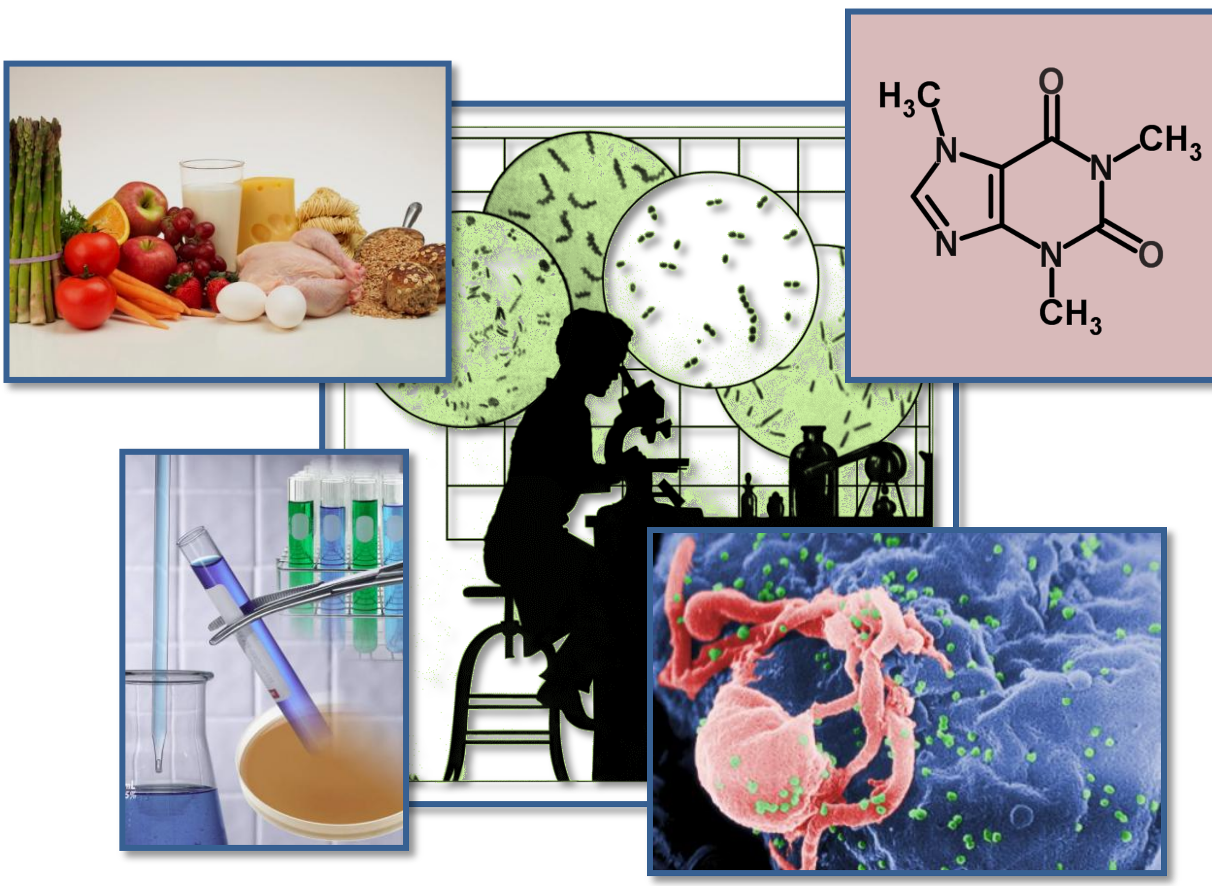
THE INS AND OUTS OF THE PUBLIC HEALTH LABORATORY



WHAT IS PUBLIC HEALTH?

According to C. E. A. Winslow (1877-1957), an American bacteriologist and public health expert, public health is the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations public and private, communities and individuals. The focus of public health lies in the protection against threats to and the improvement of the health of the population, which might be represented by as small as a handful of people within a community or could span the inhabitants of several continents. This is accomplished primarily through the education of the public, via the promotion of healthy lifestyles, or through research on prevention of disease and injury. There are myriad examples of public health intervention from the simple stop sign to the more complex surveillance of infectious diseases. Some other examples include the mandatory use of seatbelts, smoking bans, delivery of vaccinations, the distribution of condoms to control the spread of sexually transmitted diseases, improved sanitation, pest control, and the promotion of hand washing and breastfeeding.

