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Testing for Zika in the state of Texas

Mosquitoes have been around for millions of years, and certain species have adapted to breeding and living in close proximity to humans. Specifically, *Aedes aegypti* mosquitoes have a predisposition for feeding on humans, often biting multiple people during a single meal.

We owe the naming of this pesky insect to the Greeks who named the genus '*Aedes*,' which means

‘extremely unpleasant or repulsive.’

The *Aedes aegypti* mosquito sports distinctive black and white markings on its legs and body, giving it the appearance of having just leaned against a freshly whitewashed fence (page 10).

As if being pesky, unpleasant and repulsive is not enough to establish a bad reputation for any insect, it is now associated with the mosquito-borne virus Zika.

ZIKA is an arbovirus (arthropod-borne virus) associated with the likes of dengue, yellow fever, chikungunya, and West Nile viruses, all transmitted by mosquitoes. Those not familiar with the clinical spectrum of arboviral diseases should note that these viruses can all start out looking pretty much the same under a microscope.

“This can create issues for clinical diagnostics in areas where multiple arboviruses are circulating,” said Joanne Day, Microbiologist at the Department of State Health Services’ public health laboratory.

The laboratory receives and tests thousands of mosquitoes from all over the state each year. The labratory’s interest is focused on *Aedes* and *Culex* species mosquitoes, as these insects are considered to be the primary vectors for transmitting viruses of public health concern.

And the rest of Texas is interested as well.

“When Zika was spreading in other countries this past summer, it received a lot of media attention. We had several news crews come in to do stories on our lab,” said Bethany Bolling, Microbiologist.

“We welcome the press and encourage their questions to help the public understand more about the testing process,” said Bolling.

The importance of their work for the community is not lost on the Arbovirus Team.

“The most interesting part of my work is when an arbovirus or mosquito-borne disease is in the news. I’m proud that I am part of a team that is working to serve the public and protect people from the disease,” said Hima Rambhatla, Microbiologist.

Health works from across Texas collect mosquitoes and then send them to the laboratory in Austin for identification and testing.

Once a batch of mosquitoes arrives at the DSHS Laboratory, technicians receive and record each delivery. The insects are frozen and manually identified to species by laboratory scientists.

“We provide a very valuable service to public health districts in Texas,” said Joseph Hancock, Microbiologist.

“It is a unique job that requires skillsets in both entomology and microbiology.”

Hancock’s main job is to visually identify and manually group each mosquito in nearly every batch of insects shipped to the laboratory each and every day (page 10).

Once sorted and identified, each batch of mosquitoes is ground up and placed onto cell culture plates for the virus detection process. If a virus is detected, antibodies are used to identify which virus is present. The antibodies are engineered with a fluorescent dye so when they attach to a virus, they light up when viewed with a fluorescent microscope.

“If you see bright green cells, this means that the sample is virus-positive,” said Mary D’Anton, Microbiologist.

“We have virus-specific antibodies for many different arboviruses that are, or could potentially be, circulating in Texas. This helps our surveillance program detect and track mosquito-borne diseases so that local health officials can initiate preventative measures,” D’Anton said.

The laboratory records and analyzes the testing data in order to communicate public health concerns for each area from which the batch of mosquitoes are received for testing.

"Texas public health and safety is our main objective here in the lab," said Day. "So we make sure to be accurate, timely and dependable in our work."

Texas announces local Zika virus case in Rio Grande Valley: Press Release November 28, 2016

The Texas Department of State Health Services and Cameron County Department of Health and Human Services today announced the first case of Zika virus disease likely transmitted by a mosquito in Texas. DSHS is supporting Cameron County's response to the case and to the ongoing risk of Zika in the community.

The patient is a Cameron County resident who is not pregnant and who was confirmed last week by lab test to have been infected. She reported no recent travel to Mexico or anywhere else with ongoing Zika virus transmission and no other risk factors. Laboratory testing found genetic material from the Zika virus in the patient's urine, but a blood test was negative, indicating that the virus can no longer be spread from her by a mosquito. There are no other cases of suspected local transmission at this time, but health officials continue to conduct disease surveillance activities as part of the state's ongoing Zika response.

