Laboratorian Volume 8 Issue 2 text

Story 1: Director Grace Kubin's Letter on CDC awards

I would like to take a moment to recognize some of the outstanding work our people do every day. Our laboratory consists of many multifaceted areas, each tasked with a specific part of public health for the State of Texas.

We have just wrapped up two very important, years-long national collaborations concerning the identification and targeted testing of *Salmonella* and *Listeria*. This work has earned our Laboratory two accolades from the United States Department of Health and Human Services and the Food and Drug Administration in their annual Leveraging/Collaboration Awards. These awards were presented to us in 2017 for the 2016 awards season.

Avocados

Our **Consumer Microbiology** laboratory is charged with monitoring and identifying foodborne contaminants across the state. You can see their work in the news, usually when there is an outbreak or health concern, but I want to focus today on their national work.

Our Consumer Microbiology Team is part of the Food Emergency Response Network, or FERN, a national collaboration among laboratories which was formed to streamline the identification of food emergency events.

FERN also works with the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA) to advance scientific understanding of food-borne illness vectors. This means that, when they aren't doing routine testing of the food we eat every day, our team is hard at work creating better and faster ways to find and negate public health threats.

From May 2014 to August 2015, the Consumer Microbiology Lab was a part of a FERN/FDA Project, testing avocados for the presence of *Salmonella* species and *Listeria monocytogenes*. This testing took place as part of a project designed by the FDA

to determine the risk factor of these pathogens in avocados in a sample size of about 1000 of the fruits.

Our Consumer Microbiology laboratory was one of 16 laboratories that participated in this project. These laboratories were chosen because they were part of the FERN/FDA Microbiology Cooperative Agreement Program grant. Thanks to the Consumer Microbiology Team for their efforts to make this project successful.

Advancement

Scientific advancement often brings with it innovative ways to approach public health. However, before we take on any new equipment, or instrument method, we ensure it meets or exceeds the performance and accuracy of our existing laboratory technology. For example, we wouldn't replace an instrument that runs a test in an hour with one that runs the same test in three hours with errors.

Our laboratory is often asked by various national health organizations to participate in validation studies for emerging technologies. In this case, the FDA asked our **Molecular Biology** laboratory to join 16 other state laboratories in testing a new method for identifying *Salmonella* by one of its genes. Where the Consumer Microbiology laboratory tests food samples for contaminants, the Molecular Biology laboratory tests human samples at the molecular level as part of our Bacteriology/Parasitology Diagnostic Group.

For this State Collaborative, Multi-Laboratory Validation Study, two new instruments were tested by our laboratory and other laboratories around the nation. These new instruments were designed to more efficiently test samples for *Salmonella*, which can cause severe illness in afflicted patients. We currently test samples for *Salmonella* by growing the sample, which can take several days. These new instruments look at the sample's DNA to identify the *invA* gene in *Salmonella* species samples. This test only takes a few hours, and has the potential to expand our existing testing practices.

To test, and potentially validate, this new *Salmonella* identification method, the FDA sent us controlled

sample kits to use on the instruments. These kits contained both samples that did and did not have the bacteria, so as to simulate a real-world example. In doing several rounds of testing, our laboratory reported a 100 percent success rate with both machines in correctly identifying all samples sent by the FDA for this study.

Thanks to our Molecular Biology Team's dedication to accuracy and precise work, our nation's public health system is one step closer to validating a new type of test that can save time, and therefore identify outbreaks faster, helping prevent illness.

It is with great pleasure every day I come to work to support this diverse set of public service employees.

This Issue

In this publication, we focus on drinking water testing and biological threat preparedness, two straightforward, yet complex, parts of our laboratory testing services. We explore our scientific testing, but more importantly, we give you a look into the daily lives of the people whose careers ensure the safety of Texans across the state.

If you are interested in knowing more about a particular area of our laboratory, or would like to suggest an article for a future issue, please do not hesitate to contact me.

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Picture: Woman in lab coat looking at test tube samples and paperwork

ACCURATE TRACKING

Chandra Brown, Microbiologist in the Serology Check-In Team, assigns accession numbers to incoming specimens. Serology Check-In is part of the Laboratory's Quality Assurance Unit, and is one of the two check-in groups for the Austin laboratory.

