STATE HEALTH LABORATORIES
ANNUAL REPORT 2014

Nicole Alexander-Scott, MD, MPH
Director Designee

Ewa King, PhD
Associate Director of Health

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Message from the Director Designee

Dear Colleague:

Your State Health Laboratories are an important part of the Department of Health. Every day, they perform essential services that help to protect the health and safety of all Rhode Islanders. The Laboratories help to investigate the spread of a variety of diseases such as HIV, tuberculosis, and influenza; identify causes of foodborne illnesses such as salmonella; monitor our environment by testing our air and drinking water; help law enforcement with crime investigations and impaired driving determinations; and test autopsy specimens to help determine causes of death. The Laboratories also have the ability to test for less-likely threats such as anthrax and other bioterrorist and chemical terrorism agents. Their work supports not only almost every program of the Department of Health, but also many other state and federal agencies.

This report highlights some of the Laboratories' success stories from 2014, such as Ebola preparedness, the response to the Listeria outbreak that caused three deaths, the implementation of an air-quality monitoring station near I-95, the laboratory response to Rhode Island's drug-overdose epidemic, and special public water supply source water testing.

I invite you to learn more about the exceptional work of our State Health Laboratories, the high-technology equipment that is in use every day, and the qualified professionals who work diligently for the benefit of all Rhode Islanders.

Sincerely,

Nicole Alexander-Scott, MD, MPH
Director Designee

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Executive Summary

State Health Laboratories (SHL) provide laboratory services and scientific expertise in support of state and federal public health, environmental and public safety programs. This annual report provides an overview of SHL's programs and summarizes the accomplishments and challenges of 2014.

The SHL serves a unique and changing role in the delivery of the public health system services. Timely and accurate laboratory data help solve outbreak investigations, monitor the spread of disease, and guide treatment. The programs provide specialized reference testing for hospital laboratories and are the first line of defense in the detection of biological and chemical terrorism. In cooperation with Rhode Island's community health centers, it also provides selected lab services to the uninsured and indigent populations in the state.

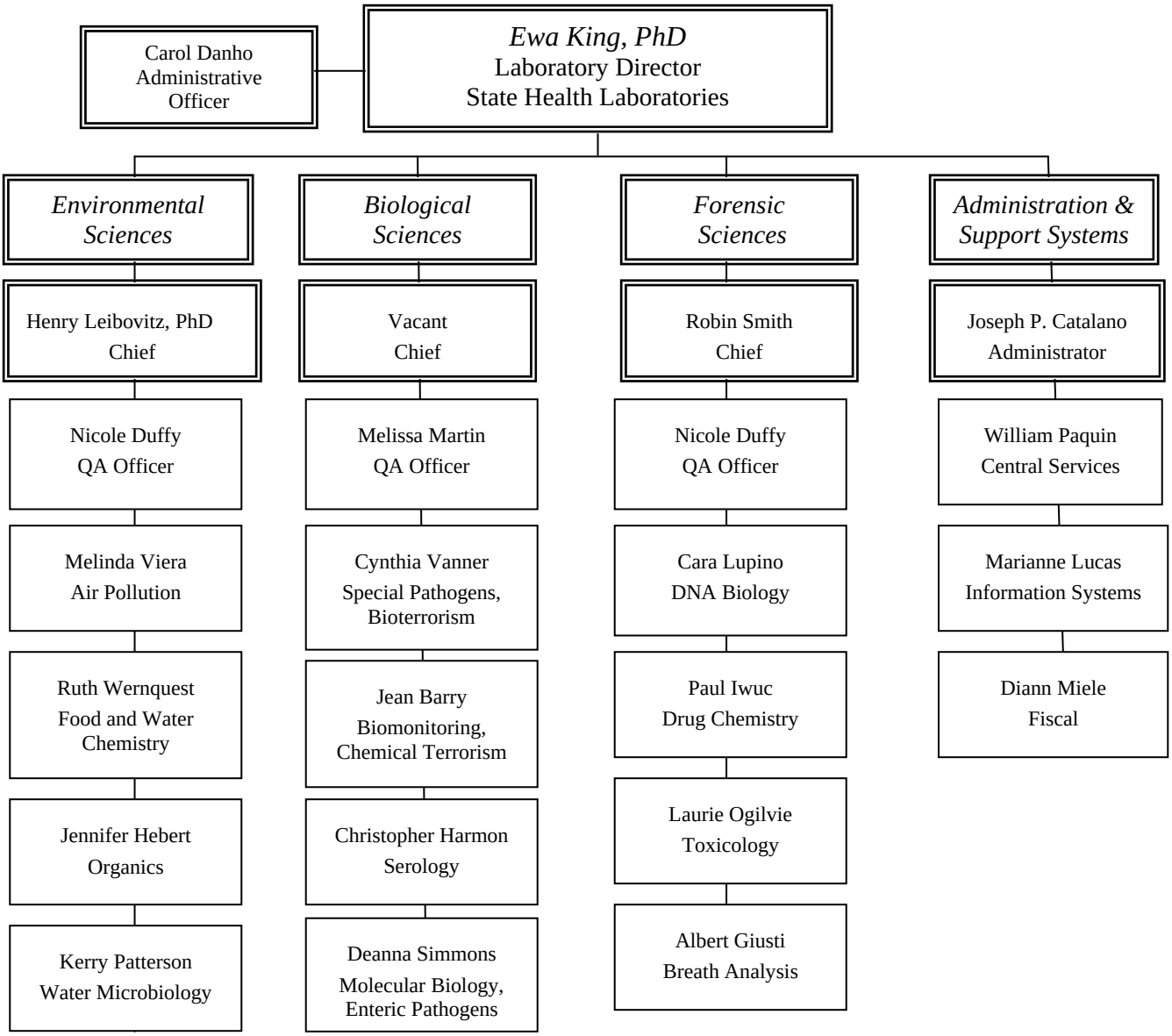
The SHL helps mitigate the effects of environmental pollution on the health of populations and individuals. In cooperation with HEALTH's Office of Drinking Water Quality, the SHL helps assure safe drinking water by providing water quality and safety tests to the public water systems and private well owners. It partners with the Rhode Island Department of Environmental Management to operate a statewide network of air-monitoring stations and performs thousands of water quality tests. It also performs lead screening tests for thousands of Rhode Island children to help identify children who may be suffering from lead poisoning and who may need specialized follow-up care.

The SHL operates and maintains sophisticated forensic laboratories to support the needs of state and municipal police departments who are attempting to solve criminal cases, for the Office of State Medical Examiners. Forensic laboratories aid in the determination of cause of death investigations, identify confiscated illegal drugs, and test crime-scene evidence for the presence of DNA that can be used to identify perpetrators.

In 2014, the SHL continued to provide a full array of testing services while improving the efficiency of operations. Pending test results and turnaround times are monitored and reported monthly. In addition, the SHL continues to implement the LEAN Six Sigma management approach by consolidating inventory and purchasing and by streamlining laboratory operations.

State Health Laboratories Organization

The SHL is organized into three sections: biological sciences, environmental sciences, and forensic sciences. Laboratories in each section, with their own distinct roles, are supported by staff in the administration and support section. Section chiefs and the laboratory administrator report to the Laboratory Director, and the Laboratory Director is responsible for the overall management and leadership of all Laboratory programs. At the end of 2014, the State Lab had 74 employees. The State Lab employs four scientists at the Doctoral (PhD) level, 26 with a master's degree, 32 with a bachelor's degree, three with an associate's degree, and nine administrative and support staff.



Administration and Support Systems

The Administration and Support section provides the overall leadership and management, and maintains the budgetary, personnel, purchasing, billing, information technology, and clerical support functions for the SHL. Additional support functions specific to laboratory operations are provided by Laboratory Central Services. These functions include shipping and receiving, hazardous and medical waste storage and disposal, and glassware washing.

