



# Division of Forensic Science 2018 Annual Report

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*State of Delaware  
Department of Safety and Homeland Security  
200 South Adams Street  
Wilmington, DE 19801*

John Evans, Director

Dr. Rebecca Walker, Chief Operating Officer

Dr. Gary Collins, Chief Medical Examiner

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Johna Esposito, Quality Assurance Manager

## *Table of Contents*

The Division of Forensic Science .....	3
Divisional Initiatives, Collaboration, and Information Sharing .....	4
Overview .....	4
DFSRP- Delaware Forensic Science Reporting System .....	5
National Violent Death Reporting System.....	6
Centers for Disease Control Biorepository Program .....	7
Delaware Drug Monitoring Initiative.....	7
Disaster Preparation .....	8
Overall Reporting & Collaboration.....	8
Community Engagement.....	9
Assessment, Accreditation, and Quality Assurance.....	9
Medical Examiner Unit.....	11
Overview .....	11
Training and Outreach .....	12
Partners .....	13
Data .....	13
Toxicology .....	22
Overview .....	22
Staffing and Accreditation .....	22
Data .....	23
Projects and Grants .....	29
DNA.....	30
Overview .....	30
CODIS.....	30
Casework.....	31
Grants .....	33
Data .....	34
Forensic Chemistry .....	35
Overview .....	35
Casework and Accomplishments .....	35
Staffing.....	36
Data .....	37
Conclusion .....	39



**State of Delaware**  
**DEPARTMENT OF SAFETY AND HOMELAND SECURITY**  
**OFFICE OF THE SECRETARY**  
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**302-744-2680**

**The Honorable John Carney**  
Governor

**The Honorable Robert M Coupe**  
Cabinet Secretary

May 1, 2019

To the Citizens of Delaware:

I am honored to recognize the outstanding work of the women and men of the Division of Forensic Science (DFS) highlighted in this year's annual report. Their dedication and professionalism has resulted in numerous accomplishments while carrying forth the mission of the Division in serving the citizens our great State.

One of the most noteworthy undertakings of the past year was the Division's work to expand operations within the Chemistry Unit. With the State's support, DFS increased the number of Forensic Chemist positions. As a result, in January 2018, the Unit began operating at full capacity for the first time since the DFS was transferred to the Department. With additional chemists on staff, the Unit was able to accept drug evidence from all law enforcement agencies statewide. Being independently capable of accommodating all criminal justice related drug testing needs of the State and no longer dependent on an outside laboratory, resulted in a significant cost savings to the State.

In July 2018, Director John Evans worked with Facilities Management to begin a major renovation of the Wilmington Medical Examiner's Morgue and Autopsy Suite. The project included the installation of a new dedicated negative pressure HVAC system separate and apart from the shared HVAC system currently in the building, two new body coolers, three state of the art autopsy work stations and a new epoxy floor. These upgrades are in accordance with National accreditation standards. To accommodate an extended construction period, the Division performed its autopsy work at the Georgetown location and established a temporary morgue on the property of Emily P. Bissell Hospital grounds.

In partnership with the Criminal Justice Council and the Sexual Assault Kit Initiative (SAKI), the DNA Unit continues to test kits that police agencies in the State had not previously submitted in an effort to help provide resolution for victims when possible. This work has resulted in the closure of several cold cases.

While working with the Center for Drug & Health Studies at the University of Delaware, the DFS provided data to help better understand the opioid epidemic in Delaware. DFS continues to partner with other State agencies and committees studying and working to address the various concerns related to opioid addiction and death.

Please join me in extending sincere thanks and congratulations to the women and men of DFS for a year filled with many accomplishments and successes.

Robert M. Coupe

A handwritten signature in blue ink, appearing to read "R M Coupe".

Secretary



**STATE OF DELAWARE  
DEPARTMENT OF SAFETY AND HOMELAND SECURITY  
DIVISION OF FORENSIC SCIENCE  
200 South Adams Street, Wilmington, DE 19801  
302-577-3420**

**The Honorable John Carney  
Governor**

**The Honorable Robert Coupe  
Cabinet Secretary**

To My Fellow Delawareans:

On behalf of the men and women of the Division of Forensic Science (DFS), I am proud to present the 2018 Annual Report, which highlights the outstanding work and critical role that the (DFS) plays in the criminal justice process in Delaware.