> *"the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private communities and individuals" – C. E. A. Winslow, 1920*

Public Health awareness and intervention have been an on-going and growing process since the dawn of humankind, evident among the Neanderthals and early humans. The ancient Indus basin city states utilized drainage and toilets as early as 3000 BC, the Chinese used inhalation of dried scabs from individuals infected with smallpox as it afforded some immunity against the disease around 1000 BC, while the Romans realized that diversion of human waste away from the population at large limited the acquisition of diseases. The practice of removal of the dead during the plague epidemic, of quarantine, location of cemeteries etc., introduced 'social medicine' as a means to improve public health during the next millennium. The science of epidemiology, founded by the discovery of the source of a cholera outbreak in London in 1854, the discovery that microorganisms caused infections, the chlorination of water, the pasteurization of milk, and the development of vaccines and drugs against diseases like polio, small pox and tuberculosis heralded the modern era of public health.

SO, WHAT DOES THE PUBLIC HEALTH LABORATORY DO?

The Public Health Laboratory stands as the first line of defense to protect the community against diseases and other health hazards. Historically, the first public health laboratories in the US started as 'chemical laboratories', in the late 1800s, to test milk, water, and other substances. The first four of these laboratories were in Minnesota, New York, Massachusetts and Michigan. The first diagnostic laboratory in the US was established by Drs. Hermann M. Briggs and T. Mitchell Prudden when they isolated *Vibrio cholera*, the causative agent of cholera from ill passengers on a ship anchored in the New York City harbor in 1887. They next went on to isolate the causative agent of diphtheria from another outbreak. The initial role of Public health laboratories was to serve any of the perceived laboratory needs for the specific jurisdiction, including isolation and identification of disease causing agents. Over time, the Public Health Laboratory evolved into more structured entities with increased core functions. Currently, in the US there are 55 State and territorial Public health Laboratories, one for each state plus DC, Guam, American Samoa, Northern Marian Islands and Puerto Rico, along with numerous local PHLs. The PHLS are not all organized the same way with some being more centralized than others where all the different testing matrices fall under one roof or one agency. Some PHLs are specialized for specific matrices such as food or environment. The PHL has eleven core functions, some of them described below, with about a quarter of them related directly to testing.

Drs. Briggs and Prudden establish the first diagnostic laboratory in the U.S., in 1857, by identifying Vibrio cholera during a cholera outbreak.

TESTING, AD INFINITUM.

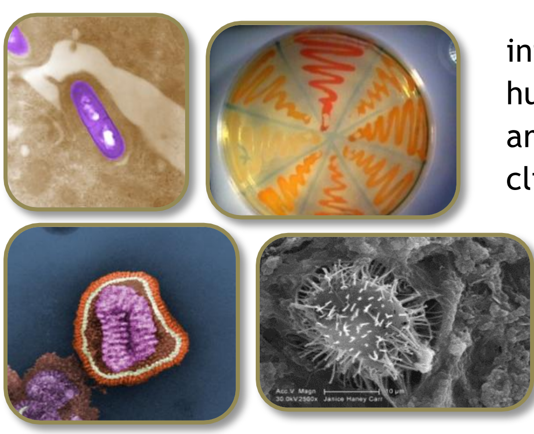
The primary role of a modern PHL comprises of the testing of various specimens and samples whether for outbreak investigations, population-based surveillance for diseases of public importance, routine diagnosis or the monitoring of low-incidence or newly-emergent diseases. Other aspects of testing conducted by PHLs are reference and specialized testing. Towards this role PHLs confirm atypical results from clinical laboratories, support the diagnosis and surveillance of unusual and emerging pathogens and for other diseases of public health importance, verify the results of other laboratories, act as a reference service for other laboratories that might not have the capacity to fully identify diseases of public health importance.

PHLs test a vast variety of samples from diverse sources. These include samples that are from humans, from animals, or from food, air, or water. The kinds of testing performed by the PHLs can be classified into biological, chemical or radiological, while the sample source might be human, animal, environmental, or food, for each classification.

BIOLOGICAL TESTING. When late breaking news informs the public of another influenza pandemic, of a particularly drug resistant strain of tuberculosis, or of contaminated cantaloupe, the information disseminated is mainly the result of the PHLs doing their job. Biological testing, in PHLs, involves the testing for agents of biological origin whether they are infectious organisms or human genetic screening. Infectious organisms are viruses, bacteria, fungi, or parasites that are capable of infecting and causing disease in humans, animals, or plants and include your everyday run-of the-mill agents, such as the virus that causes flu, as well as the more exotic infectious agents that cause diseases like dengue, malaria or schistosomiasis.

> *"Newborn screening is a public health intervention that involves a simple blood test used to identify many life-threatening genetic illnesses before any symptoms begin." - Lucille Roybal-Allard*

HUMAN. The screening of whole blood from newborns, which encompasses an entire panel of tests, is an important aspect of testing conducted by the PHLs. Infants are screened shortly after birth for a list of disorders that are treatable but are either difficult or impossible to detect clinically. These diseases, if left untreated, are usually extremely debilitating, cause severe damage and are oftentimes fatal. The disorders tested can vary from region to region depending on the funding available or the prevalence of a particular condition in the population. Examples of conditions that are screened for include endocrine disorders, inborn errors in fatty acid or amino acid metabolism, sickle cell anemia, and thalassemia.