The Fiscal Year 2015 budget for all laboratory programs is $10.5 million. Approximately $6.5 million of the budget is supported by state funding, and $4 million is supported by federal funding from the Centers for Disease Control and Prevention (CDC), the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the US Department of Justice (DOJ). In addition to grants received directly by the SHL, many HEALTH programs designate funding to supporting laboratory personnel or supplies. These partner programs include the HEALTH's Office of Drinking Water Quality, Office of Food Protection, the Office of HIV and Sexually Transmitted Diseases (STDs) and the Center for Emergency Preparedness and Response (CEPR). DEM and DOT also allocate a portion of their federal funding to support state laboratory programs.

Since 2012, expenditures of state funds remained relatively unchanged despite the impact of increasing salaries and supply costs.

Approximately two-thirds of the budget is dedicated to personnel. The remaining funds are allocated for testing supplies and reagents, equipment maintenance and repairs, proficiency testing, and accreditation costs.

Laboratory Expenditures (fiscal years 2012-2015)

Funding Source	***2012***	***2013***	***2014***	***2015****
State Funds	$6,011,211	$6,300,363	$6,199,240	$6,491,555
Federal Funds	$2,997,833	$3,475,428	$4,068,701	$3,987,345
Totals	**$9,009,044**	**$9,775,791**	**$10,267,941**	**$10,478,900**

Note: * Figures for 2015 are based on FY15 State Budget Office projections.

Laboratory Customer Satisfaction Survey

The SHL is committed to meeting the needs of its partner programs, and uses customer satisfaction indicators as a performance measure. In addition to customer satisfaction, the SHL also measures a variety of specific process measures like critical-test turnaround time and proficiency-testing results. The customer satisfaction survey consists of several questions assessing customer satisfaction related to various aspects of laboratory services.

- Quality and reliability of results
- Test-turnaround times
- Scope of services
- Notification about urgent test results
- Response to customer concerns
- Clarity and usefulness of lab reports

The 2014 customer satisfaction survey solicited responses from external customers and internal customers. Respondents to the 2014 survey included other HEALTH programs, DEM, hospital and commercial laboratories, community health centers, and state and local police departments. A total of 67 responses were received, a slight decrease compared to the number of respondents to the 2013 survey (75). Overall, 95.2% of respondents rated laboratory services as exceeding or meeting expectations.

The State Health Laboratories will continue to administer and analyze the results of the annual satisfaction survey. The survey has become an excellent tool to gauge overall performance and pinpoint areas where improvements are necessary. Individual laboratory results and customer comments are conveyed to managers and supervisors for quality improvement.

Feasibility Study

Beginning in April 2013, a planning team, comprised of HEALTH and Department of Administration (DOA) Capitol Projects staff, started working with DiGiorgio Associates, Inc. of Boston and Crime Lab Design of St. Louis on a feasibility study meant to analyze and compare building development options for providing a new, state-of-the-art facility to house the SHL and the Office of State Medical Examiners. The year-long project examined program needs and focused on the functional aspects of modern laboratory and medical examiner operations in the 21st century, as well as the unique needs of the Health Laboratories and Medical Examiner's Office.

During the initial phases of the study, program space needs were determined and projections for future growth were included. Schematic layouts were created, reviewed, and revised to ensure proper work-flow and appropriate adjacencies among programs. Mechanical systems and utilities were examined in an effort to achieve optimal usage, energy efficiency, and achievement of LEED (Leadership in Energy & Environmental Design) Silver Level standards and/or certification.

Upon completion of the study, it was the consensus and recommendation of the planning team and the State Budget Office that state-owned land at the Pastore Complex in Cranston would be best utilized for the construction of a new SHL and Medical Examiner facility. At this time, the Budget Office has recommended that voter approval for funding for this project be placed on the November 2016 ballot.

Biological Sciences Laboratories

The primary mission of the Biological Sciences Laboratories is to provide essential laboratory support to public health programs concerned with the early detection, surveillance, and containment of infectious diseases in the state. Through the rapid detection of infectious disease outbreaks, preventive measures can be taken to reduce the risk of disease transmission and mitigate adverse health effects. The section maintains the capacity to rapidly identify emergent infectious diseases such as novel strains of influenza, HIV, or tuberculosis. The Biological Sciences Laboratories have worked closely with CDC laboratories to incorporate sophisticated molecular tests to identify microbial agents and toxins of bioterrorism. Microbiological testing is also performed to assess the safety of the state's food supply. The Biological Sciences Laboratories also include the Biomonitoring Laboratory, which follows CDC procedures to test human specimens for the presence of environmental toxic substances such as lead or mercury and obtain a more accurate assessment of population exposure to environmental chemicals.

Bioterrorism Response and Special Pathogens Laboratory

The Bioterrorism Response and Special Pathogens Laboratory continues to prepare clinical microbiology laboratories throughout the state to respond rapidly to a large-infectious disease outbreak. The Bioterrorism Response program is prepared to test clinical specimens and analyze suspicious environmental powders and other evidence for potential agents of bioterrorism.

Clinical specimens and isolates submitted by area hospital laboratories are tested for pathogens of public health significance and this laboratory also serves as a reference laboratory to assist in identifying bacterial isolates that are not able to be identified by hospital laboratories. During 2014, the laboratory analyzed 1,455 specimens for *M. tuberculosis*, the causative agent of tuberculosis and also received 128 *Mycobacteria species* isolates from hospital laboratories for identification.

The Special Pathogens Laboratory tested 1,138 specimens for *B. pertussis*, the causative agent of pertussis (whooping cough). In addition, clinical laboratories throughout the state and the OSME submitted 238 primary specimens and 93 bacterial isolates that required testing, confirmation, or shipment to the CDC. Of this total submitted, 58 specimens were sent to CDC to be tested for Enterovirus D68, and 51 blood smears were examined for the presence of blood parasites.

2014 Success Story: Laboratory Ebola Preparedness

Beginning in the summer of 2014, the Bioterrorism Response and Special Pathogens Laboratory began preparing for the possibility of handling and testing of specimens from patients under investigation for Ebola Virus Disease (EVD) and assisted the hospital laboratories with their preparedness efforts. Hospital laboratories were sent regularly-updated guidance from CDC, supplied with appropriate packaging and shipping supplies, and advised on safe handling of specimens from suspect EVD patients. Training workshops were conducted so hospital laboratorians could refresh their knowledge and practice properly packaging Category A infectious specimens in compliance with federal transport regulations. Laboratory staff also served as the laboratory evaluators for hospital stress test exercises conducted by HEALTH and provided feedback to hospital labs on how to address any gaps that were identified during the exercise.

Clinical Laboratory Scientist Nancy Benoit prepares a Category A substance for shipment to the Centers for Disease Control and Prevention in Atlanta. Any specimens or infectious agents that are packaged and shipped must meet strict federal regulations.

Molecular Diagnostics and Enteric Pathogens Laboratory

The Molecular Diagnostics and Enteric Pathogens Laboratory provides rapid testing of clinical specimens for pertussis, norovirus, and influenza. This laboratory receives and characterizes microbial isolates potentially associated with local or national foodborne outbreaks and continues to participate in national and international foodborne disease surveillance programs. In 2014, the lab tested 158 specimens for norovirus**.** The majority of specimens that were tested for norovirus came from long-term care facilities or from schools as part of investigations of outbreaks of gastrointestinal illness. The lab also performed 1,112 molecular tests for pertussis.

In 2014, the lab completed 650 tests for influenza – almost twice the number of tests completed in 2013. The laboratory continued the use of an FDA-approved molecular method for identifying Influenza A and B, as well as various subtypes of Influenza A. In 2014, the laboratory implemented a test that further characterized Influenza B viruses by identifying them as “lineage Victoria” or “lineage Yamagata”.

The Enteric Pathogens section completed screenings on 22 specimens (mostly associated with outbreak investigations), and received 431 microbial isolates for confirmatory testing in 2014. Microbial isolates are sent from hospital and other clinical laboratories for definitive identification of the following pathogens: Salmonella, Shigella, Campylobacter, Yersinia Enterolytica, Vibrio, Aeromonas, Plesiomonas and E.Coli O157:H7.

The Molecular Diagnostics Laboratory continued testing food samples for microbial contamination as part of foodborne disease-outbreak investigations with continued support from an FDA grant. These tests support food-safety investigations of HEALTH’s Division of Infectious Disease and Epidemiology and the Office of Food Protection, or food safety surveillance conducted by the Food and Drug Administration.

