

## Diagnostic Microbiology in Post-Genocide Cambodia



*Despite formidable challenges, Cambodians are making progress as they build clinical microbiology capacity from the ground up*

**Jim McLaughlin**

### **SUMMARY**

- ▶ The laboratory at the Kampong Cham Provincial Hospital, run by Nhem Somary, epitomizes the challenges she and other clinical microbiologists face as Cambodia recovers from setbacks under the Khmer Rouge regime.
- ▶ Although international agencies provide resources for diagnosing high-profile infectious diseases, reliable Gram stains or routine blood, spinal fluid, or even urine cultures are not available in most Cambodian hospital laboratories.
- ▶ Organizations and individual volunteers are helping Cambodians to build clinical laboratory capacity and knowhow.
- ▶ Challenges to progress include poor salaries, shortages of affordable supplies, and difficulties in educating lab staff and physicians about basic clinical microbiology practices.

The microbiology laboratory that Nhem Somary supervises in the Kampong Cham Provincial Hospital along the Mekong River, three hours northeast of Phnom Penh, serves as a model for labs in other Cambodian hospitals. She began supervising the laboratory in 1998, but did not offer diagnostic microbiology laboratory services until 2009 when the Diagnostic Microbiology Development Program established a microbiology laboratory there. Early that year, she used her only bottle of TCBS agar to isolate more than 60 strains of *Vibrio cholerae* during an outbreak of "acute watery diarrhea." Somary gave physicians at the Kampong Cham Hospital an accurate diagnosis.

Somary is continuing to provide quality diagnostic microbiology services despite a host of challenges, including low salaries for her staff, poor-quality reagents, and physicians who remain skeptical of test results. These are very specific signs of how Cambodia still struggles to recover from the Khmer Rouge (KR) regime. From 1965 to 1973 during the Vietnam War, the United States dropped more bombs on neighboring but neutral Cambodia than were dropped on Germany and Japan during World War II. This bombing contributed to the fall of the Lon Nol government in Cambodia and the takeover in 1975 by the Pol Pot-led KR. Under that regime, educated and skilled Cambodians were executed or removed to rural work camps where many died from hunger or disease. Although the KR regime was overthrown in 1979 when Vietnam invaded, the fighting between the KR and the central government did not completely cease until 1998.

### **Highly Uneven Clinical Microbiology Testing Resources in Cambodia**

I first learned about U.S. forces bombing Cambodia in the spring of 1970 while a graduate student at Tulane University School of Medicine. After graduating, I did a two-year postdoctoral fellowship in Medical and Public Health Microbiology at what is now called the Centers for Disease Control and Prevention (CDC) in Atlanta, Ga. From there, my wife, Roberta, our three young children, and I moved to Bangladesh, where I worked at the Cholera Research Laboratory for two years before moving to Hartford Hospital to work with Ray Bartlett and embrace the principles of cost-effective, clinically relevant microbiology. I then spent seven years as the Director of the Clinical Microbiology Laboratory at the University of New Mexico Hospital.

I was granted tenure and promoted to full professor, but left to pursue another dream. My wife

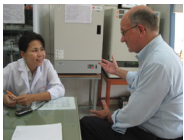
Roberta and I left our jobs to work with street children, first in Bolivia and then to Cambodia in 2003 as Maryknoll Lay Missioners.

While studying the Cambodian language, I realized that, as one of only two Ph.D. clinical microbiologists in the country, rather than working with street children, I should again be doing diagnostic microbiology. I began working as the CDC/Global AIDS Program (CDC/GAP) liaison to the Cambodian National Institutes of Public Health (NIPH).

HIV/AIDS, tuberculosis, malaria, and influenza attracted multinational donors, who helped build active programs in Cambodia to address these diseases. Although these programs improved laboratory capacity as part of testing for these specific diseases, routine diagnostic microbiology did not receive comparable attention. Although international agencies provide resources to apply molecular methods for diagnosing tuberculosis, malaria, and influenza in Cambodia, reliable Gram stains or routine blood, spinal fluid, stool, or wound cultures are not available to physicians in most provincial hospital laboratories.

The few Cambodian laboratories that test for antibiotic susceptibility usually do not follow recognized guidelines. Antibiotics are available without prescriptions. Pharmacists freely recommend antibiotics to customers. Cambodians who cannot afford full courses of antibiotics may take ill-advised short courses of such drugs, and counterfeit antibiotics are an ongoing problem. Although antibiotic resistance is likely a serious problem, few data are available to support this conclusion. Without reliable laboratory results, physicians treat patients on the basis of their best judgments. Until recently, it was a challenge obtaining QC strains for antibiotic susceptibility testing (AST) into Cambodia. At last, one large distributor in Phnom Penh now has a contract with MicroBiologics to provide American Type Culture Collection (ATCC) strains to laboratories.

