

GLOBAL HEALTH

Innovation Insight Series



Photo courtesy of East Meets West

An infant receiving phototherapy with Firefly

THE EAST MEETS WEST FOUNDATION I: Expanding Organizational Capacity

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JOHN ANNER, PRESIDENT

THE PROBLEM/SOLUTION SPACE

Worldwide, 60 percent of all newborns experience infant jaundice caused by hyperbilirubinemia (excess levels of bilirubin in the bloodstream).¹ The percentage of infants affected in Asia is even higher. Bilirubin is a yellow-colored pigment created when the body replaces old red blood cells. The liver breaks down bilirubin so that it can be removed by the body, but in premature babies with immature liver function and those with certain underlying diseases, bilirubin levels may be high enough to cause brain damage and permanent disability.



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In the U.S. and developed nations, infant jaundice is treated with widely available phototherapy, in which blue-light of a specific wavelength is shined upon the skin. The blue light causes chemical reactions within bilirubin molecules that enable the body to excrete bilirubin harmlessly into the urine and stool. Infants with jaundice who receive phototherapy have the same opportunity to enjoy normal, healthy lives as other newborns. Within a couple weeks, their liver function usually matures sufficiently to metabolize bilirubin such that no further phototherapy is needed.

Every year in South Asia and Africa, more than 5.7 million newborns with jaundice do not receive the simple phototherapy needed to prevent brain damage. Newborn jaundice and complications caused by jaundice account for an estimated 6–10 percent of neonatal mortality worldwide.²

ABOUT THE EAST MEETS WEST FOUNDATION

The East Meets West Foundation (EMW) is an international development agency with the mission to “transform the health, education, and communities of disadvantaged people in Asia.”³ EMW is headquartered in Oakland, California but operates programs with

its local partners throughout Vietnam, as well as in Cambodia, India, Laos, Myanmar, Thailand, and the Philippines. EMW medical programs provide direct assistance to patients and build health system capacity by training medical staff as well as building improved medical facilities. Current programs include Breath of Life, Operation Healthy Heart, Support Network for People with Disabilities, dental care, and hospital construction.

In 2012, Breath of Life (BOL) was EMW’s largest medical program. BOL targeted hypothermia, respiratory distress, hyperbilirubinemia, and other common causes of infant mortality in the developing world by providing a complete package of custom-made, low-cost medical equipment to neo-

natal care providers at no cost. The BOL suite included a continuous positive airway pressure machine (CPAP), which treated infants in respiratory distress, an infant resuscitation station, pulse oximeters, hand sanitizers, and phototherapy machines to treat neonatal jaundice. Collectively, this equipment constituted a neonatal intensive care unit (NICU) that was both cost-effective and low-maintenance. To help ensure that the equipment was used correctly and consistently over time, EMW’s BOL team proactively worked with care providers and administrators at the hospitals to help them integrate these technologies into their operations.⁴

According to EMW President John Anner, a critical part of the solution for reducing neonatal mortality in the developing world was “the development of facility-based neonatal intensive care technologies that can be delivered to millions of families around the world.” He continued, “This does not mean that every town in rural India and Africa has



Photo by Hanh Nguyen for East Meets West

A mother with a baby helped by Breath of Life

to have a NICU stuffed full of modern pieces of equipment that each cost more than a new car. But it does mean that every family should have access to a facility that offers the basics.”⁵ Anner underscored the need for equipment that was affordable and durable, with limited consumable parts. Moreover, it should be engineered specifically for low resource settings and supported by “a comprehensive solution that addresses issues of staff capacity, long-term viability, robust after-sales service, and so on,” he added. “The moment the equipment arrives at the hospital or clinic is the moment the intensive work starts, not finishes.”⁶

ONE CHALLENGE: EXPANDING ORGANIZATIONAL CAPACITY

Following its launch in 2005, Breath of Life had addressed many of the needs outlined by Anner. Between 2005 and 2009, BOL distributed more than 450 CPAP machines and more than 500 other pieces of neonatal care equipment to more than 130 hospitals in 58 different provinces in Vietnam. BOL also provided training on equipment use and advanced newborn care to more than 2,000 Vietnamese physicians and nurses. These efforts supported the treatment of approximately 20,000 infants per year.⁷ Based on the program’s success, the Lemelson Foundation supported its expansion to Cambodia and

Laos in 2008, which by 2010 had increased the number of hospitals served to 200 and the total number of infants treated each year to 45,000.⁸

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these hospitals is the number one killer of babies.*

As EMW expanded BOL in Asia, it recognized the need to develop more effective therapy for infant jaundice. Conventional phototherapy equipment from wealthy nations was too expensive for widespread

adoption in the developing world. Even when donated, this equipment was not suited to operate in hot and humid climates with unreliable electricity and rugged terrain, and broke down easily. Within five years, approximately 98 percent of western phototherapy devices donated to the developing world were broken or no longer being used because these regions had limited technical capacity for basic maintenance.⁹