Each day, Brown and her team process serum samples sent to the lab and prepare the associated forms for further testing throughout the laboratory. Each specimen is carefully processed and then tracked so staff can easily identify and give updates to submitters and laboratory employees

working to test the samples.
Brown is processing gonorrhea and chlamydia urine specimens, or GCCT probes, sent to the laboratory. Daily workload can vary for the Serology Check-In Team due to seasonal volume and other factors. In a 6-week period in 2017, the Serology Check-In team processed over 4,500 GCCT probes in addition to all other specimens processed by the team.

Story 2: Science in the State of Preparedness

***The Texas Department of State Health Services Laboratory's Biological Threat Team Lead* goes to work just like you and me. She checks her email, returns phone calls, leads a team meeting and then flips through current research online for her field.**

The Laboratorian

But where others are dressing in light fabrics to enjoy the summer weather, the scientist and her team bundle up to enter their Biosafety Level (BSL) 3 laboratory facility.
Far from a fashion statement, the BSL3 containment laboratory staff are required to wear layers of disposable personal protective equipment (PPE) when going about their daily tasks.
While working with potentially live viruses and bacteria, the microbiologists on the Biological Threat Team take many precautions to prevent infection. The team wears personal air purifying respirators, water resistant suits and booties and a double set of gloves with the inner pair taped to their suit. This PPE covers the scientists from head to toe. In the biosafety laboratory, they avoid

the use of glass and other sharp objects that may damage the integrity of the suits.

“Our Branch Manager refers to the PPE as ‘bunny suits’ but I think they make us look more like Smurfs.” the team lead said. Regardless of what you call them, these layers of plastic and smart fibers provide necessary protection barriers that allow staff to work safely with harmful pathogens like the Ebola virus. With time and practice, she says, scientists in her field get used to working in the gear.

“When scuba diving, I wear a buoyancy control vest, mask, fins, and wetsuit,” she said. “When I ride my scooter, I wear closed-toed shoes, long pants, a helmet, and a leather jacket. Whether it’s for work or for fun, wearing the appropriate PPE is important for safety.”

The biological threat laboratory handles the technical end of some of the biggest biological issues of the day such as testing for Ebola or anthrax in samples which can be sent to the laboratory 24 hours a day, seven days a week, every day of the year. When not actively involved in testing a potential biological threat, the team runs drills, maintains BSL2 and 3 work spaces, practices latest technologies and procedures, and most importantly, holds ongoing training for laboratory staff and first responders all across the state. Recently, the microbiologist and staff received a possible anthrax

specimen on an otherwise normal Thursday afternoon.
"I think we went home around 5 Friday morning," she recalls.

Foundation

Over two decades ago, in 1995, President Clinton issued a directive which outlined antiterrorism policies and provided the basis for improving the ability of public health laboratories across the nation to detect and respond to acts of terrorism.

From this presidential directive, the national Laboratory Response Network (LRN) was established in August 1999 by a collaboration of the CDC, Federal Bureau of Investigation (FBI) and the Association of Public Health Laboratories (APHL).

For Texas, the DSHS Laboratory was tasked with designating one microbiologist as the bioterrorism coordinator for all biological threats in the state.

The DSHS Laboratory began working with the CDC, FBI and APHL to upgrade its facilities and train other scientists in the laboratory as well as emergency response professionals in Texas communities. They also created a state version of the national LRN.

The Texas Laboratory Response Network first started with six local public health laboratories in Austin, Dallas, Lubbock, El Paso, San Antonio, and Houston. The state was divided into six regions, but over the years has expanded to 10 regions after adding laboratories in Corpus Christi, Harlingen, Tarrant County, and Tyler.

Anthrax

September 2001 changed the country, and it also changed the nature of national response to biological threats to public safety.