"We knew it was only a matter of time before we saw a Zika case spread by a mosquito in Texas," said Dr. John Hellerstedt, DSHS commissioner. "We still don't believe the virus will become widespread in Texas, but there could be more cases, so people need to protect themselves from mosquito bites, especially in parts of the state that stay relatively warm in the fall and winter."

Cameron County, DSHS and the Centers for Disease Control and Prevention are working together to investigate and respond to the case. Further investigation will be necessary to attempt to pinpoint how and where the infection occurred, and health officials are also responding in a number of other ways. DSHS has activated the State Medical Operations Center to support the response and is providing expertise, personnel and equipment for activities from disease investigation to mosquito surveillance to public education.

With DSHS support, Cameron County and the City of Brownsville have conducted an environmental assessment at the patient's home and have been trapping and testing mosquitoes to learn more about activity in the area. Brownsville has recently sprayed for mosquitoes in the area and will continue to take action to reduce the mosquito population.

Health workers from Cameron County and DSHS will be going door to door in the area around where the case lived beginning this evening to educate the public about Zika, help people reduce potential mosquito breeding habitat on their property, and collect voluntary urine samples to determine whether other infections are present. The samples collected will be tested at the DSHS laboratory in Austin. The DSHS regional office in Harlingen has delivered laboratory supplies, boxes of educational materials and mosquito traps to Cameron County and will continue to assist in the response. Additionally, state and local public health has been in communication with CDC, which is providing additional assistance and expertise.

Travel back-and-forth across the border is a way of life in the Valley, and news reports from Mexico indicate Zika transmission by mosquitoes in multiple communities on the Mexican side of the border. Due to the risk of birth defects associated with Zika, pregnant women should avoid traveling to Mexico and should avoid sexual contact or use condoms with partners who have traveled there. Other precautions include:

- Using EPA-approved insect repellent.
- Wearing long pants and long-sleeved shirts that cover exposed skin.
- Using air conditioning or window and door screens that are in good repair to keep mosquitoes out of homes.
- Removing standing water in and around homes, including water in trash cans, toys, tires, flower pots and any other container that can hold water.

Zika virus is transmitted to people primarily through the bite of an infected mosquito, though sexual transmission can occur. The four most common symptoms are fever, itchy rash, joint pain and eye redness. While symptoms are usually minor, Zika can also cause severe birth defects, including microcephaly, and other poor birth outcomes in some women infected during pregnancy.

DSHS is again asking health care providers to consider Zika virus infection in their patients and order the appropriate testing. DSHS recommends testing all pregnant women who have traveled to areas with active Zika transmission during their pregnancy. DSHS also recommends testing pregnant women who have two or more of the typical Zika symptoms in Cameron, Hidalgo, Starr, Webb, Willacy or Zapata counties without travel history, and anyone with at least three symptoms statewide. Providers can find additional information at www.texaszika.org/healthcareprof.htm.

Through last week, Texas has had 257 confirmed cases of Zika virus disease. Until now, all cases had been associated with travel, including two infants born to women who had traveled during their pregnancy and two people who had sexual contact with infected travelers. Additional information on cases and for the public is available at www.texaszika.org.

Meet your Scientist: Joseph Hancock, Microbiologist in the Arobvirus-Entomology area

Meet Joseph Hancock, Microbiologist in the Texas Department of State Health Services Laboratory Arbovirus-Entomology Team. His job is to manually identify each and most every mosquito coming through the doors of the Texas public laboratory. We asked him the classic 'Who, What, Where, When, Why, and How' questions for a series we call **'Meet Your Scientist.'**

WHO

My name is Joseph Hancock, and I am a Microbiologist at the Texas Department of State Health Services Laboratory Arbovirus-Entomology Team. I was born and raised in Texas, with both sides of my family going back at least four generations being from the state.

WHAT

My main role in the laboratory is identifying mosquitoes collected all across Texas and sorting out certain species of mosquitoes. We then test these mosquitoes for West Nile, chikungunya, Zika and other viruses.

My work helps the state identify where certain arboviruses can be found, or if we should be concerned with new viruses, such as Zika, circulating within Texas.