The PHLs routinely test for a multitude of infectious agents that cause disease and death in humans, easily decimating populations. These tests are usually part of routine analysis from human clinical and autopsy samples such as blood, lung aspirates, feces, nasal swabs, sputum, tissue for routine analysis, but also for the screening and surveillance of drug resistant strains or during pandemic investigations such as during flu season. Examples of biological testing from human samples include testing for sexually transmitted diseases like HIV and syphilis, enteric pathogens like Salmonella and *E. coli*, anthrax, plague and tuberculosis.

ANIMAL. Most animals share the same spectrum of infectious disease that cause sickness in humans. Wild animals, such as rabbits, skunks, fox, bats, and birds, are natural reservoirs for these infectious agents (known as zoonotic diseases) that readily infect humans, domestic animals, and livestock that come in contact with them, causing widespread devastation. Hence, the PHLs must perform this important routine and surveillance testing of veterinary and necropsy specimens. Examples of diseases in animals, that could be transmitted to humans, include rabies, plague, tularemia, and anthrax. Insects such as mosquitos and fleas are also carriers of infectious disease causing agents, like West-Nile virus. The PHLs screen these insects for viruses and other infectious agents so that the location and spread of the agent can be easily ascertained.

FOOD. Warnings that caution consumers to properly cook raw meats and poultry to a desired temperature exist for a reason. Pathogenic bacteria such as *E.coli* and *Salmonella* exist everywhere, including in the soil. These bacteria are not only naturally occuring environmental contaminants of raw foods but are also unintentional contaminants, mostly due to improper hygeine, in both raw and processed or packaged foods. Undercooked seafood could potentially be contaminated by bacteria such as Vibrio or Aeromonas or viruses like Hepatitis A, while unpasteurized (raw) cheese or milk could have Listeria or Brucella as possible bacterial contaminants. Infections from contaminated food are probably one of the more common sources of illness from infectious agents that humans encounter. All these diseases can be life-threatening if left untreated and so routine and regulatory testing of food is a vital responsibility of the PHLs. The kinds of food tested by the PHLs is varied and might differ from lab to lab, and could include anything from milk, candy, pet food, fruits and vegetables, processed food like tv dinners, canned food, or uncooked meats and seafood.

ENVIRONMENT. Ensuring the potability of tap, surface and ground water is perhaps one of the most important facets of the biological testing of an environmental sample. Such water samples are routinely tested to guarantee that the level of microorganisms remains within the acceptable limits. The PHLs also have the capabilty of testing other types of environmental samples as and when needed or during a suspected outbreak investigation. These might include anything from shower stalls, furniture, water from swimming pools and hot tubs, vacuum cleaner bags, or equipment. The kinds of pathogenic agents that could be identified from such environments include Pseudomonas, Legionella, and Norovirus.

From the case files

HUMAN OR ANIMAL

2008 – *Chronobacter sakazakii* identified from a deceased infant from samples submitted by the medical examiner's office.

2009 – *Mycobacterium avium* complex identified from two spa workers.

2009 – *Yersinia pestis*, the bacterium that causes plague, was identified from autopsy samples from a boy that was treated for strep throat. His sibling, who was also sick, was successfully treated for plague.

2010 – Rabies virus was detected from the brain tissue of a horse and a bobcat in New Mexico.

2010 – *Cryptococcus gattii* identified from a deceased person from samples submitted by the medical examiner's office.

2011 – Two morphologically distinct, multi-drug resistant strains of *Mycobacterium tuberculosis*, the bacterium that causes tuberculosis, were identified from the trunk washings of an elephant at a zoo.

2011 – *Cryptococcus gattii* identified from a culture of samples from a cat's nose.

FOOD

2002 – *Salmonella* Newport isolated in smoked meats from an eatery

2008 - *Listeria monocytogenes* isolated from Mexican soft cheese

2010 – *E. coli* O157:H7 detected from unpasteurized cheese

2011 - *Listeria monocytogenes* isolated from cantaloupes

ENVIRONMENT

2007 - *Pseudomonas aeruginosa* isolated from a swab of a cytoscope at a urology clinic.