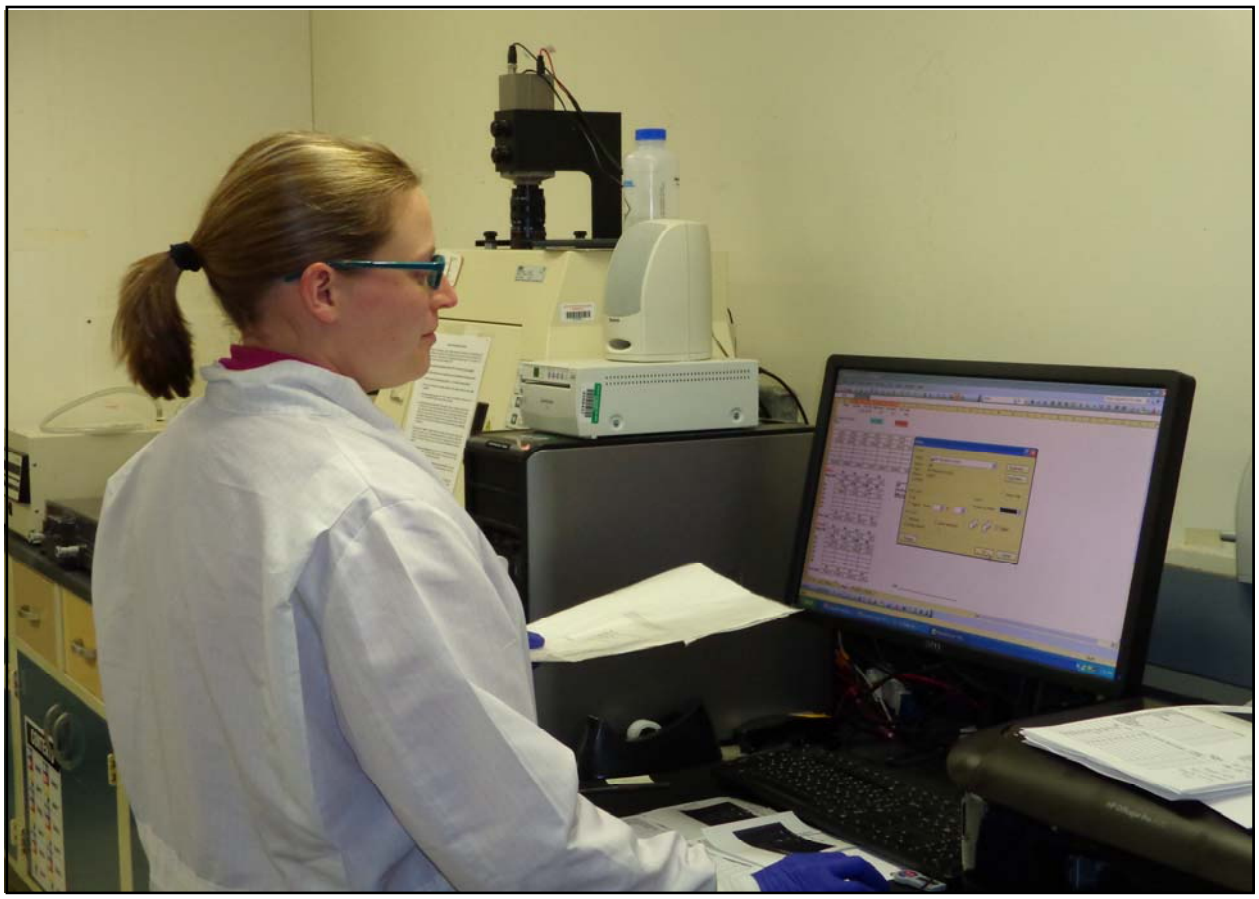
In addition to identifying foodborne pathogens using molecular or culture methods, this laboratory also performs further sub-typing (fingerprinting) of bacteria using Pulsed Field Gel Electrophoresis (PFGE).

Principal Clinical Laboratory Scientist Adam Miller tests a sample of an unknown powder substance that was submitted by the FBI. The specimen is being tested for the presence of Ricin toxin.

Molecular Biology/Enteric Pathogens Laboratory Testing	
Test Performed	***Number of Specimens Tested***
Enteric Bacterial Isolates	431
Norovirus PCR	158
Parasitology	589
PFGE	171
Pertussis PCR	1,112
Stool Cultures	22
Influenza	651
Tuberculosis	50
Total	**3,183**

2014 Success Story: Listeria Outbreak Response

In October 2014, the Molecular Diagnostics Laboratory worked with other HEALTH programs in response to an outbreak of Listeria. Four serious cases of *Listeria monocytogenes* were identified, and three of the individuals died. After performing routine interviews with patients, it was discovered that each patient had visited at least one of four different food establishments. Whole Genome Sequencing (WGS) and Pulse Field Gel Electrophoresis (PFGE) were used to determine if the bacteria causing the illness in the four individuals were likely to come from the same source. Three of the four cases matched identically by both tests. When this was discovered, all four establishments where the individuals ate were inspected and environmental and food samples collected for laboratory testing. *Listeria monocytogenes* was found in all four establishments, and again, tests revealed that the genetic "fingerprints" of the bacteria matched the three individual cases. As a result of these public health investigations, the food establishments were ordered to take measures to sanitize the facilities and equipment to prevent further infections.



Clinical Laboratory Scientist Kristin Carpenter-Azevedo performs Pulse Field Gel Electrophoresis (PFGE) analysis to determine if Listeria monocytogenes bacteria are present.

Serology Laboratory

The Serology Laboratory conducted testing for the serological and molecular diagnosis of infectious diseases. These help physicians diagnose illness and assist epidemiologists in detecting and controlling the spread of communicable diseases. Specific analyses include serological and molecular tests for viruses causing AIDS, hepatitis A, B, and C, and bacteria causing sexually transmitted diseases: chlamydia, gonorrhea and syphilis

The number of chlamydia and gonorrhea tests continued to increase in 2014. The Serology Laboratory performed a combined total of 48,838 tests for chlamydia and gonorrhea compared to 48,260 in 2013. Tests for syphilis increased from 7,656 in 2013 to 10,049 in 2014, and tests for HIV increased from 14,620 in 2013 to 18,105 in 2014.

Recently the hepatitis testing program was expanded to include testing for hepatitis A and B, in addition to hepatitis C. The number of clinical specimens tested for hepatitis remained at levels similar to previous years with 1,321 total tests performed.

Testing for West Nile Virus (WNV) and eastern equine encephalitis (EEE) in human specimens continued as a responsibility of the Serology Laboratory, with 53 WNV IgM tests performed. Federal grant funding supported surveillance testing programs for mosquito-borne diseases involving the testing of mosquitoes trapped by DEM staff. In 2014, 1,727 mosquito pools were tested in the Serology Laboratory; 11 mosquito pools tested positive for WNV, one pool tested positive for Jamestown Canyon Virus, and 11 pools tested positive for Highlands J Virus. While both Jamestown Canyon Virus and Highlands J Virus are not of clinical significance, they are thought to be predictors of the presence of human pathogens in the surveyed virus population.

Laboratory Assistant Jose Tavares and student intern Diamond Sandy enter patient demographic information and laboratory test orders into the Serology Laboratory's computer system. The Serology Laboratory tested nearly 80,000 specimens in 2014.

2014 Success Story: 16S Ribosomal DNA Sequencing

The State Lab implemented a new test method to identify bacterial isolates. This method compares DNA sequences found in virtually all bacteria to DNA sequences unique to each species. A fragment of the small ribosomal RNA gene (16S) from a sample is amplified and its DNA sequence is determined. This sequence is then entered into five different national DNA databases in an attempt to match to a sequence that has already been entered in the database. Once a preliminary match is identified, established criteria are then used to identify an isolate at either the species level, the genus with similarity to species level, or to only the genus level. Through validation of this testing method as well as by comparing Rhode Island's results to CDC results, 16S Ribosomal DNA Sequencing has proven to be a valid method for bacteria identification.