Letters contaminated with anthrax were sent to Florida, New York City and Washington DC; 22 people were infected and five died from the threat which manifested seemingly overnight for the laboratory testing community. That

TEAM TRAINING

The DSHS Biological Threat Team lead conducts a training exercise for Ebola sample testing in one of the laboratory's Biological Safety areas. Scientists in these areas take special precautions such as wearing personal protective equipment (PPE) such as the gloves, masks, jumpsuits, and other gear. The team works inside these special areas which are completely isolated from the other parts of the laboratory, complete with independent air and power systems.

next month, in October, Governor Rick Perry established a task force on homeland security in Texas. In addition, funds for emergency preparedness poured into the state from the federal government, resulting in the formal formation of the Biological Threat Team, increasing in size from one microbiologist to four trained scientific professionals.

The FBI gave the situation the codename "Amerithrax" as organizations coordinated their findings.

Thanks to the quick work and previous preparation of the LRN, member laboratories were able to detect and identify the powdery substance contained in the mail.

Bacillus anthracis, a weaponsgrade anthrax strain, was isolated as the causative agent.

Over the next three months, the DSHS laboratory tested over 2,100

environmental specimens related to the event. Staff stayed in the laboratory all day, every day, running test after test, to add to the collective knowledge and sample volume of the LRN.

Over the next few years, the laboratory expanded its facilities to a new, seven-story building on the Austin campus with facilities for the new Biological Threat and Chemical Threat Teams.

In 2005, the Emergency Preparedness Branch was created to manage the Biological Threat and the Chemical Threat Teams.

The team continued to expand as it gained notoriety within the field of emergency preparedness, developing training programs for emergency responders across the state.

The laboratory team also worked to increase their skill set, taking training and earning certifications for emergency use.

Ebola

Just a month after receiving its certification to run Ebola testing, in September 2014, the DSHS Laboratory received its first request for testing of a clinical sample suspected of Ebola virus.

The Texas laboratory was one of a baker's dozen in the nation to attain this certification, and because of its work with the LRN and its BSL3 testing rooms, was one of the first testing centers to then receive packages of specimen samples to screen.

As the Biological Threat Team settled into its new testing routine in Austin, across the state a patient was quarantined in a

Dallas hospital. He had recently traveled from Liberia, and was getting sicker by the hour. Though precautions were taken, two health care workers treating the patient also became ill. Samples sent to the Biological Threat Team showed the patient had contracted Ebola. The samples were then sent to, and confirmed by, the CDC. This was the first diagnosed case in the United States. The second and third cases of Ebola, which were the patient's nurses, were also tested and confirmed by the DSHS team in early October 2014.

Safety

All Biological Threat Team personnel are thoroughly trained in BSL3 safety procedures and work using the buddy system. No one is ever in the BSL3 lab alone. In addition to PPE, the BSL3 laboratory has restricted access, interlocking doors and singlepass, directional airflow into the facility. All exhaust air is filtered. Everything that comes out of the BSL3 laboratory is either autoclaved or decontaminated with chemicals to eliminate the possibility that anything infectious might escape.

The BSL3 laboratory recently received upgrades to improve workflow, safety and security in the high containment laboratory suite. Two new staff members were added to the team in 2016, bringing the total number of microbiologists on the team to six.

The team works in shifts to ensure an unbroken testing cycle, should

the need arise, for high consequence infectious diseases.

“Although some people may be apprehensive about working with agents of bioterrorism, identifying these organisms is both exciting and gratifying knowing you can make a difference in people’s lives by doing a job that is not as conventional as most,” one of the team members said.

His coworker agrees.

“Working on the Biological Threat team is a rewarding experience,” he said. “Just knowing that I am making a difference in helping protect the public, whether it be regular work hours or an allnighter, I am ready to do my part. My family is a part of the community and I treat every sample with the same care as if it were one of theirs.”

With a dedicated staff using its facilities and the knowledge to train and coordinate emergency response efforts for potential biological threats, the DSHS laboratory has become one of the premier laboratories in the national LRN.

For more information on the laboratory’s research and participation in local, national and international biological threat topics through the LRN, read selected presentations by DSHS laboratory scientists at www.dshs.texas.gov/lab/EPR/Texas-Laboratory-Response-Network-2016-Meetings.shtm.

For information on upcoming trainings, forms, the Texas network, and other resources, visit

www.dshs.texas.gov/lab/epr.shtm.