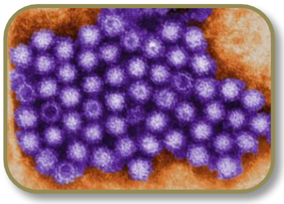
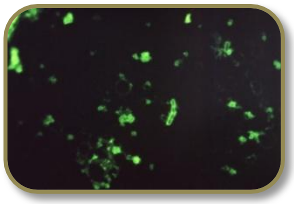
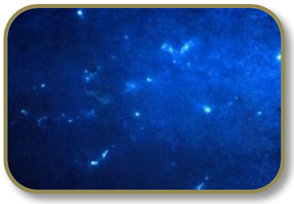
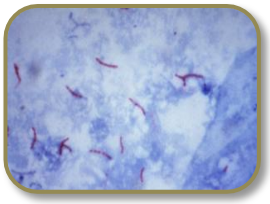
2008 – *Chronobacter sakazakii* isolated from powdered infant formula.

2009 – *Salmonella* isolated from gravel, water, and filters from a household African dwarf frog aquarium.

2010 – Legionella, a respiratory pathogen, isolated from a hotel spa.

2010 – Norovirus, an enteric pathogen that causes severe diarrhea, identified from a prison shower stall.

2010 – Pseudomonas aeruginosa isolated from sinks, drains, faucet aerators from a Neonatal Intensive Care Unit.

NOROVIRUS: Noroviruses are a group of RNA viruses that cause "stomach flu" or gastroenteritis. It is estimated that around 90% of non-bacterial epidemics around the world and 50% of foodborne outbreaks of gastroenteritis in the U.S. are caused by noroviruses. These viruses are typically transmitted by fecal contamination of food or water, by person-to-person contact, or via aerozolization and subsequent contamination of surfaces.

TUBERCULOSIS: Tuberculosis is a serious human respiratory disease that affects millions worldwide especially due to the emergence of multi-drug and extremely-drug resistant strains of the bacterium, *Mycobacterium tuberculosis*. Besides humans, the bacterium can infect animals, such as elephants and badgers. Tuberculosis is pretty widespread in the US with 11,182 new cases of TB reported in 2010, and is usually fatal if left untreated.

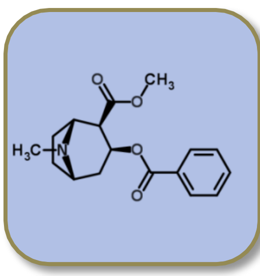
RABIES: Rabies is caused by the Rabies virus and is usually transmitted by a bite from an infected animal. There is no treatment for rabies and it is fatal unless prophylactic vaccination is administered immediately. Lab workers are vaccinated against rabies and their immune status routinely monitored. In the 1990s the number of human cases dropped to 2-3 per year from over 100 a year in the previous century. In 2010, the total number of reported human cases was two, while the total number of reported animal cases was 6,153. Rabies can infect horses, skunks, fox, bats, cats, dogs, and bears among others.

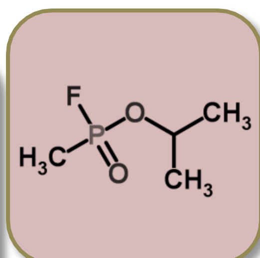
PLAGUE: *Yersinia pestis*, the bacterium that causes plague, is endemic among the rodent population in the Southwest and Western regions of the U.S. It can be transmitted through the bites of ticks and fleas, through contact with animals that died of plague or via aerosol through inhaling secretions of sick animals or humans. Infection with the plague bacteria causes one or more of three forms of plage; bubonic, septicemic and pulmonary. Plague has an extremely high mortality rate if untreated with appropriate antibiotics and is often difficult to diagnose. As a result of this and the fact that it is highly infective if aerosolized, the plague bacterium is considered a bioterrorism agent and is on the federal select agent list. In 2010, two human cases were reported in the U.S., while in 2006 seventeen human cases were reported.

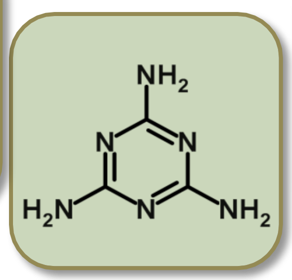
CHEMICAL TESTING. Routine regulatory and emergency testing of samples from food, air, water, or humans for toxic chemical contaminants is another important repertoire of the testing conducted by the PHLs. These contaminants could be anything from heavy metals, organic compounds, narcotics, hydrocarbons, or any other harmful substance.