Clinical Laboratory Scientist Robert Ireland, PhD, performs 16S sequencing in the Serology Laboratory.

Biomonitoring and Chemical Terrorism Response Laboratory

The Biomonitoring and Chemical Terrorism Response Laboratory tests blood and urine specimens for toxic substances such as lead or mercury. These tests are called "biomonitoring" and help assess the type and quantity of chemicals that enter an individual's body from the environment, and may cause negative health consequences.

The Chemical Terrorism Response Laboratory continued to implement new analytical methods developed by scientists at CDC's National Center for Environmental Health. These methods are designed to test clinical samples collected from individuals who were exposed to toxic chemicals and determine if they were used as agents of terrorism. The laboratory has demonstrated proficiency in multiple methods for the detection of industrial chemical poisons and warfare agents and maintains readiness to assist with shipping of large numbers of specimens to CDC in the event of an intentional or accidental release of toxic chemicals.

Clinical Laboratory Scientist Noyo Shrestha gets the ICP/MS instrument ready for testing specimens in the Chemical Terrorism Response Laboratory.

The Biomonitoring Laboratory includes a specialized blood lead testing program. In support of Rhode Island's universal childhood lead-screening requirement, this laboratory performs blood lead screening tests on children younger than six years of age. Specimens are received from hospitals, physicians, and community health centers and are tested using atomic absorption spectrophotometry. In 2014, 15,063 blood-lead-level screening tests were performed. Children who have elevated screening results or patients of any age who have symptoms of lead poisoning must be retested, resulting in an additional 800 follow-up diagnostic tests.

Clinical Laboratory Technician Anthony DellaGrotta calibrates the graphite furnace atomic absorption (GFAA) instrument before it is used to test blood samples for the presence of environmental lead.

Environmental Sciences Laboratories

The primary mission of the Environmental Sciences Laboratories is to monitor the safety of resources vital to public health including public drinking water supplies, ambient air, the environment, and food supplies. In support of the state's environmental health and protection programs the Environmental Sciences Laboratories test samples collected by HEALTH, DEM, other state agencies, public water systems, and private homeowners for a variety of chemical and biological substances that can be harmful to people's health and to ecosystems. Tests on drinking water, ambient and recreational water, air, and food are performed in accordance with strict scientific standards set by the Environmental Protection Agency (EPA) and the FDA.

Air Pollution Laboratory

The Air Pollution Laboratory maintains a network of eight air-monitoring sites to measure pollutants in outdoor air. This lab has five scientists and performed a total of 480,015 air-quality measurements in 2014. The pollutants monitored include carbon monoxide, metals, nitrogen dioxide, ozone, particulate matter, polycyclic aromatic hydrocarbons, sulfur dioxide, volatile organic compounds, and other airborne toxic compounds that have the potential to cause adverse health effects. All air-quality measurements undergo a quality-control review before being submitted to DEM and EPA. DEM and EPA use the test results to define air-quality conditions that help to forecast and to develop air-pollution control measures for the state and for the region. Current and forecasted conditions are then used to define the Air Quality Index, that is posted on EPA's website (www.epa.gov/airnow). Testing parameters include 2.5 and 10 micron particulate matter, ozone, carbon monoxide, sulfur dioxide, nitrogen oxide, total reactive nitrogen, ammonia, nitric acid, volatile organic compounds (VOCs), and surface meteorology. The Air Pollution Laboratory collects, compiles, reduces and reviews these analytical data before providing them to the EPA and scientific community in support of public health, technology, and ecosystem assessment strategies.

2014 Success Story: Near-Road Air Monitoring at I-95

In April 2014 the laboratory established a "near-road" air-monitoring station on the east side of Interstate 95 near downtown Providence to monitor air for NO_2/NOx, as well as CO, $PM_{2.5}$ and black carbon. This site was selected by DEM and EPA in order to meet the EPA requirement to monitor pollutants in the air close to downtown, major thoroughfares in urban centers. When DOT completes its highway reconstruction and bridge repair project to the northbound lanes of Interstate 95, this air-monitoring station will likely be moved.

Food and Water Chemistry Laboratory

This laboratory supported the regulatory efforts of HEALTH's Office of Drinking Water Quality and Office of Food Protection and DEM's Water Resources programs. In 2014, the Food and Water Chemistry Laboratory conducted tests for routine and special monitoring of environmental contaminants in drinking water, ambient waters, and wastewater, as well as shellfish and food products by physical, chemical, and instrumental analysis.

This laboratory continued the private well water testing program as part of the state's effort to protect the safety of all drinking water. Drinking water samples collected from public water systems or from privately-owned wells were tested for the presence of chemical substances and contaminants including nitrates, nitrites, and heavy metals such as lead, copper and arsenic. In addition, the laboratory analyzed water samples from homes in Providence for lead contamination as a follow up to the city's lead-line replacement project.

Inorganic Chemistry Tests, 2014	
Test type	***Quantity performed***
Cyanide	90
Mercury	92
Iron	153
Minerals	514
Lead and Copper	749
Metals	1,133
Other	3,854
Total	**6,585**

2014 Success Story: Special Public Water Supply Testing

The Water Chemistry Laboratory worked collaboratively with HEALTH's Office of Drinking Water Quality on a special project designed to evaluate potential health risks from 1,2,3-trichloropropane, 1,4-dioxane, hexavalent chromium, and perchlorate. These four chemicals are not currently regulated and were found to be contaminating drinking water supplies in other states. The laboratory analyzed an estimated 1,500 water samples. By using specialized, sensitive methods, the laboratory was able to detect very small amounts of the four chemicals of concern. (Detection ranged from 50 parts per trillion to 500 parts per trillion.) Laboratory results were shared with the Office of Drinking Water Quality, and the report showed that two of the contaminants - hexavalent chromium and 1, 2, 3-trichloropropane - were not detected at concentrations that required further action. The laboratory will continue to monitor concentrations of perchlorate and 1, 4-dioxane, and any recommendations for additional treatment necessary will be based on future regulatory standards or guidance values. On a larger scale, the EPA is considering adding all four of these chemicals to the list of regulated compounds under the federal Safe Drinking Water Act.

In 2014, the SHL received its third annual FDA grant to become an ISO/IEC 17025:2005 accredited food-testing laboratory. This designation allows the Food Laboratory to assist the state in complying with the Manufactured Food Regulatory Program Standards (MFRPS). As part of the accreditation process, the laboratory continued to standardize its quality-assurance systems, food-testing programs, trained staff, and prepared equipment for this accreditation. The laboratory anticipates that in 2016, an FDA-approved accreditation body will assess the laboratory's abilities to perform food analyses in the event of a foodborne illness outbreak or in response to food contamination emergencies. In 2014, the laboratories performed 348 tests of food products related to MFRPS activities, consumer complaints, and foodborne illness outbreaks.

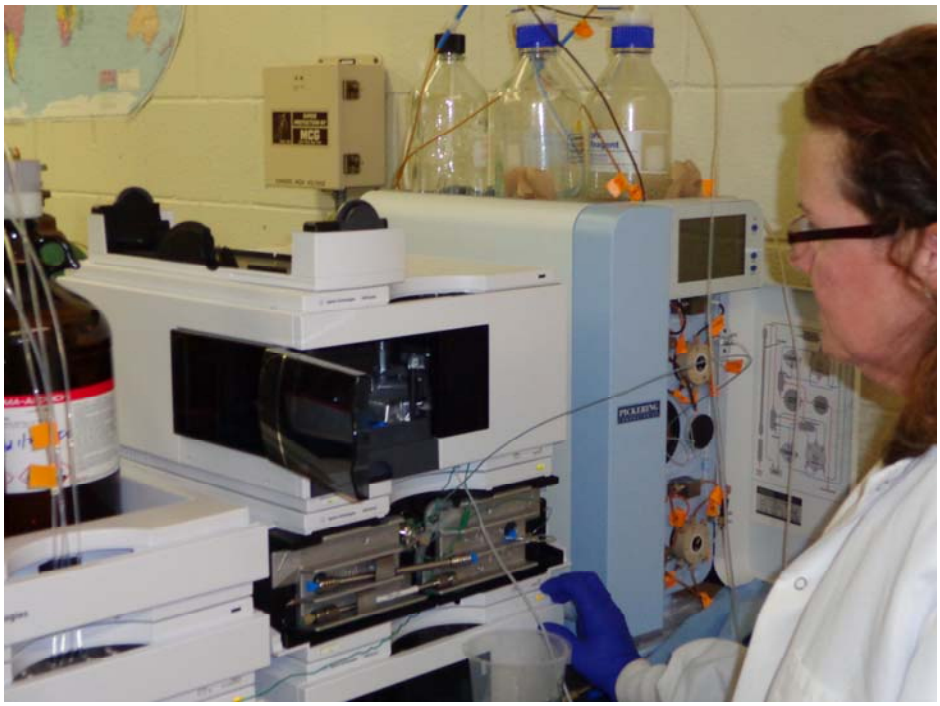
Laboratories involved in food and water testing participate in proficiency exercises with the Food Emergency Response Network (FERN) and the Environmental Response Laboratory Network (ERLN). These network exercises are administered by FDA/Department of Agriculture (DOA) and the EPA, respectively. By participating in these national laboratory-network activities, the State Lab's ability to assist in a large-scale response to an accidental or intentional chemical poisoning of food or water supplies is significantly increased and contributes to the state's high level of emergency preparedness.