### **Addressing Clinical Laboratory Challenges in Cambodia**



Cambodia faces a number of challenges in developing its clinical microbiology capacity. The deaths of so many skilled laboratory technologists during the KR regime disrupted all continuity between experienced mentors and the enthusiastic new graduates from the Technical School for Medical Care (TSMC). With support from the U.S. CDC and the Naval Medical Research Unit (NAMRU) 2, the staff at NIPH is trying to close this gap. Although the mandate of NAMRU-2 and the IPC is research rather than capacity building, both provide hands-on training to graduates. Additionally, clinical microbiology laboratories were developed at the Angkor Hospital for Children in Siem Reap with support from the Wellcome Trust and at the Sihanouk Hospital Center of Hope in Phnom Penh with assistance from the Institute of Tropical Medicine in Antwerp. These laboratories are also training microbiology laboratory staff.

The U.S. CDC/GAP Cambodia has worked with the American Society for Clinical Pathology to review and revise the medical technology curriculum, including clinical microbiology, at the TSMC. This effort has improved the curriculum, and will provide teachers with training in lesson planning and participatory teaching.

Continuing education (CE) opportunities are taken for granted in the United States, but they do not exist in Cambodia. Although the government has approved plans for the creation of a Cambodian Association of Medical Technology, those plans have languished for several years. Another problem is that the country does not publish its own clinical laboratory-oriented journal.

Cambodian physicians do not learn about microbiology in medical school and generally do not know how to use or interpret results that diagnostic microbiology laboratories provide. This lack of knowledge contributes to poor infection control practices and limited understanding of appropriate antibiotic treatments.

As for medical technologists, there is as yet no requirement for continuing education for physicians.

Obtaining equipment and supplies for clinical microbiology laboratories is another ongoing challenge. The Ministry of Health (MoH) orders and the Central Medical Store distributes supplies for government laboratories in provincial hospitals, following approval from the Ministry of Economy and Finance. Supplies typically are obtained from lowest bidders without regard for technical requirements.

### **Cambodian Clinical Lab Challenges Viewed on the Personal Level**



Salaries for lab technicians are about \$40 per month for those in government hospital laboratories, a sum that is nowhere near enough to support a family. Thus, many lab techs open their own labs or work in private labs or clinics. This situation frequently leads to real conflicts of interest, with specimens from hospitals being diverted to private labs or specimens from outside labs being processed in government hospital labs. Until the government pays reasonable wages to lab workers, these practices will continue. In my experience, this practice is the norm throughout the developing world.

Without commercial sources, every clinical microbiology laboratory in Cambodia must find its own supply of sheep blood agar plates. For instance, Somary relies on a faith-based development organization to supply blood from its small flock of sheep, on a farm about 12 km south of Phnom Penh. Once every 3 weeks, a tech from the National Pediatric Hospital in Phnom Penh rides there on his motorbike, bleeds several sheep, and brings the blood to the NPH microbiology lab to test for sterility. The blood is then given to Somary's husband, who transports it from Phnom Penh when he goes home on weekends to Kampong Cham, where it is used to prepare media. Somary and her colleagues experience various difficulties with their in-house prepared blood culture media, including contamination.

The microbiology laboratories in Cambodia that the U.S. government funds—the National Institutes of Public Health and NAMRU 2—can afford to buy blood culture bottles from abroad, but local Cambodian government laboratories cannot. Last year, I learned that the government-owned Pharmaceutical Factory #2 in Vientiane, Laos, was producing blood culture broth bottles. I challenged Ket Vansith at the National Pediatric Hospital to begin producing them also in Cambodia. He and Chou Monidarin at the School of Pharmacy of the University of Health Sciences responded by centralizing production of blood culture broth bottles in Phnom Penh and will soon begin distributing them to government-run microbiology laboratories around the country.



Clinical microbiologist Ellen Jo Baron, then at Stanford University, visited Cambodia in 2008 and, sponsored by the Fondation Merieux, presented week-long workshops on diagnostic microbiology in Kampong Cham, Battambang, and Phnom Penh. Because these workshops were too short, Baron and I established the Diagnostic Microbiology Development Program (DMDP), to which we recruit U.S. clinical microbiologists to visit and train Cambodian laboratory staff.