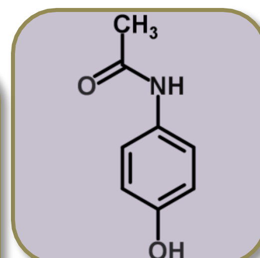
- *There have been five exposures to mustard gas in the U.S. since World War I.*
- *In 2009, 32% of all traffic deaths in the U.S. was a result of alcohol.*

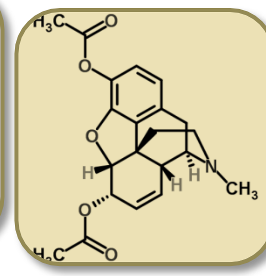
HUMAN. Toxicology is a branch of chemical testing that deals with the presence and identification of harmful chemicals in living organisms. When a person is pulled over for drunk driving a sample of his blood collected goes to the PHL to be tested for blood alcohol levels. Blood alcohol determination is just one of the chemical tests, for toxic chemicals, performed by the PHLs on humans. Specimens, like blood or urine, are routinely tested from corpses (for cause of death determination) or from the living. Examples of tests include detection of heavy metals, such as lead or arsenic, chemical weapons, such as nerve agents, and narcotics such as cocaine or methamphetamine.





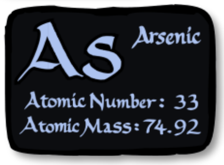






FOOD. Harmful chemicals that are accidental or intentional contaminants of raw or processed foods can cause serious health problems or even loss of life. As an example, fish from a stream might get contaminated with mercury from a runoff and upon consumption of the contaminated fish the consumer would develop symptoms of mercury poisoning. The PHLs routinely monitor food when a chemical contaminant is suspected or just to ensure that levels of certain chemicals are within an acceptable threshold. Some examples of such testing includes the melamine that was detected in pet foods and infant formula, testing for the presence of ephedra in dietary supplements, nutritional analysis to determine carbohydrate, salt or lipid composition, and monitoring of bakery products for filth and rodent contamination.

ENVIRONMENT. The monitoring of air, soil and water is another area of chemical testing carried out by the PHLs. Most water, including drinking, ground and surface water is tested for the presence of various chemical contaminates. These tests could include anything from heavy metals like arsenic, lead and mercury, pesticides, volatile organics, petroleum, or salts such as nitrites, fluorides and cyanides. Air quality is checked routinely, and during emergencies, for the presence of particulate matter or other chemical contaminants. Soil, sludge, or sediments can also be tested for contaminants such as heavy metals.



From the case files

HUMAN

2006- Urinary levels of arsenic were measured in the population of a small town in NM to investigate their claims of arsenic poisoning through the local water source (they were not being poisoned).

2010 – Mustard gas detected in blood and urine from a fisherman who dredged up munitions shells tainted with the compound.

FOOD

2003 – Histamine detected in Blue Marlin when twenty-three cast and crew members of a film group contracted food poisoning.

2007 – Melamine detected in pet food.

ENVIRONMENT

2010 – Mercury detected in face cream imported from Mexico

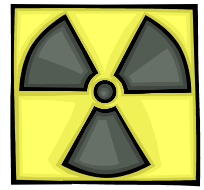
2010 – Lead detected from well water in a county community

ARSENIC: A naturally occuring element, arsenic is toxic and even lethal in varying doses to most life forms, including humans. Arsenic has various applications such as wood preservative, making alloys, in rat poison, as a chemical weapon and could be a contaminant in drinking water. The effects are cumulative and the symptoms of arsenic poisoning include headaches, confusion, severe diarrhea, and drowsiness. When the poisoning is acute symptoms become more severe and include vomiting, blood in urine, organ failure, coma and death.

SARIN: An organophosphorous compound, Sarin is a colorless, odorless liquid used as a chemical weapon. It's mechanism of action closely resembles that of common insecticides. Sarin's high volatility is similar to some nerve agents and, depending on the dosage, can be lethal if inhaled, absorbed through the skin, or ingested. It is 500 times more toxic than cyanide. Initial symptoms include a runny nose, a tightness of the chest and constriction of the pupils followed by difficulty in breathing, nausea and drooling. Eventually the victim loses control of his bodily functions and starts vomiting, urinating and defecating which is followed by twitching and jerking. Ultimately the victim becomes comatose and suffocates in a series of spasms.

MERCURY: A rare, naturally occuring element, mercury has many applications in the clinical setting and in lighting. Due to its high toxicity, however, some of these applications such as mercury thermometers have been replaced with safer options. Mercury can be inhaled or absorbed through the mucous membranes where it can cause either chronic or acute poisoning. Symptoms of mercury poisoning range from tremors, reduced cognitive skills, impairment of lung function to psychotic reactions that are characterized by delirium, hallucinations, and suicidal tendencies.