Because our lab is focused on surveillance, we receive thousands of mosquitoes from all over Texas. It may be hard to comprehend, but several different species of mosquito are stunningly beautiful under the microscope. The amazing diversity means that there are new surprises day to day and season to season.

WHERE

I work at the DSHS' main campus in North Central Austin. The public health lab is a seven-story building which processes thousands of tests each day.

WHEN

I started working in the lab in 2013 within Microbiology check-in, and moved to the Arbovirus-Entomology Team in 2015.

WHY

I have always had one main goal when pursuing a career in science; to have my work help the small rural communities like the one I grew up in. This position definitely fits that goal since mosquito-borne viruses (arboviruses) impact people who stay outdoors more and are very deadly to horses and other equines.

Furthermore, this laboratory has been very dynamic, as we must adjust to new arbovirus threats (such as chikungunya and Zika) as well as prepare for sudden upswells of activity from existing arboviruses (e.g., West Nile). The constant challenges of meeting the needs of the communities that send us samples is very interesting and rewarding.

The diversity of mosquitoes sent to our laboratory is astounding. Species can vary from the small black and white Aedes aegypti mosquito, which is a possible vector of Zika, to the massive and iridescent Toxorhynchites rutilus septentrionalis, which is a beneficial mosquito as its larvae feed on other mosquitoes.

HOW

I obtained both my Biology undergraduate and Entomology Master's degrees from Texas A&M University. Unfortunately, I graduated in the middle of the 2008 recession and I was worried that to get a decent job in my field I would have to leave the state. Luckily the Texas Department of State Health Services had positions that fit my expertise, and so now I work in the Arbovirus-Entomology Team identifying mosquitoes.

Sending out an S.O.S.

An infant doesn't know mores code, yet with a few dots dashed on a card, they can give us an SOS about a major health condition within the first hours of life.

Little Texans have been "stuck" with care since 1965, when the 59th Legislature mandated newborn screening for phenylketonuria (PKU), an inherited disorder which, if left untreated, causes intellectual and physical disability, among other complications. If diagnosed in infancy, a simple diet change is usually enough to circumvent the devastating effects of this disorder.

Even in one lifetime, the Texas newborn screening effort has made tremendous leaps in screening care, assisting thousands of Texans to make sometimes life-saving decisions based on information gathered, or "drawn" within the first few hours of life.

One such lifetime belongs to Amber Conrad, a recent new-hire at the DSHS Laboratory.

In 1985, 5-hour-old baby Conrad's blood was drawn at the hospital and sent to the Austin

laboratory to be screened for PKU, galactosemia, hypothyroidism and sickle cell disease.
A second screening was also mandated, so it was back to that doctor again for baby Conrad and her stuffed rabbit when she was a week old.
“Many of us were only screened for a few disorders,” said Lynette Borgfeld, Newborn Screening Group Manager.
“It’s only fairly recently for those in their early teens and younger to be screened for dozens of tests. Children currently in elementary school are now the ones who have the largest number of disorders within the infant screening. Even in the relatively short last 20 years, we have seen tremendous growth in the NBS program.”
Borgfeld came to the Texas public health laboratory in 1988 just as the state added congenital adrenal hyperplasia (CAH) to the list of screened diseases in infants in 1989.
“Thanks to public and legislative interest and medical breakthroughs, newborn screening has stayed on the minds of Texans for the past 20 or so years,” Borgfeld said.
As Conrad sang Disney tunes with her middle school choir in 1998, the largest public health laboratory in the nation initiated a fee for newborn screening, and by the time she graduated from high school in 2003, the NBS program was settling into a new facility and testing for seven disorders.
In 2007, the same year Conrad shook her dean’s hand at college graduation, the laboratory started a six day work week and began testing for 27 disorders as mandated by the 79th Legislature.
When Conrad became a Department of State Health Services Laboratory employee in 2016, the agency housed the largest newborn screening program in the world with statewide infant testing of 53 disorders, point of care screening for two more disorders and clinical care coordination for infants with out-of-range test results.
The Texas Laboratory’s NBS is responding to legislative inquiries **about adding another three disorders.**
Annually, the Laboratory Services Section tests approximately 400,000 infants, once in the first 48 hours and again between the first and second week of life, for a total of 800,000 specimens each year. Of these, roughly 20,000 samples are found to be abnormal, which leads to the early diagnosis and treatment of around 800-900 infants a year.
“It’s amazing to see such leaps in growth of a program over just a few decades,” Conrad said. “Working for the lab now, the fact that we can track such major progress over just my life really hits home.”
Each morning, dozens of assorted boxes and stacks of mail bins filled with blue and white envelopes arrive at the Department of State Health Services Laboratory receiving center off 49th Street in Austin.
The packages, with return addresses from Texarkana to El Paso, from Dalhart to Del Rio, contain all the NBS program samples from all the babies born in Texas over the last 24 hours and within the last 14 days. Eight dots are punched from five spots of blood on each sample card into eight different types of microtiter plates for the eight different tests used to screen for the 53 conditions. After these eight dots are tested, and if a result is positive for a disease or inconclusive, a DSHS Clinical Care Coordination nurse or public health and prevention specialist reaches out to the family and medical providers.
“Our staff takes each sample and handles it as if it were from our own children,” said Dr. Grace Kubin, Laboratory Section Services Director.