The Mission of the (DFS) is to provide the most reliable scientific analysis of evidence for the administration of justice. Sound and timely pathology and forensic science services are provided for the justice system, driven by crimes committed and deaths occurring in the State of Delaware.

The organizational structure of the Division is a collaborative model where each discipline is equally invested in the overall success of the Division. A stratified model of accountability is used, where each team member has a specific role toward meeting the overall mission.

By continuing to meet accreditation standards and certifications, the (DFS) maintains the highest scientific standards and ensures both organizational and individual integrity. The work ethic of the employees of the (DFS) is strong and we hold true to our core values of Integrity, Honesty, Thoroughness, Timeliness and Professionalism.

The number of case submissions in 2018 continued to increase across each of the four disciplines; Toxicology, Forensic Chemistry, DNA and the Medical Examiner Unit. The dedicated staff continues to meet the increased demands, while keeping turnaround times on test results at an acceptable level and within Court established deadlines.

Significant progress has been made in adding fire debris testing and analysis to the Forensic Chemistry Unit, which successfully completed an outside assessment of accreditation standards. Thanks to collaborative support from the Office of the State Fire Marshal, a necessary piece of sophisticated instrumentation has been purchased and validated to be used in fire debris analysis.

With the New Year in 2019 comes the completion of a major morgue renovation project at the Wilmington Office, resulting in a state of the art autopsy suite. Coupled with our data sharing, the Division continues to pursue grant opportunities allowing the (DFS) to increase our drug testing capabilities in an effort to combat the on-going opioid epidemic.

I would like to thank the members of the Commission on Forensic Science for their dedication and commitment to providing oversight and guidance to foster professionalism within, and the development and growth of, the Division of Forensic Science. I am confident that with the continued work of the Commission and with the support of Governor John Carney, Secretary of the Department of Safety and Homeland Security Robert Coupe, and the General Assembly, the forward momentum of the Division of Forensic Science will continue in 2019.

I take great pride in the hard work and dedication of the men and women of the Division of Forensic Science and for their continued focus on providing the level of service that our customers and stakeholders deserve and expect and I remain confident that they will meet any challenge in order to fulfill our mission.

Sincerely,

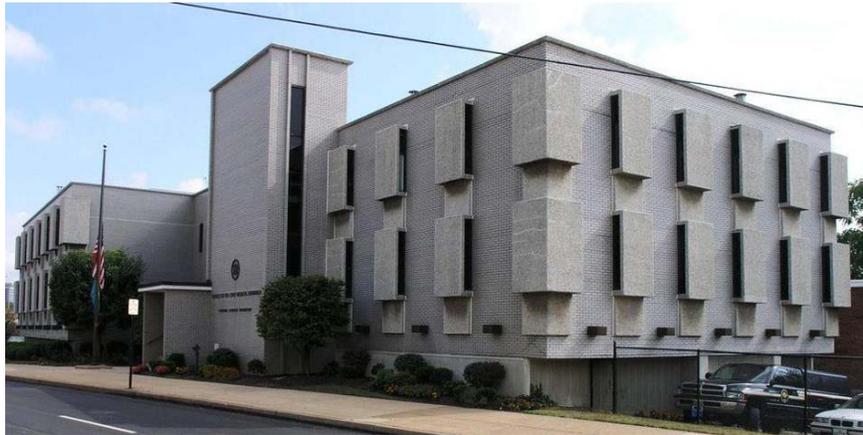
A handwritten signature in black ink, appearing to read "John R. Evans". The signature is fluid and cursive, with the first name "John" being the most prominent.