RADIOLOGICAL TESTING. Every day of our lives we are exposed to radiation; from the sun, from microwaves, from radon and naturally occurring radioactive elements, or from medical procedures. There is a threshold of radiation that the human body can withstand, beyond which the consequences can be disastrous. Radiation sickness is associated with acute exposure while chronic exposure is associated with cancers and premature aging. The PHLs test food and the environment, including water, air, and soil, for the presence of radioactive elements that might have been released either intentionally or accidentally from naturally occurring sources or from man-made facilities that carry large quantities of radioactivity, such as nuclear power plants. For example, the aftermath of the tsunami and destabilization of the Japanese nuclear plant encouraged the PHLs in the U.S. to screen air and milk for the presence of radioactive elements in order to ensure that the radiation had not traversed the ocean.



From the case files

HUMAN

2008 - Urinary levels of depleted uranium (used in munitions to increase their penetrating power) was measured in Gulf War veterans in NM to assess their exposure.

ENVIRONMENT

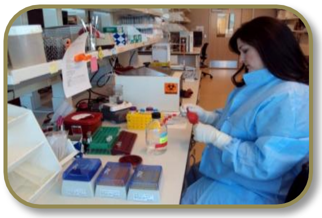
1986 – Polonium-210 detected in diesel fuel.

1998 – Sc-46 and Sb-124 was discovered in oil field sand disposal drums.

URANIUM: A naturally ocurring, silvery-white metal, uranium is radioactive and exists as sixteen different isotopes. All the isotopes decay releasing energy while some of these isotopes can be bombarded to release great amounts nuclear energy that forms the basis of nuclear reactors and weapons.

METHODOLOGIES AND EQUIPMENT. Laboratory testing is both an art and a science that requires the laboratory analysts to undergo rigorous training above and beyond their already specialized degrees. This is essential for them to handle the complex methods and instrumentation that is part of everyday testing. Laboratory analysts typically have at least a Bachelor's degree in the sciences or in medical technology, although several have a Master's or a Ph.D. in various specialties of chemistry or biology.

The methodologies used for testing by the PHLs are varied not only for a particular test but also from laboratory to laboratory. These might include archetypal detail-oriented techniques such as culturing, biochemical, chemical or immunological analysis, and chromatography, or more modern molecular ones such as nucleotide amplification or hybridization, sequencing and molecular fingerprinting. Such techniques require an assortment of equipment and instruments, some state-of-the art low-, medium-, or high-throughput, while others that are more mundane.

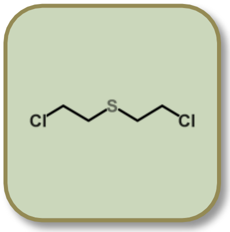


Examples of such equipment include spectrophotometers, incubators, liquid and gas chromatographers, tissue digesters, scintillation counters, plate pourers, autoclaves, nucleotide extractors and thermocyclers.

Due to the hazardous nature of the chemical and biological agents that laboratory analysts come in contact with, many rooms in a PHL might have a negative pressure and safety cabinets or fume hoods to protect personnel and the environment from exposure to these agents. Also, most PHLs have a Biosafety Level-3 facility in order to safely work with highly infectious biological agents. All such facilities are engineered for minimal exposure and laboratory analysts that work in there are required to wear proper personal protective equipment including respirators.

PUBLIC HEALTH EMERGENCY PREPAREDNESS AND RESPONSE.

An emergency could cover anything from a SARS or influenza pandemic, natural disasters like hurricanes, forest fires near sources rich in radioactivity, to the anthrax attacks or any other form of biological or chemical terrorism. Emergencies could be local, national or global and since most emergencies directly or indirectly affect the health of the public, the role of the PHL in preparedness and response remains vital. A major chunk of this involves not only the rapid triaging and testing of samples but also includes planning for and ensuring that surge capacity, with respect to staff and instrumentation, is available during a public health emergency. The PHLs must also have a continuity of operations plan in the event of a disruption of laboratory services due to emergencies that directly affect the PHL.



In 2011, a plot to spread the toxin Ricin across major cities in the U.S., was thwarted.

Examples of such emergencies include an earthquake or a flood that causes structural damage to the laboratory or an epidemic which results in staff shortage. One of the more common non-epidemic related type of emergency testing done at the PHLs, probably as a direct consequence of the 2011 anthrax attacks, involves testing of mysterious powders in envelopes. These are tested for biological and chemical agents and toxins such as ricin, nerve agents, anthrax or botulinum within negatively pressurized glove boxes and biosafety cabinets. During an emergency the PHLs coordinate with local, state and federal emergency responders depending on the magnitude of the emergency. In most PHLs, there exist personnel who are trained in Hazardous Materials Response and are part of their institutional Emergency Response Team capable of dealing with minute localized emergencies.