BOL included a “bili bed” to treat jaundice but, according to Anner, it provided suboptimal phototherapy and “just didn’t work that well.”¹⁰ Additionally, the equipment could only be operated within an intensive care unit, which exposed jaundiced neonates to critically ill infants. As Anner explained, “The intensive care unit is a very dangerous place. That’s where all the germs live. The hospitals we work in often put two, three, four infants to a bed. Any of those babies that have sepsis easily transmit all those germs to all the other babies. If you have a single baby that does not have to be in the intensive care unit, then you can make a big reduction in infection rates as infection in many of these hospitals is the number one killer of babies.”

As the BOL program grew, it also sought to expand from large, provincial referral hospitals to small district-level and community hospitals, as well as health care facilities in rural areas. These health care settings did not have the staffing, technical expertise, and electrical power sources needed to utilize the bili bed or the complete Breath of Life NICU suite. EMW was interested in an infant phototherapy solution designed specifically to fit the needs and conditions of these environments.

Based on its experience in the field, EMW had a detailed understanding of the design requirements for a new jaundice solution. Yet it did not have the design capabilities needed to develop the product and neither did its existing partners. EMW had been relying on Medical Technology Transfer Services (MTTS), a local Vietnamese firm, to manufacture and deliver its neonatal care tools. MTTS specialized in adapting Western technology to the needs, resources, and other conditions of the local environment. EMW routinely presented MTTS with specific clinical problems, financed the necessary research and development to create or adapt solutions, and then purchased the finished products. However, at the time, MTTS did not have a team of seasoned design engineers. Anner would have to look elsewhere for this support.

THE SOLUTION: ESTABLISHING A PARTNERSHIP FOR CUSTOM PRODUCT DESIGN AND ORGANIZATIONAL LEARNING

In deciding how to address this challenge, EMW took a forward-looking perspective that would allow it to strengthen its existing partnership with MTTS rather than simply work around it. Anner wanted to find a way to augment MTTS capabilities while also developing the new phototherapy solution. “I wanted to get MTTS moving away from sheet metal bending into work with plastics, injection molding, or plastic extrusion, which is a capacity they did not have, and which did not exist in Vietnam,” he recalled. His goal was to help MTTS to “move along the knowledge trajectory” to develop more advanced engineering and manufacturing capabilities.

The EMW team prepared a design brief and shared it with several well-known design companies. It ultimately chose to work with Design that Matters (DtM), a nationally recognized nonprofit design firm headquartered in Cambridge, Massachusetts. EMW and DtM began collaborating in 2009. This decision was driven, in part, by DtM’s willingness to partner closely with MTTS throughout the design and development process.

DtM’s mission is to develop products and services that allow social enterprises in developing countries to overcome barriers to achieving scale and impact in the health care, education, and clean water fields. The company had acquired substantial experience designing low-cost, contextually appropriate innovations for neonatal care in low-resource settings. These innovations included NeoNurture, a model incubator fashioned from used car parts, and a low-cost CPAP device.

Using EMW’s design brief as a launching point, DtM engaged hundreds of volunteers from academia and industry in the U.S., Europe, and parts of the developing world to contribute their expertise towards solving the following problem:

Low-resource hospitals providing overnight care that wish to improve treatment outcomes and reduce newborn referrals need a cost-effective, intuitive, durable tool that can be placed in the mother’s room to provide individual infant phototherapy to otherwise healthy newborns with mild to severe jaundice while allowing infant warming.

The team’s main challenge was designing a phototherapy solution that could yield effective clinical outcomes while being compatible with low-cost manufacturing, maintenance, and repair techniques to enable neonatal care teams in Vietnam to take over production, distribution, and servicing. Yet “the techniques still needed to give the device a high-quality, professional aesthetic.”¹¹ Anner told DtM early on, “I really want you to

come up with a medical device that looks just incredibly cool so that physicians in rural hospitals would say, ‘I really like that. That looks great. I want that in my hospital. It looks like something that works well.’”