Through decades of change, the newborn screening program remains one of the state's most successful, ongoing public health projects ever undertaken by the people of Texas.

Photo captions for newborn screening test processing

TOP LEFT: Stephanie Banda, Laboratory Technician, reviews Newborn Screening cards for quality and defects such as improper sample size. TOP RIGHT: A scientist carefully places one of the NBS cards on a specially-designed punching instrument. Scientists use this instrument to punch 8 dots from each NBS card into 96-well plates. The NBS cards are kept on file so technicians can find them again if further testing is necessary for a sample. BOTTOM LEFT: These dots are then organized into batches and delivered to different areas of the NBS laboratory for the dozens of tests mandated by the State of Texas. BOTTOM RIGHT: As the dots are punched, they are loaded into the 96-well plates. This is what it looks like inside each of the plastic plates in the bottom left image. The plate is used by scientists to carry and test the dots. Each plate contains the quality control and actual specimens that make up an individual analytical batch.

Texas Lab History: Vaccines, geese, sheep and Petri dishes

In 1936 the Bureau of Laboratories, now the Department of State Health Services Laboratory, was licensed by the National Institute of Health (NIH) to make biologics, including Typhoid vaccine, rabies vaccine, tetanus toxoid, diphtheria toxoid, and pertussis.

For almost half a century, the state laboratory housed rabbits, mice and guinea pigs and kept sheep and geese in pastures nearby the laboratory, around the present-day intersection of North Loop and Grover in Austin.

A staff member took care of the animals, providing for their every need. The laboratory supervisor, with the help of the caretaker and sometimes other staff, performed blood draws.

All animals were otherwise free to do as they pleased, and the phlebotomists rotated the animals so blood was not taken too frequently.

Sheep blood was used to make media such as blood agar plates and slants. The state's laboratory kept some of the media onsite and shipped the rest to other local laboratories around the state. Other animals' blood was used for various tests around the laboratory.

The biologics area of the laboratory was kept away from other parts of the laboratory because staff had to be sterile and aseptic with special clearance before entering the specific buildings used to create vaccines. Because of this seclusion, many of their peers even within their own agency overlooked the efforts of the biologics area, a tactic that was often used to keep important work, like work done to create vaccines for the American public, as low-key as possible.

Nicky Danysh, a retired unit chief for the creation of the pertussis vaccine at the state laboratory, began in 1967 as a media preparation worker and stayed through 1980. "I remember feeling that the rest of the lab thought we never did anything," Danysh said. "I wish they would really know the truth because it was a lot of hard physical work."

According to Danysh, about eight staff members worked on vaccine production when she started in 1967. It took two years of working in the area to become trained on all steps involved in the creation of vaccines. Each vaccine was created in heavily-monitored steps, each of which were standardized and double-checked. There were also various components of vaccine in production at one time and the different components would be combined into a final product. Once the internal creation and testing was complete, all the quality control information and samples of each vaccine were sent to the NIH or the Federal Drug Administration for final approval before a batch could be released to requestors.