From the case files

It was just another balmy day on October 27th, 2010, in Albuquerque, New Mexico. The APD, having obtained a search warrant for a handgun, entered the suspect's residence. There, they located the hand gun but also stumbled upon numerous chemicals, some precursors to methamphetamine, anarchist literature, and biological equipment. The response personnel consisted of several teams including the bomb squad, the meth team, the Civil Support Team, and the FBI. Further examination of the biological equipment identified fermenters, a refrigerator with a biohazard symbol, and an incubator with flasks in it. The suspect, an ex-employee of a private clinical laboratory, confessed that he often brought his 'work' home, but denied growing any agents or toxins. Based on the suspect's employment history and the paraphernalia found, the situation was considered a credible threat by the authorities in charge and as soon as the residence was deemed safe from explosives and other hazardous chemicals, swabs from the incubator and refrigerator were transferred, for testing, to the New Mexico State Public Health Laboratory. Fortunately, all tests conducted were negative for certain pathogenic bio threat microorganisms.

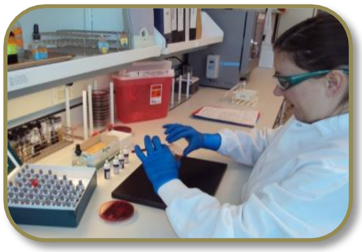
SULFUR MUSTARD: A thick liquid, sulfur mustard was made for use as a chemical weapon and is not found naturally in the environment. It is more commonly known as mustard gas. It enters the body rapidly if it contacts skin or eyes, or upon inhaling vapors. Depending on the concentration, sulfur mustard can cause the eyelids to swell, the skin to burn and blister, coughing, bronchitis and long-term respiratory illness if inhaled, and eventually cancer. Exposures to large amounts of sulfur mustard is lethal, and hence is classified as a chemical threat agent by federal agencies.

BOTULINUM TOXIN: Botulinum is a neurotoxin produced by the bacterium *Clostridium botulinum*. There are seven different forms of this protein toxin although only some cause disease in humans, and it is the most powerful neurotoxin discovered. Four kilograms of toxin, if evenly distributed could kill the entire human population of the world. The toxin can be absorbed through the eyes, mucus membranes, respiratory tract or non-intact skin but the most common cause is ingestion of foods contaminated with the bacteria that have produced the toxin, such as improperly canned or pasteurized foods. The toxin is used in cosmetic applications (Botox). Botulism, the disease caused by the toxin, is lethal in high doses or if left untreated and is characterized by flaccid paralysis. Botulinum toxin is considered a biothreat agent by federal agencies.

RICIN: Ricin is a toxin that is naturally found in castor beans. Accidental exposure to ricin is unlikely unless one ingests castor beans, so the deliberate production and dissemination of the protein toxin is a more likely way for people to be poisoned. Depending on the dosage, ricin can be lethal and symptoms depend on the route of exposure which could be via ingestion, inhalation, or eye and skin exposure. The symptoms range from fever, nausea, diarrhea, vomiting, tightness of chest, hallucinations and seizures. Death occurs 36 to 72 hrs after exposure depending on the route and the dose. Ricin is considered a biothreat agent by federal agencies.

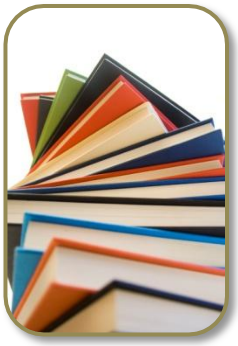
RESEARCH.

Another important facet of life in the PHL is engaging in research that improves and expands the scientific and policy basis of public health laboratory practice and assures their optimal application in support of the public health system. This involves the development, evaluation, and implementation of new methodologies and technologies, partnering and collaborating with other public health disciplines, academic institutions, or the private sector to foster scientific innovation and clinical or translational research. Such investigations and explorations aid in expanding the scope of testing capabilities of the PHL by creating novel ways to rapidly detect existing or emerging hazards. These might include the development of more sensitive assays or creating methodologies for certain agents where none existed before. Examples of such research include the development of "homebrews" for the detection of the bacterium that causes pertussis, or modified assays for the detection of norovirus or Salmonella.



TRAINING AND EDUCATION.

In order to remain proficient, laboratory analysts must undergo rigorous training



to improve their scientific and technical skills. Analysts who are sponsored get this training in-house or through the attendance of conference and workshops as and when funding is available. Besides training laboratory analysts, PHLs also facilitate access to training and education by supporting management and leadership development opportunities, by providing continuing education in the area of laboratory practice or by partnering with academic institutions. PHLs train the local community on health-related or testing issues such as safe transport, proper handling and submission of samples, or on emergency preparedness related activities. PHLs have designated training coordinators who go out in the field to train local and state health offices and clinics on the various aspects of sample handling, collection, or testing. A vast majority of PHLs also participate in the global health initiative and lend a hand in the training of international PHLs on different portions of the testing process.