The resulting product was named “Firefly.” As DtM CEO Tim Prestero explained, “The firefly is a symbol of hope and joy, light in darkness, and is found worldwide.”¹² The new product offered numerous innovations, including energy efficient, long-lasting LED lights; lighting above and below the bassinet to maximize the body surface area of infants receiving treatment, which yielded the potential for reduced treatment time and lower rates of infection; a compact and portable design that allowed installation in the recovery room next to mothers and kept babies out of the intensive care unit; and a bassinet designed to hold only one infant, which discouraged multiple infants from blocking light or spreading infection.¹³ Firefly also had a low manufacturing cost and offered cost-effective performance relative to competitive products. DtM estimated that Firefly could cure newborn jaundice for \$1.50 per infant compared to \$5–8 per infant with other phototherapy devices (clinical trials ongoing).¹⁴

Throughout the design process, DtM provided MTTs with introduction to modern engineering methods and training, as Anner had hoped. Together, DtM and MTTs discussed every engineering detail and selected materials and manufacturing methods that would improve the performance of Firefly while enabling local production. DtM provided MTTs with new metal tube bending equipment at a low cost, and instructed MTTs engineers how to operate it to form Firefly’s structure.¹⁵ DtM also introduced MTTs to other low-cost manufacturing techniques, including vacuum forming, aluminum extrusion, and injection molding to improve the durability and aesthetic of Firefly.¹⁶ Each of these new capabilities would enable MTTs to better serve EMW’s product design, development, and production needs in the future.

In parallel, DtM also realized significant benefits from this partnership. Although DtM had a track record of developing

innovative design concepts, it had virtually no experience bringing them to market at a large scale. Through MTTs, EMW provided DtM with access to local production and product support capabilities. Perhaps most importantly, EMW shared with DtM its extensive network of neonatal care partners throughout Southeast Asia, providing the clinical infrastructure and organization needed for testing and distribution to patients.

EMW completed a clinical trial in November 2011, and Firefly officially cured its first infant with jaundice one month later. With Firefly, the baby required only 17 hours of phototherapy; physicians estimated that with a conventional phototherapy device, his cure would have required 2 to 3 days of treatment.¹⁷ As of mid-2012, Firefly was undergoing larger-scale clinical testing and production, and the team was expanding the



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Firefly allows a mother to interact with her infant during phototherapy

project to India, the Philippines, and Cambodia. Having achieved significant synergy, EMW and DtM also continued working together to develop additional neonatal care tools for Southeast Asia. ♦

NOTES

- 1 "Hyperbilirubinemia and Jaundice," Lucile Packard Children's Hospital, <http://www.lpch.org/diseasehealthinfo/healthlibrary/hrnewborn/hyperb.html> (June 14, 2012).
- 2 "Project Firefly," Design That Matters, <http://designthatmatters.org/portfolio/projects/firefly/> (June 14, 2012).
- 3 "Overview," East Meets West, <http://www.eastmeetswest.org/page.aspx?pid=410> (June 14, 2012).
- 4 "Breath of Life: Neonatal Health, Program Overview," East Meets West, <http://www.eastmeetswest.org/page.aspx?pid=344> (June 14, 2012).
- 5 John Anner, "My Daughter's Story: Fighting Prematurity, Advancing Technology for Newborns," January 3, 2012 <http://www.healthynewbornnetwork.org/blog/my-daughter%E2%80%99s-story-fighting-prematurity-advancing-technology-newborns> (June 14, 2012).
- 6 Ibid.
- 7 "Breath of Life: Key Statistics," East Meets West, <http://www.eastmeetswest.org/page.aspx?pid=379> (June 14, 2012)
- 8 Lemelson Foundation Fact Sheet, http://www.lemelson.org/sites/default/files/Lemelson%20Factsheet_1.pdf (June 14, 2012).
- 9 "Firefly Phototherapy: A Brief Intro," Design That Matters, http://designthatmatters.org/news/dtm-blog/2012/05/firefly_phototh_1.php (June 14, 2012).
- 10 All quotations are from interviews conducted by the authors unless otherwise cited.
- 11 Leslie Gordon, "Designing for Places That Can't Afford High Tech," MachineDesign.com, March 22, 2012, <http://machinedesign.com/print/90439> (June 14, 2012).
- 12 "Firefly Lights up Vietnam Hospitals," East Meets West, <http://www.eastmeetswest.org/page.aspx?pid=584> (June 14, 2012).
- 13 "Firefly," Design That Matters, http://www.designthatmatters.org/pictures/portfolio/firefly/Firefly_Phototherapy_Brochure.pdf (June 4, 2012).
- 14 Ibid.
- 15 Leslie Gordon, "Designing for Places That Can't Afford High Tech," MachineDesign.com, March 22, 2012, <http://machinedesign.com/print/90439> (June 14, 2012).
- 16 "Yanko Design Features Firefly Phototherapy," Design That Matters, <http://designthatmatters.org/news/dtm-blog/type/design-news/> (June 14, 2012).
- 17 "Firefly Clinical Trial Initial Feedback," Design That Matters, <http://designthatmatters.org/news/dtm-blog/type/field-study/> (June 14, 2012).

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Edward Sheen and Lyn Denend prepared this vignette with Professor Stefanos Zenios as the basis for discussion rather than to illustrate either effective or ineffective handling of a management situation. Copyright © 2012 by the Board of Trustees of the Leland Stanford Junior University. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, used in a spreadsheet, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without the permission of the Stanford Graduate School of Business.