Organic Chemistry Laboratory

The Organic Chemistry Laboratory tested public drinking water, private-well water, ambient waters, and wastewater for pesticides, herbicides, and volatile or synthetic organic chemical contaminants. Historically, these organic contaminants entered the environment due to industrial and household processes, the use of petroleum and its by-products, and the commonplace use of pesticides. These chemicals do not decompose easily, and they remain in the soil and groundwater for many years. Once these chemicals make their way into the groundwater, they have essentially entered the drinking-water supplies. Regulations like the Safe Drinking Water Act and the Clean Water Act require drinking water to be tested for any of these organic chemicals so that the state's public water supplies and watersheds are protected from further chemical contamination. Routine monitoring is necessary to ensure drinking water continues to be safe. In 2014, this laboratory tested 1,800 water samples and ran a total of 30,795 individual tests for chemicals.

This laboratory also works closely with DEM's Division of Water Resources to test ambient river, stream and pond samples and with the Division of Agriculture Pesticide Program to test pesticide formulation samples. The test results are used to monitor the quality of freshwater and estuarine systems and to assure that agricultural pesticides are applied at the right concentrations.

Organic Chemistry Tests, 2014	
Test Type	**Quantity Performed**
Volatile organic chemicals	11,594
Synthetic organic chemicals	7,995
Pesticides, herbicides	4,481
Chlorophyll	140
Harmful algal toxins	6,585
Total	**30,795**



Environmental Laboratory Scientist Tara Rountree using high performance liquid chromatography and fluorescence detection to test drinking water samples for carbamate pesticides.

Water Microbiology Laboratory

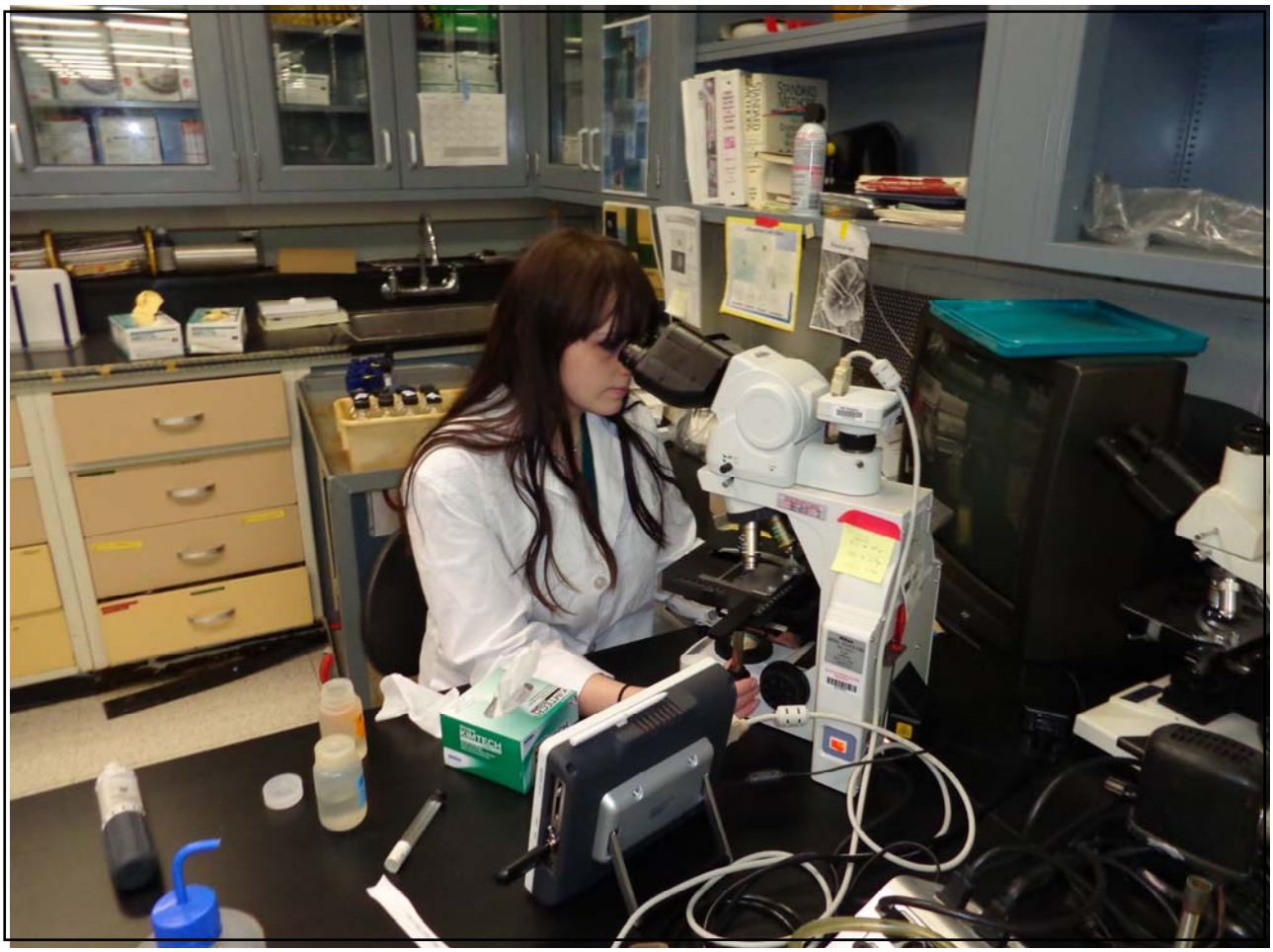
The Water Microbiology Laboratory conducts microbiological tests to help monitor the quality of drinking water and other environmental samples to help maintain safe public water systems, beaches, shell fishing, and dairy industries. (This laboratory also manages the Rabies testing program). The tests detect when drinking water, recreational water, dairy products, shell fishing areas, or shell fish are contaminated. These tests are also used to determine when it is safe for the public to resume utilizing water supplies and for shell fish and dairy industries to resume normal production.

More specifically, the laboratory tests a wide variety of water samples to help state programs and municipalities locate and define sources of pollution and to monitor the spread of pollutants. Shell fish harvesting and growing areas were tested weekly for evidence of fecal contamination and are routinely re-tested after heavy rains. Harvesting and growing areas that show evidence of contamination are closed until subsequent bacterial tests show they are safe for harvesting. In addition, the laboratory analyzes water samples, collected by DEM, from Narragansett Bay for the presence of red-tide toxin producing plankton so that shell fish consumers and manufacturers are protected from paralytic and amnesiac shell fish poisoning. The laboratory tested beach waters for any fecal contamination. Rapid testing of the beach waters and shell fish beds resulted in earlier detection of safe swimming and harvesting conditions, allowing quicker re-opening of recreational facilities, and adherence to DEM, EPA, and FDA standards.

