, including 10 products in global use that have had a major impact on policy, practice, or local capacity. The most widely disseminated technologies have been vaccine vial monitors, which detect problems in the cold chain, and SoloShot™ single-use, disposable syringes, which improve injection safety. Several billion of each product have been used worldwide.

Collaboration is vital to PATH's approach to innovation. We collaborate closely with end-users at every phase of product development and introduction, and we engage partners with complementary expertise and resources—including private firms—to achieve global

health goals. Internally, we work through multidisciplinary teams that include business specialists as well as technical staff and global health experts. In all of these efforts, we follow a comprehensive framework for product introduction that has been molded by our experience.

User-driven development

Extensive collaboration with end-users is critical. We involve users at all stages of the product-development process, from assessing the need for a particular health product to designing it and then refining it in response to user evaluations.

We rely heavily on user input to ensure that all of our technologies are appropriate for the settings in which they are used. Core components of this focus include ensuring that the technologies are acceptable to the communities and cultures that will



Unit Kartoglu



Wendy Stone

A vaccine vial monitor (left) is a small, round sticker whose color changes to show exposure of vaccine over time to potentially damaging heat. The SoloShot™ single-use, disposable syringe (right) improves injection safety by preventing reuse of contaminated needles.

SoloShot is a trademark of BD.

use them, affordable to the public sector, and available to developing-world markets.

Public-private partnerships

Like many nongovernmental organizations, PATH has successfully partnered with public-sector institutions such as the World Health Organization (WHO), United Nations Children's Fund (UNICEF), US Agency for International Development, and developing-country governments. Unlike many other groups, however, we also collaborate extensively with commercial firms to advance specific health technologies. Because PATH does not manufacture or distribute products, we partner with the commercial sector to advance our ideas or assist them with theirs.

Our goal in any collaboration is to achieve the maximum sustainable benefit for public health, and we do this by harnessing the complementary expertise and assets of each organization. Typically, PATH engages with private-sector collaborators in one of five ways:

- Transferring a technology developed or owned by PATH.
- Supporting development or adaptation of a partner's product.
- Co-developing a technology.
- Supporting introduction of a collaborator's product.
- Working with industry to advance not only specific products but also an entire class of products that will benefit global health (for example, autodisable syringes).

PATH's Guiding Principles for Private-Sector Collaboration (www.path.org/files/ER_gp_collab.pdf) provides additional information on our approach to partnerships.

Multidisciplinary teams with business expertise

To advance technologies, PATH creates small, semi-autonomous



project teams with three types of professionals. First, each product team has a technical specialist proficient in the technical or scientific aspects of the proposed product. Second, it has a program specialist, often a public health expert who has worked in the developing world. Finally, each team has a business development expert, usually with an advanced business degree or extensive experience in health technology. This team member plays a critical role in working with private-sector collaborators and anticipating market realities for proposed products. Together, these team members craft an integrated approach to a specific health problem.

Increasingly, advocacy has become an important part of PATH's work to ensure uptake and sustainability of health technologies. To gain support for developing-country solutions, PATH serves as the secretariat for the Global Health Technologies Coalition (see update, back cover).

Comprehensive framework for product introduction

To increase the likelihood of successful product integration into health systems, PATH employs a rigorous, comprehensive framework for product introduction. The first of three main phases is product development, which typically ends with regulatory approval and endorsements by organizations

such as WHO and UNICEF. The second is product introduction, in which the technology is employed in one or more developing countries on a limited scale. The third is product integration, which involves extending use beyond the initial implementation areas to increase impact. The process may take ten years or more.

The value chain for health product development is illustrated in the figure above. *PATH's Framework for Product Introduction* (www.path.org/files/TS_product_intro_framework.pdf) provides a complete description of this process.

New challenges and opportunities

The recent decline in global wealth may require even more ingenuity to make health technologies affordable for poor countries. Weak markets and diminished public resources may make product introduction even more challenging.

Meeting urgent global health needs will require overcoming these challenges to take advantage of current opportunities for technology solutions. Expanding use of proven technologies has the potential to not only reduce suffering and save lives but also save money by preventing disease. Developing and validating promising new technologies will further expand our abilities to efficiently, effectively, and appropriately meet ever-growing health needs around the world. ■

Resources and announcements

Global Health Technologies Coalition progresses

The Global Health Technologies Coalition has received a three-year grant from the Bill & Melinda Gates Foundation to accelerate the development of new health products to prevent HIV/AIDS, tuberculosis, malaria, and neglected tropical diseases. The funding will enable the coalition to increase its advocacy efforts and build political support for creating innovative technologies to save lives. PATH serves as secretariat of the coalition, which has more than 25 member organizations ranging from product development groups to global health advocates and think tanks.

New alliance for global health in Washington State

Washington State has become a hotbed for organizations working to improve health in the developing world. PATH now hosts the secretariat for the newly established Washington Global Health Alliance, which strives to connect, organize, and motivate groups with similar goals. PATH's president and CEO, Dr. Christopher J. Elias, serves as president of the alliance's executive board. Learn more at www.wghalliance.org.

Website on nutrition for children and mothers

The Infant and Young Child Nutrition (IYCN) Project, a US Agency for International Development program led by PATH, offers news and resources on maternal nutrition, infant and young child feeding, prevention of mother-to-child transmission of HIV, and more on its new website. Visit www.iycn.org.

PATH's annual report available


PATH's 2008 annual report explores the birth of innovative solutions and follows them as they take shape and take hold in some of the world's poorest communities. Download the

print version of the report from our publications catalog at www.path.org/publications or see our online annual report—new this year—at www.path.org/annual-report/.

PATH at the Global Health Council Conference

PATH will have a strong presence at the Global Health Council's 36th Annual Conference in Washington, DC, May 26–30. Staff members will host a conversation on diarrheal disease and participate in several panel discussions about our work in global health, including a presentation on PATH's methods and approaches for creating new technologies and a show-and-tell of PATH's innovative products. Please join us.

New online resource for diarrheal disease control

 www.eddcontrol.org

PATH has launched a new website to provide more resources about important solutions for curbing diarrheal disease, the world's second-leading killer of children less than five years old. The Resources for Diarrheal Disease Control website offers tools to spread the word about the impact of diarrheal disease and presents key documents and links to simple, lifesaving interventions such as oral rehydration therapy, breastfeeding, and new vaccines.



PATH is an international nonprofit organization that creates sustainable, culturally relevant solutions that enable communities worldwide to break longstanding cycles of poor health. By collaborating with diverse public- and private-sector partners, we help provide appropriate health technologies and vital strategies that change the way people think and act. Our work improves global health and well-being. For more information, please visit www.path.org.

Directions in Global Health shares information about PATH's programmatic work with colleagues around the world. To subscribe, please send your contact information to publications@path.org. To learn more about PATH's work, visit the PATH website or sign up to receive our email updates by contacting publications@path.org.

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