Picture: Man in clean suit leading others with bags over their heads to simulate darkness in a drill

WE'VE GOT SAFETY IN THE BAG

Biological Threat Team members lead participants from Texas Laboratory Response Network (LRN) Labs and the DSHS Laboratory through a power outage evacuation exercise during one of the Biological Threat Team's Biological Safety Level 3 (BSL3) Trainings. Participants are trained to handle different types of emergency situations that may occur in the laboratory.

Grocery bags are placed over participants' heads to cover bulky safety helmets to simulate darkness in the event of a power outage. These helmets, white jump suits, gloves, and other gear are part of the personal protective equipment (PPE) required for biological hazard testing at the Biological Safety Level Three (BSL3).

Participants must learn how to navigate their laboratory and safely exit without compromising their safety. Workshop participants are guided through many examples of biological hazard emergency processes, including proper BSL3 laboratory attire and sample handling procedures. Laboratory staff hold onsite and offsite trainings for various organizations throughout the year for emergency preparedness.

Story 3: Bottles with Barcodes

On the top floor of a regular looking office building, water samples from across Texas whirl and swirl through glass pipes to fill little bottles which gently tap against each other as they are transported from one lab to another for routine testing.

"When water makes the news, it's usually because there either isn't enough, there's too much, or it's gross. We test to detect the gross," said Brandon Flammang, a Chemist at the Department of State Health Services' (DSHS) public health laboratory.

Laboratory Testing

The Texas DSHS Laboratory, one of the largest public health laboratory in the nation, and is responsible for 60 percent of drinking water testing conducted in Texas.

“Our laboratory processes about 42,000 samples from over 4,000 different public water systems a year,” said Andrew Vinyard, DSHS Chemist and Team Lead. “It keeps my team busy, but our work quietly ensures the safety of one of the most basic resources in everyday life.”

Vinyard leads the Gas Chromatography Analysis Team at the laboratory. Each day, Vinyard and his team test water samples sent to the laboratory from potable water sources across the state.

Laboratory scientists first concentrate the water samples into little vials which are then run through machines which separate all the molecules in each sample. The machines then generate readouts from each sample, which are used by the scientists to create a test report. This report is sent to the Texas Commission on Environmental Quality (TCEQ), which determines if corrective or legal action is necessary for the water body entity.

“Our job is to indiscriminately and accurately test each and every water sample that comes through our doors,” said Tammy Dunn, DSHS Organic Chemistry Group Manager. “After a while, they all become just bottles with barcodes. I think it’s better for the scientific process that we

continue our work and record our results so the enforcement arm of the state and the citizens of Texas can have the most accurate data available."

Countable Contaminants

The federal Safe Drinking Water Act (SDWA) allows the Environmental Protection Agency (EPA) to set standards for the nation's drinking water supplies. In Texas, the TCEQ is tasked with monitoring, regulating and enforcing these as well as other state-set standards. TCEQ looks at all the permitted water sources in Texas, determining which sources need which type of sampling at what frequency. TCEQ officials then divide the testing authority between DSHS (60 percent) and the Lower Colorado River Authority (LCRA) (40 percent), coordinating with water entities across the state to send samples to their specified laboratory.

Trickle-down Standards

What Texans consider 'drinking water' is actually just another liquid compound of natural resources, like cactus juice or Dr. Pepper.

"Your body depends on the various chemical compounds found in water to survive. We make sure those compounds are the good, not the bad kind," said Todd Borowski, DSHS Chemist.

Because of the many different compositions of what is considered safe drinking water, scientists focus on Maximum Contaminant Levels (MCLs) of known potential

contaminants as defined by the SWDA, to determine when a water source is hazardous.

The SWDA defines contamination limits for microorganisms, disinfectants, disinfection byproducts, inorganic chemicals, organic chemicals, and radionuclides. Scientists at the state public laboratory then test water samples, flagging samples which approach, meet or exceed these maximum levels.

Each contaminant has specific limits based on its immediate health concern to humans. For example, Chlorine used to disinfect water from microbes is allowed to have more of a concentration in a water sample than, say, the coliforms it protects against.

“We’re all water-based organisms, we need water to survive, and if it’s contaminated, we’re not going to survive for as long as we could,” said Flammang.