John R. Evans, Director

## The Division of Forensic Science

The Delaware Division of Forensic Science (DFS) was established on June 24, 2014 with the signing of Senate Bill 241 by Governor Jack Markell. Retired Senator Robert I. Marshall was the primary sponsor of the legislation with broad bi-partisan support in both the Senate and House. The bill reassigned

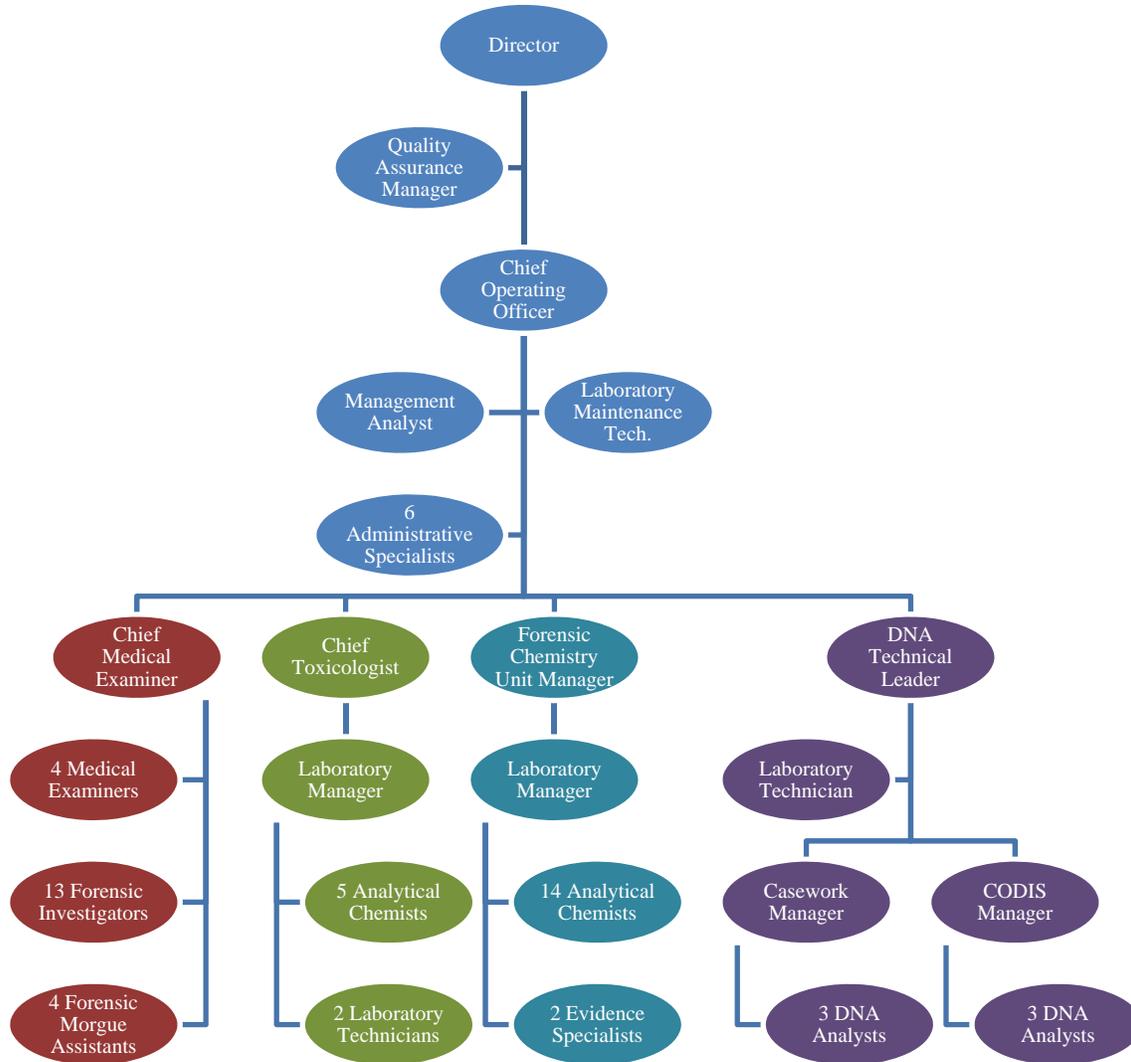
forensic and pathology examinations, formerly performed by the Office of the Chief Medical Examiner (OCME) within the Department of Health and Social Services (DHSS), to the Department of Safety and Homeland Security (DSHS), Division of Forensic Science.