WHAT ARE THE OTHER COMPONENTS OF A PUBLIC HEALTH LABORATORY?

While the heart and soul of the PHL might consist of a bunch of nerdy or geeky laboratory analysts scurrying along with their pipettors and lab coats, the meat and bones of the PHL are the silent few working assiduously in the backdrop ensuring that our core functions are attained. These include administrators such as directors or bureau chiefs, maintenance people, fiscal managers, specimen receiving, safety and security officers, and IT folks. Below is a bit more information on some of these activities.

SPECIMEN RECEIVING. All samples that enter a PHL are first brought into the Specimen Receiving area. Here each sample is accessioned and given a unique identifier number and all relevant information inputed into a computer database, before it heads on to the relevant sections where testing occurs.

FISCAL. Money makes the world turn around or so they say, but it unquestionably makes the PHL spin, allowing it to accomplish what it needs to. The folk, in this section, are generally in charge of managing and allocating budgets from various sources, ordering supplies and equipment, arranging for travel approvals and managing reimbursements.

INFORMATION TECHNOLOGY. Computers play an significant role in the PHL, whether merely for sending email or accessing the internet, for networking or for creating complicated databases that store laboratory information. Most PHLs have some sort of complex electronic laboratory information management system that allows information on samples received to be stored, and results to be reported out to the clients of the PHLs or to be delivered electronically to various state and federal agencies. The computer 'geeks' at the PHLs are responsible for maintaining, creating, and securing these complex network systems and for keeping them 'bug-free'.

DO THE PUBLIC HEALTH LABORATORIES WORK ALONE?

Although the PHLs perform an invaluable service by being on the front lines of defense against public health hazards, they are by no means the sole torchbearers. Daily, the PHLs must cooperate and communicate with other agencies and organizations. These might include local, state or federal health agencies, environmental agencies, departments of agriculture, or law enforcement agencies. Examples of federal agencies that PHLs might interact with include the Centers for Disease Control and Prevention, the USDA, the FBI, the Food and Drug Administration (FDA), and the Department of Homeland Security. At the state or local level the PHLs might interact with epidemiologists, city drinking water bureaus, police officers, food safety officers and regulators, and environmental, health, and agricultural state departments. This cooperation and communication is essential so that the information from the results obtained by the PHLs can be utilized out in the field in preventing endemics and disasters. Some of the federal agencies that PHLs interact with also serve in a regulatory capacity ensuring that the quality of work conducted by the PHLs exceeds standardized acceptable limits.

WHY WE DO WHAT WE DO.

"My mission in life is to be of service to others. Working in Public Health provides me the opportunity to be of service, with the additional benefits of an intellectually stimulating job *and* a paycheck!"

Christine McClelland, Microbiologist, Molecular Biology, NM Scientific Laboratory Division

I love working in public health because my job is continually changing. Old microorganisms re-emerge, variant strains are identified and previously unrecognized microorganisms require new methods of detection and identification. The CDC is continually developing and validating testing assays for use in the state public health labs, so every season brings us new methods, updated procedures and even changes in instrumentation. My work is stimulating, challenging and it contributes to the good health of citizens in New Hampshire!

Carol Loring, Microbiologist II, Virology/STD Lab SupervisorNH PHL

"I happened to fall into my job by pure luck. I had never heard of 'Food Safety' or understood what 'Public Health' was when I applied to be a Biological Scientist at the FL Dept. of Agriculture and Consumer Services in 2002. I also didn't know what an impact my job would have as it relates to protecting the residents (and tourists) of the great State of Florida. But I'm grateful to have had the opportunity over the last 10 years to learn and understand the necessity of jobs like mine and I've been happy to contribute just a small part in a huge effort to keep the public safe and healthy."

Lyndsey Caulkins, Biological Scientist III, FL Department of Agriculture and Consumer Services

"Working in the Public Health Laboratory has provided me a unique opportunity to apply my skills as a molecular biologist to the implementation of new tests to identify and monitor infectious diseases of public health significance, such as Influenza, Pertussis and foodborne illnesses."

Robert C. Ireland, Ph.D., Chief Clinical Lab Scientist, RI State Health Lab

"Public health is important. It's so much behind-the-scenes work and it's not always appreciated, but it is critical to all people. It's also fun to see all the interesting cases that find their way to us!"

Celina Phelps, Microbiologist, Molecular Biology, NM Scientific Laboratory Division

"I love my job. I encounter such a dynamic range of problems and projects during my week, there is never a dull moment. Working in public health is a fulfilling, engaging, and titillating career, one which constantly keeps me and my colleagues on our collective toes."

Karen Stephani, Quality Assurance Manager, NY State Department of Agriculture and Markets Food Lab