Water Works

Among the many firsts and greatests of Texas boasting comes from its water: by volume, the Lone Star State has the most inland water of all the 48 contiguous states. This is no small boast either, considering in the last 100 years Texans have built thousands of water retention areas as the state only has one naturally occurring lake, the Caddo, on the Texas-Louisiana border.

Yet even with the 6,000 square miles or so of water spread out over around 7,000 reservoirs, these water sources account for less than half of Texas’ water supply

annually.
The heavy lifting of the state's annual consumption of 16 million acre-feet of water actually comes from groundwater. Texans get roughly 60 percent of their water from the nine major and 21 minor aquifers within state borders.
All that water mixes with the elements before it is purified and sent through pipes straight to kitchen sinks and other drinkable access points across the state.

Watching Your Water

Agriculture, farming and industry play a major role in Texas economics, but sometimes byproducts from these livelihoods can accumulate in high enough concentrations to become concerning to public health.
Sometimes routine disinfection by drinking water entities creates a spike in certain contaminant readouts, such as those associated with Chlorine. Other times water storage and transportation systems and even the weather may contribute to a questionable water sample.
"Common contaminants in drinking water include stuff that runs off from lawns and properties like herbicides and solvents," said Carl Hogberg, DSHS Environmental Sciences Branch Manager. "Disinfection products which go down the drain or into water retention areas also cause issues, because they can form hazardous chemical bonds with the chlorination products used to treat the water."
Hogberg has been a natural resource

scientist for decades, and has assisted with a wide range of drinking water issues around the state. He credits the vigilance of state laboratory scientists at DSHS along with public officials committed to the health of Texans for working together when issues arise.

“Here in the lab, we have helped identify contamination cases where lead casings were still in use in water fountains at older public schools, or minerals breaking down from the underlying geology of a place had contributed to a water system’s degradation. Regular testing will tell you where to look for contaminant issues. We are fortunate to have the tools and scientists in our facility to quickly identify what the problem is so that health officials can then find where the problem is among the hundreds of thousands of gallons of water used daily by Texans,” he said.

For more information on the SWDA, visit www.epa.gov/grounwater-and-drinking-water.

For more information on Texas drinking water protection, visit www.tceq.texas.gov/drinkingwater.

Story 4: Meet your scientist: Todd Borowski, Chemist

Meet Todd Borowski, Chemist at the Texas Department of State Health Services Laboratory’s Organic Chemistry Group. His job at the laboratory is to test drinking water for contaminants that could make Texans sick. We asked him to tell us about his education and career for a series we call **‘Meet Your Scientist.’** This is what Todd shared with us:

EDUCATION

I obtained my Bachelor's degree in Biology from North Central College in Illinois. I excelled in the lab part of my degree, and naturally looked for a position after I graduated that played to my strengths in analytical chemistry testing. I found a job performing extraction of waste water and soil samples , and the profession clicked: 20 years later and I've stayed in the same diverse field of natural resource compliance.

CAREER

I've had a pretty normal career in laboratory science. It's funny, you know, the fundamental basis of our jobs hasn't change, we still scientifically profile natural resource samples, but depending on where you work, the expectations of a chemist can vary widely. Because natural resource management testing is so broad, I have been fortunate to get to explore the many different types of laboratories, from one-person labs to multinational laboratories in primarily the private and most recently the public sectors.

Water itself is not just composed of hydrogen and oxygen. In fact, it usually contains traces of calcium and other natural minerals. We test water to help state officials at the Texas Commission on Environmental Quality (TCEQ) keep the public updated and aware of the contents of their water, so it's important to me to make sure my results are timely and accurate.

In my profession, I've had major successes digging down into the process of my job and innovating for accuracy and client needs. For example, the majority of my background is in wastewater and soil sampling, another environmental testing area required on the state and federal levels. One time while working at a private company, our client wanted to build on a site, but forgot to fill out the appropriate paper-work to get soil sample tests for the site. The client found themselves looking at a possible setback of several months due to required soil testing I used my resources to create a streamlined testing process and personally ran over 1200 samples