Water Microbiology Tests, 2014	
Test type	**Quantity performed**
Drinking water samples	2,459
Marine/shell fish water samples	2,507
Recreational water samples (beaches)	3,148
Dairy samples	2,687
Total	**10,801**

2014 Success Story: Digital Video Microscopic Imaging

In 2014, the FDA loaned a digital video imaging system to the SHL so that staff could record images of toxin-producing plankton in weekly Narragansett Bay samples collected from shellfish harvesting and growing areas while the sample was under the microscope. This technology improved the laboratory's ability to identify, count, and document toxin-producing plankton in bay samples. Laboratory staff was also able to take digital images that can be used in the future for confirmation of plankton tests or for training of other scientists. Prior to obtaining this equipment, microscope identification of plankton was difficult because it required scientists to identify the plankton's morphology as them swam in and out of focus under the microscope.

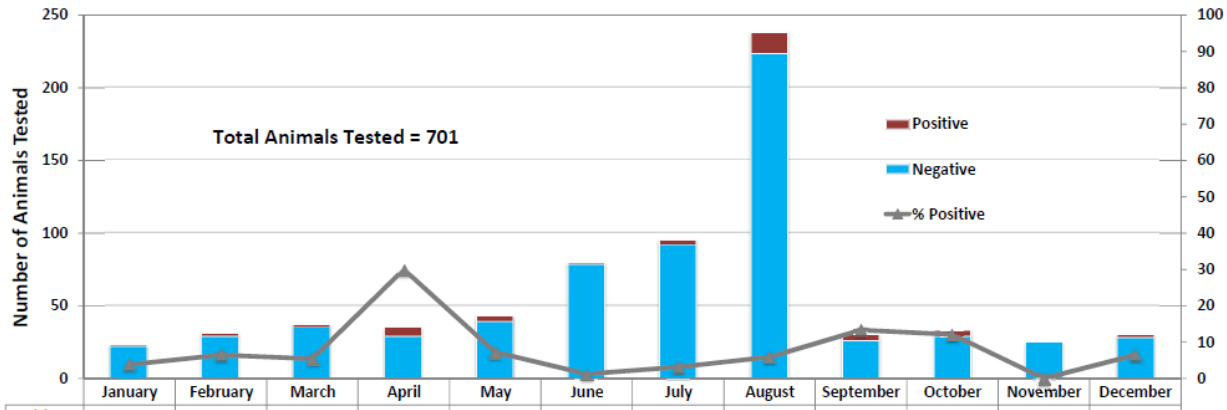


Environmental Laboratory Scientist Samantha Jalette uses the digital video microscope to examine water samples from Narragansett Bay shell fish harvesting areas and to test the samples for the presence of a toxin-producing plankton that can cause shell fish poisoning in humans.

Rabies Testing Program

The Rabies Testing Program conducts rabies testing on animals that exhibit symptoms of neurological illness and have bitten or potentially had contact with a person or other animals. The animals tested most frequently for rabies are bats, cats, dogs, raccoons, skunks, and woodchucks. Animals that were tested for rabies on a less frequent basis included farm animals, opossum, fox, squirrel, ferret, and muskrat. Animal specimens were brought to the State Lab by DEM, local animal-control officers, animal shelters, veterinarians, and the general public. The need for animal rabies testing is determined by the State Epidemiologist (for human exposures) or the State Veterinarian (for animal exposures).

Because rabies is a neurological disease of viral origin that is fatal if untreated, the timely clinical management of individuals who have had a known or suspected exposure to a rabid animal is critical. Timely treatment is dependent on obtaining test results quickly. Therefore, the State Lab maintained a group of on-call scientists who are trained to conduct, interpret, and rapidly report rabies tests.



	January	February	March	April	May	June	July	August	September	October	November	December
Positive	1	2	2	6	4	1	3	14	4	4	0	2
Negative	22	29	35	29	39	78	92	223	26	29	25	28
% Positive	3.8	6.5	5.4	30.0	7.3	1.2	3.2	5.9	13.3	12.1	0.0	6.5

Animal Rabies Test Results in 2014 by Month, Conducted by the State Health Laboratories

Animals Tested for Rabies in 2014 by State Health Laboratories *								
Month	Bat	Cat	Dog	Raccoon	Skunk	Woodchuck	Fox	Other**
January	11	6	4	0	0	0	0	0
February	10	8	8	2 (2)	0	0	0	0
March	12	10	7	3 (1)	5 (1)	0	0	0
April	13 (1)	11 (1)	3	5 (4)	1	1	1	0
May	18 (1)	13 (1)	2	2	1	5 (2)	1	0
June	44 (1)	11	5	4	6	9	0	1
July	62 (2)	14	7	2 (1)	5 (1)	3	0	2
August	207 (11)	14	5	5	3 (1)	1	2 (1)	0
September	9 (2)	12	1	1	2	1 (1)	1	2
October	9 (1)	11	3	2	4 (2)	0	2 (1)	2
November	10	8	5	0	1	0	0	1
December	11	12	4	3 (1)	0	0	0	1 (1)
Total	416 (19)	130 (2)	54 (0)	29 (9)	28 (6)	20 (3)	7 (3)	9 (1)
% Positive	4.6 %	1.5%	0%	31%	21.4%	15%	42.8%	11.1%

*Counts in parentheses are number that tested positive.

** Muskrat, goat, opossum, squirrel, coyote, monkey, weasel, pony, horse

Analytical Laboratory Certification Program

The State Lab is required to follow a systematic approach for quality assurance to maintain the high standards of their laboratory testing services. HEALTH's Analytical Laboratory Certification Program certifies any commercial, municipal drinking water, or wastewater-testing laboratory that provides analytical services for testing the quality of drinking water or wastewater for environmental lead-hazard mitigation. The program is required to inspect in-state analytical laboratories every three years and to evaluate each lab's proficiency test results on an annual basis. State law allows reciprocity with other state laboratory certification programs, so Rhode Island accepts an out-of-state laboratory's home-state certification as evidence to qualify for analytical laboratory certification in Rhode Island. In 2014, the program certified 82 analytical laboratories. Of this total, 31 were in-state laboratories, and 51 were out-of-state laboratories. A current list of laboratories certified for drinking water, wastewater, and environmental lead testing is available on HEALTH's website: www.health.ri.gov/find/labs/analytical

This program also responded to customer concerns and answered technical and customer service questions from programs served by laboratories. The program works closely with HEALTH's Office of Drinking Water Quality, HEALTH's Beach Monitoring Program, and DEM's Wastewater Treatment Program to provide guidance about certified analytical laboratories that report to the program, to evaluate findings from the laboratory inspections of municipal water treatment facilities that maintain laboratories on site.

Forensic Sciences Laboratories

The primary mission of the Forensic Sciences Section Laboratories is to support Rhode Island's criminal justice system through the accurate, thorough, and timely examination of evidence; to provide the most scientifically-advanced and technologically-proficient investigative capabilities; and to provide unbiased evaluation of evidence and courtroom testimony.

During all stages of an investigation, and in the courtroom, the criminal justice system relies on the knowledge and objectivity of forensic scientists to establish the facts. The findings may identify a perpetrator or exonerate a suspect and scientists' testimony may convict or acquit a defendant; however, the forensic scientists consistently apply the scientific method when examining evidence.