“Diphtheria and tetanus [were tested] in another building,” recalls Danysh. “And talk about smell; that really smelled. [Vaccine technicians] could come in from that building and [you would] smell it.”

The smell, a dense sulphur aroma of really bad eggs, would often cling to clothes long after the vaccines were processed, as the odorous process required anaerobic bacteria. Anaerobic bacteria reduce sulphur compounds to create thiols, mercaptans and finally hydrogen sulphide. These are highly aromatic chemicals humans have evolved to dislike, as they are present in expired foods and harmful bacteria like, for example, the microorganisms that are responsible for diphtheria and tetanus.

In 1978, the laboratory stopped producing vaccines because the director at the time determined it was no longer cost-effective for the state to continue producing vaccines. The labor and responsibility was greater than the amount of revenue. Vaccines also became very inexpensive, and other vaccine production companies were going out of business.

“We also made the whole cell pertussis [vaccine],” remembers Danysh. “Towards the end, we got calls from all over the world wanting that, because it was not being made.”

The state laboratory now focuses on specimen testing, with approximately 5,000 test results leaving the laboratory each day.

“If you individually consider all of the panels, identifications, and screenings offered by our laboratory, we are able to provide over 500 unique tests relevant to public health. Our laboratory testing directly impacts and improves the well-being of nearly 2 million Texas citizens each year,” said Tori Ponson, Project Coordinator for the Quality Assurance Unit.

As the laboratory gears up to celebrate its 90th anniversary in 2018, many people are coming forward to share their experiences with the state laboratory as it has drastically grown over the last nine decades. If you have information you would like to share with our historians or questions you would like answered in our upcoming history series, please contact: laboratorian@dshs.texas.gov.

The more you know: Laboratorian facts

Laboratorian:

noun lab·o·ra·to·ri·an(lab-(ə-)rə-ˈtōr-ē-ən) One who works in a laboratory. May supervise, examine or perform tests with various types of chemical and biologic materials. These tests and examinations aid in the diagnosis, treatment and control of disease or serve as a basis for health and sanitation practices.

Commonly referred to as a Scientist

BASE OPERATIONS

Texas has the largest public health laboratory in the United States. The laboratory is part of the **Department of State Health Services (DSHS)**.

The Texas Legislature created the **Bureau of Laboratories** in 1928. The Bureau was located in downtown Austin and provided testing for multiple health concerns. Prior to the establishment of a dedicated public health-focused laboratory, the Bacteriological Laboratory was located on the 3rd floor of the Capitol in the early 1900s, west of the galleries of the House of Representatives. It was then moved southeast of the Senate, sharing space with the Food and Drug Laboratory.

BACTERIA

“Bacteria” comes from the Greek word for **small-rod**, the first shape of bacterium identified under a microscope.

People have on average 3.3 pounds of living bacteria inside their body. This does not include the bacterial colonies living on the skin.

You are more bacteria than human: for **every human cell in your body, there are 100 bacteria cells.** It is estimated that each human has more bacteria in its gut than there are people on earth.

In a 2014 paper, Joe Alcrock, Carlo C. Maley and C. Athena Aktipis theorized that the **bacteria in our gut actively talks to our brains through our vagus nerve.**

BABIES

The Texas DSHS Newborn Screening (NBS) laboratory in Austin is the largest of its kind in the world because of the centralization of testing. It tests all newborn blood samples collected in the state as opposed to having multiple labs scattered geographically. **All** newborns in Texas are tested twice after birth.

Newborn screening started in the United States 51 years ago. The Centers for Disease Control recommend every state test newborns for at least 29 core disorders.

The **Kuddle-Up line** of blankets is made by the company Medline out of Mundelein, Illinois. The company started producing baby blankets in 1910 and soon found a market in hospitals across the state then world over the next 116 years. Today, the company’s blue and pink-striped, white cotton blankets wrap 99 percent of babies born in United States hospitals each year.

The 5-second rule: germs can’t tell time, but the prefer watermelon to hard candy

The iron-clad idea of chanting ‘Mississippis’ until your pizza slice is rescued from the floor’s many microscopic assailants, is used routinely by most. Further charms to ward off ill-effects include, but are not limited to, blowing on, shaking or lightly tapping the fallen morsel.