With the support and collaboration of the Global Health Security Initiative, the World Health Organization, and the Fondation Merieux, we have built or equipped and supplied several diagnostic microbiology laboratories in Cambodian provincial hospitals. Subsequently, six volunteer clinical microbiologists have traveled to Cambodia to provide training for up to four months. Each volunteer brought unique skills. For instance, with Somary, Larry Buck from Albuquerque, N.M., helped to launch the Kampong Cham laboratory. Then while at the NPH laboratory, Buck recognized *Burkholderia pseudomallei* in a blood culture from a 12-year-old patient who fell into a drainage ditch and nearly drowned. The correct diagnosis and longterm antibiotic therapy saved this boy's life.

Although *B. pseudomallei* is a well-known pathogen in Thailand and Vietnam, until recently it was little recognized in Cambodia. In September 2010, the University Research Corporation (URC) held

a three-day workshop to raise awareness of this infectious disease in Cambodia. Identifying this organism correctly in clinical specimens could help to save lives in Cambodia. Another pathogen, *Streptococcus suis*, is now being identified as a common cause of meningitis in Cambodian patients. For instance, *S. suis* was isolated from 14 patients in a small provincial hospital in Takeo, according to Baron and Cambodian colleagues, who reported their findings at the 2012 ASM General Meeting in San Francisco. Typing of these isolates from Cambodian patients proved the pathogen to be identical to the most common type found in Vietnam.

Sivly Boun Ray, a more recent visitor to Cambodia, graduated from the medical technology program at San Jose State University and then was an intern at Stanford University Medical Center Laboratories. Ray not only knows diagnostic microbiology, but as a Cambodian-American she speaks Khmer, a skill that proved essential for training staff in the lab in Battambang. After training the Cambodian lab staff to identify *S. aureus* on blood agar plates, she was hired by the Stanford University Hospital laboratories to do molecular microbiology.

In addition to training lab staff, DMDP volunteers also coach nurses and physicians on how to use findings from microbiology laboratories. Cambodian physicians are not accustomed to receiving instruction from laboratory staff or having a microbiology laboratory to rely on, so there is much to do.



I tried to convince a laboratory director that reporting anything other than "Beta-hemolytic Streptococcus, probable Group A Streptococcus" from a throat swab was inappropriate. The response was that doctors expect to know everything that is isolated from a specimen and want a long list of antibiotic susceptibility results for the isolates. One way to bridge this gap is through young physicians such as Phe Thong, an infectious diseases specialist, who is working as a liaison to improve communications between the microbiology laboratory and the clinical staff at the Sihanouk Hospital Center of Hope (SHCH) in Phnom Penh.

There are other exciting developments affecting diagnostic microbiology in Cambodia. Examples include volunteers from other programs and countries helping in these efforts, NAMRU 2 accepting clinical isolates for state-of-the-art identifications, the NIPH laboratory providing microbiology bench training for laboratory staff from provincial hospitals, provincial hospital laboratories isolating and identifying *B. pseudomallei* and *Streptococcus suis* from clinical specimens, and the recent convening of the national workshops on melioidosis and antibiotic susceptibility testing in Phnom Penh. Moreover, at the national level, the Ministry of Health established a Bureau of Medical Laboratory Services and adopted a strategic plan for such laboratories.

Nonetheless, for those providing diagnostic microbiology services in Cambodia, there are more challenges to meet. The Global Fund Round 10 proposal, which included support for four additional microbiology laboratories, was not funded. Salaries for laboratory staff in government hospitals are so low that the best TSMC graduates are hired by private laboratories, which are neither regulated nor inspected. The NIPH should be, but is not yet, providing quality-assured agar plates to provincial hospital microbiology laboratories. Hospital administrators must agree to consolidate laboratories to take advantage of the few technologists trained in microbiology. The recent outbreak of enterovirus 71 infections in Cambodia with an apparently high fatality rate emphasizes the need for a strong laboratory-based surveillance system, and the WHO is taking the lead to implement one.

Meanwhile, Somary continues to struggle with hospital administrators and MoH officials to obtain consumables and build her staff for the hospital lab in Kampong Cham. To her credit, that lab did all the diagnostic microbiology for the Singapore-based Regional Emerging Diseases Intervention (REDI) Centre, which conducted a study of soft-tissue infections in surgical patients at the Kampong Cham Provincial Hospital. The lab has made significant progress, despite the many challenges it faces. If readers are interested in connecting resources to DMDP or volunteering with DMDP in Cambodia and Haiti where DMDP is presently building capacity, contact me or Ellen Jo Baron. You can also see our



website at [www.dmdp.org](http://www.dmdp.org) and read our blog at [blog.dmdp.org](http://blog.dmdp.org).

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### **Suggested Reading**

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