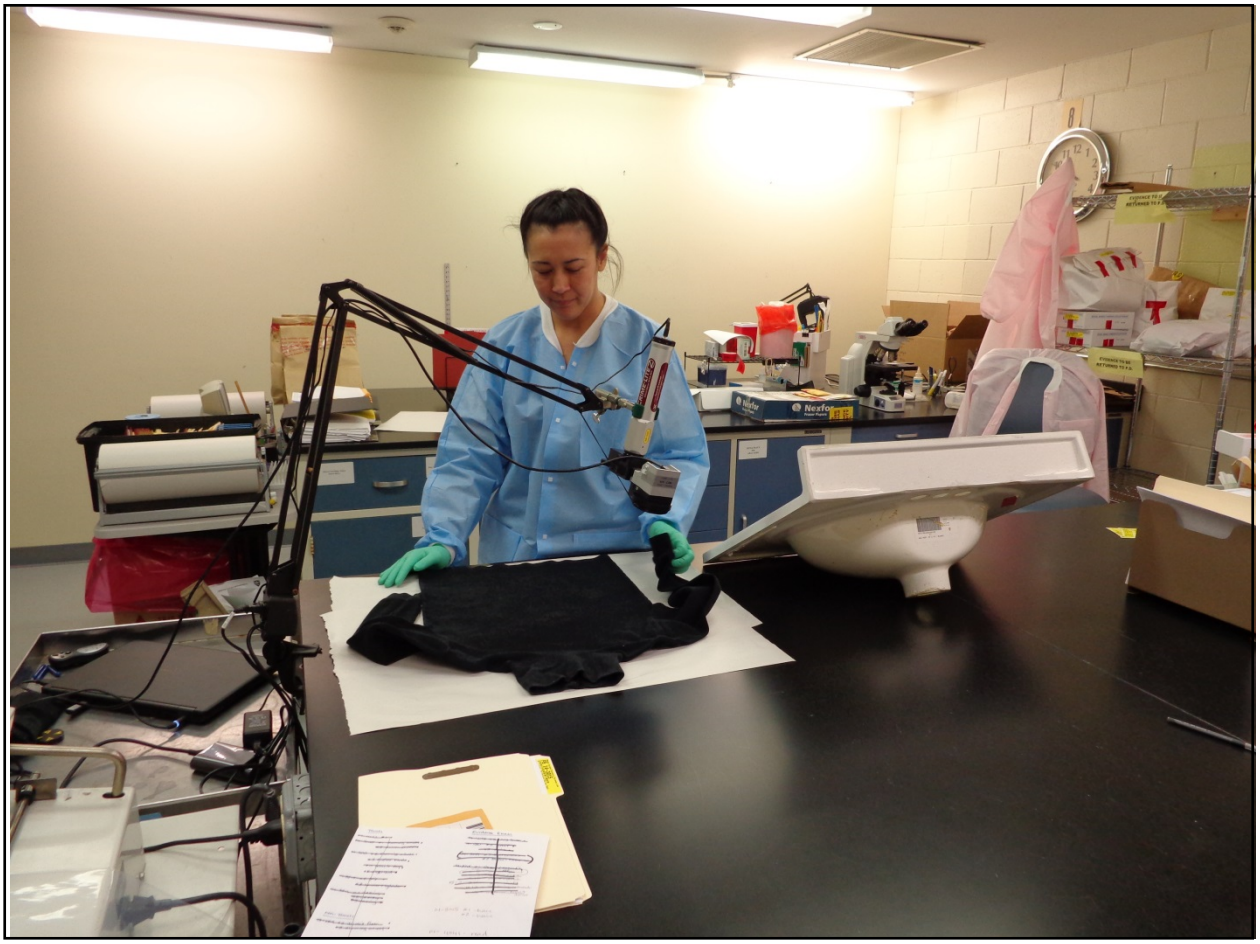
Forensic Biology/DNA Laboratory

The Forensic Biology Laboratory examines evidence in homicides, sexual assaults, burglaries, and other violent crimes for sources of DNA that could be compared to potential suspect(s). Forensic scientists examine clothing, weapons, body tissues, bodily fluids, and debris to determine if a reliable DNA sample can be extracted. Staff work closely with investigators to determine which evidence is probative and evaluate findings. Scientists also provide expert courtroom testimony on the topic of bodily fluid identification and DNA testing and can provide consultations and training if requested. In 2014, law enforcement officials submitted evidence from 432 cases and many of the cases included multiple items for DNA examination. As of December 31, 2014, the average time for case completion was 98 days.

This laboratory also administers the Combined DNA Index System (CODIS) for the state. CODIS is a national database of DNA profiles collected from convicted offenders, crime scenes, and missing persons. Rhode Island law requires all convicted felons to provide a DNA sample for inclusion in the database, and this laboratory collects and analyzes DNA samples from the individuals and enters the results in the CODIS database. Effective July 1, 2015, anyone who is arrested on violent crime charges will be required to provide a DNA sample.

Since the program began in Rhode Island, 19,848 convicted offender DNA samples and 941 forensic crime-scene DNA test results have been entered into CODIS. Nationally, the CODIS database holds DNA profiles from more than 11 million offenders, more than 1.3 million arrestees, and more than 607,173 DNA samples from crime scenes. The FBI searches the database every week and notifies the CODIS laboratory of any potential matches (hits) between an individual in CODIS and DNA evidence from an investigation. The hits could be between an offender and an unsolved crime or could link unsolved crimes to one another. Through December 2014, Rhode Island aided in 248 law enforcement investigations. On a national level, CODIS has provided more than 274,000 hits and aided more than 260,000 investigations.

Forensic DNA Sample Tests, 2014	
Crime Type	**Quantity Performed**
Homicide	24
Sexual assault	71
Property	145
Other	148
Total	**388**



Senior Forensic Scientist Tamara Wong examines evidence from a crime scene with the DNA Laboratory's new Infrared Light. The light was purchased with federal funds and makes it easier to see bloodstains on dark clothing.

Forensic Toxicology Laboratory

The Forensic Toxicology Laboratory examines autopsy specimens (tissues, organs, fluids, and medications) for the presence and quantity of drugs and/or poisons that may have contributed to the cause of death. The results are used primarily by the OSME to carry out its mission. In 2014, this laboratory tested specimens from 1,015 Medical Examiner cases. Each case required multiple screening and confirmatory tests on numerous specimens.

This laboratory also examines blood specimens obtained from motor-vehicle operators arrested for driving under the influence of alcohol or drugs (DUI/DUID). In 2014, the laboratory analyzed samples for the presence of alcohol and/or drugs for 289 cases. This reflects a steady increase in submissions to the laboratory under this program. Requests for court appearances have also continued to increase.

Forensic Scientist Chelsey Danella prepares toxicology samples to screen for the presence of prescription or illicit drugs using the ELISA method. The ELISA method quickly screens a specimen for 17 different classes of drugs and means the toxicologist only needs to perform confirmatory testing for the classes of drugs that are present.

2014 Success Story: Laboratory Response to the Drug Overdose Epidemic

Beginning in May 2013, a previously unidentified drug was detected in a number of autopsy specimens during a short time period. The Forensic Toxicology Laboratory, in conjunction with the DEA, CDC, and the Drug Chemistry Laboratory, identified the unknown substance as acetyl fentanyl, which has a structure similar to the clinically-prescribed painkiller fentanyl. The use of this illicit drug led to 13 deaths in that short period of time. The trend of opiate-related deaths in Rhode Island continued in 2014 with 232 deaths attributed to opioid overdose. Of the 232 deaths, 90% involved at least one illicit opioid and/or prescription drug, and at least 73 were associated with the illicit form of fentanyl. People from 31 cities and towns died from an apparent overdose: the people represented a diverse range of demographic and socioeconomic status. The age range of the decedents was 20 to 72 years of age. On a national level, law-enforcement seizures of illegal drugs containing fentanyl more than tripled from 2013 to 2014.

Forensic Drug Laboratory

The Forensic Drug Laboratory examines evidence confiscated in drug-related crimes (pills, powders, plant material, or paraphernalia) for the presence of controlled substances. Staff also assist federal and state law enforcement agencies in the investigation of local clandestine-drug laboratories. In 2014, 2,430 separate cases were submitted for examination, and each case often contained more than one type of sample. In total, 5,616 separate identifications were made. Cocaine, heroin, and marijuana were the most frequently identified substances. Despite a 2013 change of law that reclassified synthetic cannabinoids and cathinones ("bath salts") as Schedule I substances, the substances continue to be identified and are now tracked in the laboratory information system. In 2014, they became one of the top five drugs identified. Despite the 2013 change in RI law that decriminalized marijuana, it continues to be the third most common drug identified in Rhode Island. Quantities of marijuana that exceeded one ounce continued to be submitted by prosecution.