The 5-, 2- or even 10- second rule as some call it, varies by user, however the notion of a grace period that somehow protects delectable morsels between drop and contamination is common.

How does the rule measure up scientifically?

“If you drop that cookie on dry ground, you should have plenty of time [to retrieve and eat it],” said Mark Rober, NASA engineer. Rober and his colleague Mike Meacham went on the Science Channel’s *The Quick and the Curious* to explain.

“Well, when it’s not being helped along by your hundred mile per hour sneeze, the average bacteria moves along at a blistering speed of 0.00045 miles per hour,” said Rober.

“That is 67 times slower than the average garden snail. The ‘5-second rule’ is really the ‘30-second moisture and surface rule.’”

The NASA scientists and a late 2016 Rutgers study found that not only is time a factor, but the food’s liquid content and the surface on which it fell. Carpet, with its tiny fibers, has less surface area touching the slipped-away cookie, so it would take longer for germs to move onto it. But linoleum, found in most kitchens, has more contact surface area, making foods dropped on that surface collect germs relatively fast. The Rutgers study found the best case scenario for eating food that has been dropped on the floor is hard candy on carpet. The worst: watermelon on tile.

“The 5-second rule is a significant oversimplification of what actually happens when bacteria transfer from a surface to food," Donald Schaffner of Rutgers said. "Bacteria can contaminate instantaneously."

Yet, no matter the technical and tested timeframes used in studies, professionals dealing with foodborne pathogens still ascribe to the **Drop It, Leave It rule.**

"I don't care if it's been there for 5, 10 or 30 seconds; if it falls on the floor, I'm not eating it," said Natalie Perryman-Hale, Microbiologist in the Consumer Microbiology section of the Department of State Health Services Laboratory in Austin.

"Surfaces in general are havens for microbes and bacteria, and any food on any surface you run the risk of picking up foodborne pathogens. I'd say the risk outweighs the benefits."

Texas lab selected to lead Mountain Region of the AR Lab Network

What if, instead of making you better, your next round of antibiotics actually did little more than a spoon full of sugar?

When Sir Alexander Fleming found a fungus, Penicillium notatum, which seemed to have nearly magical powers in treating bacterial illness, penicillin was soon discovered. This launched the antibiotic era, resulting with quick-fixes in little pills for our now everyday ailments.

However, there seems to be a catch: bacteria are learning to resist.

Antibiotic resistance (AR) is a concerning trend to health care providers, who are seeing more cases each year of pathogens who just do not seem phased by modern pharmaceuticals. When the Centers for Disease Control and Prevention (CDC) took a look at national-level efforts to combat AR, they realized

The CDC launched the Antibiotic Resistance Laboratory Network (ARLN) in Fall 2016. The Network is designed and funded to be a laboratory network which consists of the CDC, seven regional laboratories, state public health laboratories, hospital and other healthcare facility laboratories. Those in the Network will then join together to improve testing capacity for AR and difficult to treat pathogens.

The Texas Department of State Health Services Laboratory Services Section was named the head of one of those seven regions, taking on the lead role for the Mountain Region of the nation.

As a regional laboratory, the Texas facility will represent the second-in-command in the four-tiered chain of health care organizations, followed by state and local health departments and then other healthcare laboratories in the defined region.

Specific responsibilities include:

- Helping to ensure more consistent and improved communications
- Providing coordination for the tracking of AR threats across healthcare facilities, state health departments, and CDC.

- Working with participating hospital, state public health, and other laboratories to conduct specialized antimicrobial resistance testing
- Sharing generated data at no-cost to participating laboratories
- Providing free shipping for specimens submitted to regional laboratories by participating hospital and clinical laboratories.

The CDC said in a nationwide press release it hopes that by coordinating this information, regional laboratories can gain real-time data from regional and nation-wide scales to "monitor and create pathogen-specific solutions for emerging threats, support outbreak response, and provide better data for stronger infection control and prevention measures against these infections – all to help save lives."