for the company. I took an otherwise bureaucratic process that could have lasted half a year and condensed it down to 30 days with nonstop work.
I was driven by my commitment to the scientific implications of my work, and my commitment to help the economic development in my area continue without such a long interruption.
I fell in love with Texas while vacationing here over several years. It's true what they say: I wasn't born in Texas, but I got here as fast as I could.
TEXAS LIFE
I took a private sector attitude with me to the Department of State Health Services. I have had a lot of opportunities for innovation in my work here at the state's lab, and I hope to continue to improve in the natural resources testing industry in the years to come.
Whether its allocating staff time to priority projects, creating cost-effective procedures or just applying my years of experience to an issue, I feel that, although the state is not a for-profit entity, as public servants we can also make an impact on the general lives of all Texans through resource management testing.
At the DSHS Laboratory, I test drinking water samples for the things that would make you sick. Each year I personally see hundreds of samples from all across the state. Using lab equipment like Gas Chromatographs that separates the different parts of the water into bite-sized parts. I use a Mass Selective Detector to then identify these parts which tells us how much of a substance is in the water. We give this information to TCEQ who then decides if the data shows an acceptable or concerning level of substance in the water.

Story 5: Facts about water and then anthrax

When scientists at the **Texas Department of State Health Services (DSHS) Laboratory** test water samples, our scientists generally do not know where the water is

from or its suspected contaminants, if any.

The **Texas Commission on Environmental Quality (TCEQ)** has samplers send water samples for routine testing and other requests straight to the laboratory. Each sample gets a unique laboratory number and label. The DSHS Laboratory then tests each sample and sends the results to TCEQ for interpretation.

Wat-er You Drinking?

Water that is safe to drink under the federal **Safe Drinking Water Act** may seem unsafe if you are not familiar with the details of the water source profile.

is to figure out how many of each color there are.

It's a fun game to guess, but when it comes to public health, we want to **know**. The only way to know for sure is to dump the jellybeans out, sort them by color, and then count.

This is basically what a **GC/MS** does. DSHS chemists extract the contents from a water sample into a concentrated little vial, using a solvent. A bit of this is then put into the **GC/MS**.

All of the different compounds are separated in a long column. Compounds from the water will travel at different speeds through this column based on their physical and chemical properties, so they come out the end at different times.

When the different compounds from the concentrated sample extract come out the end of the column, they are broken apart, and **ionized** by the **mass spectrometer device** so they can be measured. Each compound

always breaks apart in the same way, always providing the same **mass spectrum**.
Using this known spectrum, and the time it takes for a compound to pass through the column, a chemical compound can be positively identified. The **GC/MS** also measures a response intensity that is proportional to the amount of a compound in the sample. **This is equivalent to counting the jellybeans.** All molecules of the same organic compound will shoot through the column at the same speed. Knowing each compound's finish-line time and spectrum is just like knowing each jellybean's color and size.

ANTHRAX

One biological threat to face Texans comes through the mail.

In recent years, a fine white powder has been a favorite scare tactic, anonymously sent to public offices around the state and nation. DSHS takes each case seriously, with Biological Threat Team personnel on call at all times to receive and test samples of suspected *Bacillus anthracis*.
Anthrax, a zoonotic disease, primarily occurs in domesticated animals which then infect humans through contact or consumption. Anthrax may seem like a modern issue, however several historical references to the microbe trace its effect on humans back thousands of years.
Plagues in Egypt around 1500 BC are attributed to *B. anthracis,* and Homer's Iliad, written around 850 BC, describes how, as punishment imposed by Apollo, a "burning wind of plague" first affected domesticated

animals, but soon affected soldiers as well.
French bacteriologist Casimir-Joseph Davaine was able to use anthrax to prove disease was caused by a microbe in 1863, and in the 1950s United States scientists and politicians successfully regulated *B. anthracis* exposure for workers in the animal industry.
The introduction of an anthrax vaccine for humans in the United States contributed to the decline in the number of anthrax cases throughout the 20th century.
By the close of the 20th century, reports had dwindled to around a case every other year in the United States. There were no cases reported between 1992 and 2000, according to the Centers for Disease Control and Prevention.

For more information, visit the DSHS article 'History of Anthrax - Anthrax Through the Ages' at www.dshs.texas.gov/preparedness/bt_public_history_anthrax.shtm

Interested in a topic? Let us know! Please write to us at Laboratorian@dshs.texas.gov to submit your questions.