Top Five Submitting Agencies	
Law enforcement agency	**Percentage of total**
Rhode Island State Police	**23%**
Providence Police	**22%**
Pawtucket Police	**7%**
Cranston Police	**7%**
Woonsocket Police	**6%**

Top Five Drugs Identified	
Drug type	**Percentage of total**
Heroin	**23 %**
Cocaine	**22 %**
Marijuana	**16%**
Synthetic cannabinoids/cathinones	**4 %**
Oxycodone	**3%**

Forensic Breath Analysis Section

The Forensic Breath Analysis section monitors instruments used by law enforcement agencies to analyze the breath of motor-vehicle operators suspected of driving under the influence of alcohol. In 2014, 811 breath instrument inspections were completed at 47 facilities. Through a DOT grant-funded program, new instruments were validated and inspected before initial use. In addition, staff in this program have been working diligently to prepare for the transition to a new breath analysis instrument, the Intoxilyzer 9000. The transition to this new equipment started late in 2013 and continued through 2014. All breath analysis instruments must be re-certified every 30 days.

This program also trained and certified every officer who will operate breath-testing instruments. In order to operate breath-testing instruments in accordance with Rhode Island law, all law enforcement personnel must successfully complete an annual training in the operation of the instrument. In 2014, program staff trained approximately 1,700 law enforcement officers throughout the state, including recruits from the Rhode Island Municipal Police Academy, the Providence Police Academy, and the Rhode Island State Police Academy. The program also worked with the state's liaison from the National Highway Traffic Safety Administration to screen and instruct police officers in drug recognition and field-sobriety protocols.

Program staff provided expert technical testimony eight to ten times per month throughout the state's court system, as well as providing 24/7 on-call support for law enforcement officials.

This program works very closely with DOT's Office of Highway Safety and has received federal funding from them. In 2014, continued funding permitted the hiring of a new, full-time Senior Laboratory Technician to assist with increased workload. Previously hired federally funded staff in Toxicology helped reduce reliance on outsourcing of drug testing and increased focus on developing new testing methods. Under federal funding, this program continued to provide blood-collection kits to law enforcement agencies at no cost. The blood-collection kit gave both police and medical personnel standardized, written instructions for proper collection of blood samples from suspected impaired drivers.

Breath Analysis Supervisor Al Giusti, tests new Intoxilyzer 9000 breath-analysis instruments before they are used by law enforcement agencies throughout the state. This office maintains all of the breath analysis instruments in the state.

Appendix A: Summary of Laboratory Testing Services

Biological Sciences Laboratory

Bioterrorism Response & Special Pathogens Laboratory

Tuberculosis	Pertussis (culture)	Identification of bacterial agents of bioterrorism
Reference Isolates: identification of infectious disease pathogens	Medical Examiner: identification of infectious diseases as a cause of death	Blood parasites

Water Microbiology Laboratory

Coliform bacteria counts	Rabies	Bacterial quality of marine (beach/shellfish) waters
Total bacteria counts	Enterococcus bacteria	Dairy products testing (antibiotics, fat content, bacterial contamination)

Molecular Biology, Enteric Pathogens Laboratory

Identification of bacteria associated with foodborne disease	Norovirus	Identification of agents of bioterrorism in food
Parasitology	Influenza (Isolation and subtyping)	
PulseNet (PFGE): genetic typing of bacteria associated with foodborne disease	Pertussis (PCR)	

Serology Laboratory

Chlamydia (amplified probe)	Gonorrhea (amplified probe)	HIV (antibody/antigen screen & confirmation)
Syphilis (screen and confirmation)	Hepatitis A, B, C	IGS Sequencing of bacterial isolates
West Nile infection in humans	Mosquito pools (West Nile/EEE)	

Biomonitoring, Blood Lead Laboratory

Lead (screen, capillary or venous blood specimens)

Lead (diagnostic, venous specimens only)

Metals panel in urine

Selected chemical warfare agents & poisons

Mercury, Lead and Cadmium in whole blood

Cyanide in whole blood

Volatile Organic Compounds in blood

Environmental Sciences Laboratories

Air Pollution Laboratory

Carbon Monoxide (CO)

Sulfur Dioxide (SO_2)

Ozone (O_3)

Meteorological measurements
(10 separate, including wind speed and direction, air temperature and humidity, barometric pressure)

Carbonyls (formaldehyde, acetone, acetaldehyde)

Coarse Particulate Matter PM10 (under 10 micrometers)

Nitrogen Monoxide (NO)

Nitrogen Monoxide (NO_2)

Nitrogen Oxides (NOx)

PM2.5--Speciation (detailed analysis for 59 chemicals, including 48 metals)

Volatile Organic Compounds (VOC) (78 chemicals)

Fine Particulate Matter PM2.5 (under 2.5 micrometers)

Food and Water Chemistry Laboratory (selected tests)

Aflatoxin: B1, B2, G1, G2
Alkalinity
Alkaline phosphatase in dairy
Allergens (egg, peanut, wheat)
Aluminum
Ammonia
Antimony
Arsenic
Barium
Beryllium
Cadmium

Copper
Cyanide
Filth
Fish/Shellfish safety (histamine, heavy metals)
Fluoride
Hardness
Hexavalent Chromium
Indicators of spoilage (pH, acidity, alcohol, moisture acetic acid)
Iron
Lead
Magnesium

Perchlorate
pH
Potassium
Selenium
Silver
Sodium
Sodium Composite
Solids, Settleable
Solids, Suspended
Solids, Total
Sulfate

Calcium	Manganese	Thallium
Chloride	Mercury	Toxic Residue Screening
Chromium	Nickel	Turbidity
Color	Nitrite	Zinc
Conductivity	Nitrate As N	

Organic Chemistry Laboratory

Carbamates and by-products by EPA method 531.1 (8 carbamate pesticides)	Volatile Organic Chemicals by EPA method 524.2 (65 volatile organic compounds in drinking water)
Chlorophyll	Pesticide formulations composition
Ethylene Dibromide and Dibromochloropropane by EPA method 504.1	Drugs & poison screen (food)
Dioxane by EPA Method 522	Volatile Organic Chemicals by EPA method 624 (30 volatile organic compounds in wastewater)
Organochlorine Pesticides and PCB screen by EPA method 508	Semivolatile Organics by EPA method 525.2 (44 synthetic organic chemicals in drinking water)
Herbicides by EPA method 515.3 (8 herbicides in drinking water)	Cyanotoxins by LC/MS/MS

Forensic Sciences Laboratory

Alcohol Proof	Controlled Substance Identification
Autopsy Specimens: Drug and Poison Analysis	DNA Profiling
Blood Alcohol Concentration	Tests related to Driving Under the Influence of Alcohol (DUI)
Blood Identification	Tests related to Driving Under the Influence of Drugs (DUID)
Body Fluid Identification	Drug Assays
Breath Alcohol Testing: Training and Certification of Police Officers	Product Tampering
Breath Alcohol Testing: Certification of Breath Testing Instruments	Sexual Assault Evidence Collection Kits
Clandestine Drug Manufacturing Laboratories	Toxicological tests related to the investigation of the cause of death
Combined DNA Index System (CODIS)	Unknown Liquid/Beverage Testing

Appendix B: Accreditations

The State Health Laboratories are accredited and inspected by the following agencies:

- Centers for Medicare and Medicaid Services, Certificate of Compliance for High Complexity Clinical Laboratory (CLIA)
- US Environmental Protection Agency, Ambient Air
- US Environmental Protection Agency, Drinking Water Testing
- Federal Bureau of Investigation, CODIS (QAS)
- ISO17025-Forensic Laboratories: Toxicology, Forensic Biology (DNA Testing), Drug Chemistry
- Food and Drug Administration, Dairy product and shellfish testing
- Rhode Island Department of Health, In-State analytical laboratory certificate
- Rhode Island Department of Health, In-State clinical laboratory license

Gina M. Raimondo
Governor

Elizabeth Roberts
Secretary, Executive Office of Health and Human Services

Nicole Alexander-Scott, MD, MPH
Director of Health (Designee)

State Health Laboratories

Chapin Laboratory Building
50 Orms Street
Providence, RI 02904

Phone: 401-222-5600
Fax: 401-222-6985
Hours of Operation: Monday-Friday, 8:30 a.m. to 4:30 p.m.
Website: www.health.ri.gov/labs