To meet this goal, the CDC will work the regional laboratories on the national level to:

- Develop testing methods and guidance
- Conduct in-depth studies of unusual samples found in lower-level labs
- Collect findings
- Report critical findings to international partners
- Identify trends in resistance
- Provide strategic prevention recommendations
- Identify gaps in information
- Request threat assessments
- Add new samples to the national collection so everyone can test and create more effective treatments
- Provide training and other technical assistance.

To begin the ARLN, laboratories from around the nation will focus on five priorities:

- Carbapenem-resistant Entebacteriaceae (CRE) logically named because they are bacteria which are resistant to an entire class of antibiotics called carbapenem. Carbapenem is used as a last resort for infections which do not react to other antibiotics.
- Its second and third priorities center on CRE outbreak support and CRE characterization.
- The fourth priority is the salmonella whole genome sequencing (WGS) program, and the last priority in the ARLN is detecting new resistance threats.

Katie Kneupper, Microbiologist in the Austin molecular biology team works on the WGS program.

"I help the CDC with testing so they can focus their efforts on analysis and finding resistance mechanisms," Kneupper said.

Kneupper receives grant funding from the CDC to purchase testing kits. These kits contain chemicals and supplies necessary for creating DNA libraries and sequencing bacterial genomes. This means that Kneupper is looking for similarities in bacteria collected from around the nation so that she and other scientists in the network can begin to understand how the bacteria work and how they make people sick.

Bacteria from one source, called bacterial isolates, are sent to the program from many places including local health departments, hospital laboratories and even isolates from food samples cultured by the DSHS Laboratory's own Consumer Microbiology Team (see page 20). This testing provides data which the CDC can use to track outbreaks and create resource information as scientists like Kneupper work in laboratories across the nation.

There are many reasons why this network of laboratories exists around the nation. Local laboratories outside of the ARLN may not have the funding to buy the special machines used in this bacteria DNA sequencing, or the bacteria the local laboratories find is out of the ordinary. Or the laboratories are simply following required protocol for when they find certain types of bacteria in their samples.

A typical day for Kneupper has her taking that culture and extracting DNA from the isolated bacteria. She then runs a test to make sure enough DNA was collected. She does this by combining the DNA with a chemical that binds florescent dyes to the DNA so they can be counted.

Next she processes the DNA to get cleaned and copied many times for the testing process using a series of polymerase chain reaction (PCR) steps and clean-up steps to create equally represented, single-stranded, machine recognizable DNA bits known as libraries. She then pools the libraries together and adds them to one reagent cartridge, preps the Illumina MiSeq, a machine that sequences the DNA, and waits for approximately 40 hours.

During that time, the machine does its own DNA copying called cluster generation, where the groups of standardized bacteria DNA, or libraries, are enlarged to create clusters of identical DNA fragments. Sequencing by synthesis then occurs where fluorescently tagged nucleotides are incorporated. This is a fancy way of saying that the MiSeq takes a picture with the help of fluorescent tags to identify the DNA. The wavelength from the bright light is caught on camera and the series of colors shows the sequence of that DNA fragment.

"The process is time consuming, but I enjoy working on something so important to modern science." Kneupper said.

The results are then shared with the CDC for assembly and analysis and the sequences are uploaded to a national database.

"Ultimately it all gets uploaded into a Genome Bank at the National Center for Biotechnology Information for all of the public to see if they wish," Kneupper said.

With the organization of the national ARLN and with the direct role Texas will play as a regional laboratory for the Mountain Region, Kneupper's testing is just the start of the DSHS Laboratory's work on the national stage of this emerging area of international study.

The more you know caption: historic antibiotic resistance

Crude, naturally-occurring antibiotics have been used for centuries to treat bacterial issues from infected cuts to urinary tract infections. The Greeks and Native Americans used cultured molds and plants to treat skin infections, and Sumerian doctors used beer soup mixed with turtle shells and snake skins to counteract the bad bacteria in the sickly. Sri Lankan army documents show troops using sweetmeats as an antibacterial. A species of ants has used sticky tree resin as a tool to protect their developing young for over 20 million years, hanging it like lightbulbs in their colonies to create antibiotic bubbles around the next generation.