Division of Forensic Science, Wilmington, DE

The Division is comprised of four disciplines including the Medical Examiner, Toxicology, DNA, and Forensic Chemistry. In addition, a Commission on Forensic Science was created by this legislation. The Commission is charged with providing oversight and guidance to ensure professionalism and integrity within the DFS and to support development and growth that better serves the justice system.

During 2018, the DFS continued to enhance operations and administration, embracing every challenge as an opportunity to improve. The DFS has maintained accreditation with the ANSI National Accreditation Board (ANAB). Additionally, the Medical Examiner Unit continues to be accredited through the National Association of Medical Examiners (NAME) and the Toxicology Unit through the American Board of Forensic Toxicology (ABFT). The DFS staff includes a board-certified Chief Forensic Toxicologist, board-certified Forensic Pathologists, as well as American Board of Medicolegal Death Investigation (AMBDI)-certified Forensic Investigators, which demonstrates a professional commitment to providing accurate, timely, and responsive forensic science service to all members of the criminal justice community in Delaware.



2018 DFS Organizational Chart. (Note that vacant positions are included in totals.)

## Divisional Initiatives, Collaboration, and Information Sharing

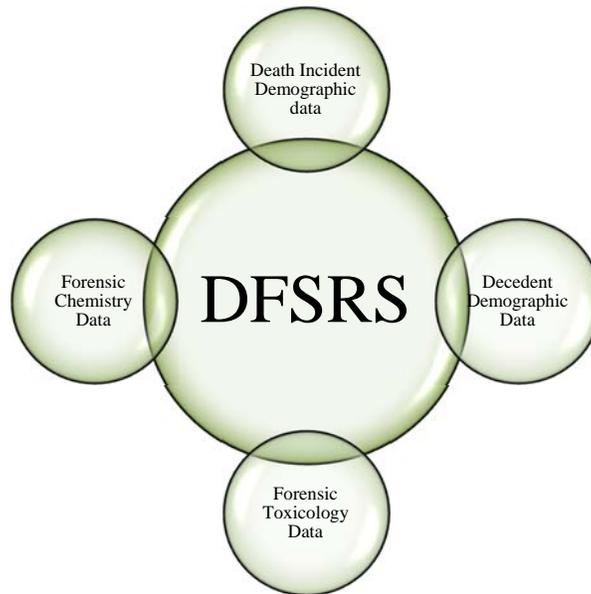
### Overview

The Division of Forensic Science believes that sharing of data and DFS information adds value to multiple governmental and academic initiatives. Working together across agencies, federal and state governments, and other stakeholder organizations supports the health and safety of all who we serve. Currently, DFS participates on two statewide commissions related to child death and overdose death, two CDC funded projects, the Delaware Drug Monitoring Initiative, the Delaware Substance Abuse Strategic Planning team, and several other forensic data driven projects with both our public health and law enforcement partners.

To forward the mission, the Division is continuously working on a comprehensive reporting system aimed at producing standardized information to key government and private sector stakeholders statewide. This work is identified as the Delaware Forensic Science Reporting Project (DFSRRP).

## DFSRRP- Delaware Forensic Science Reporting System

Delaware Forensic Science Reporting System (DFSRS) is a comprehensive reporting project aimed at producing standardized information to key government and private sector stakeholders statewide. DFSRS is a component of research conducted within the Division of Forensic Science under the Department of Safety and Homeland Security. DFSRS aims to provide consistent, reliable scientific data related to toxicology, forensic chemistry, and death related investigations to assist in law and health related initiatives statewide. This work provides a common platform for all operational and clinical data within the Division of Forensic Science.



### DFSRS Model

**Incident Demographic Dataset** is a data retrieved from the Pathology Unit. It includes data points such as: date, ME number, notification time, incident arrival times, responding agencies, incident address, and location type (home, business, accident scene, hospital, etc.). This information can be linked to OEMS, PMP and DELJIS data<sup>1</sup>.

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<sup>1</sup> Delaware State offices abbreviated are: OEMS – Office of Emergency Medical Services; PMP – Prescription Monitoring Program through the Division of Professional Regulations; and DELJIS – Delaware Criminal Justice Information System.

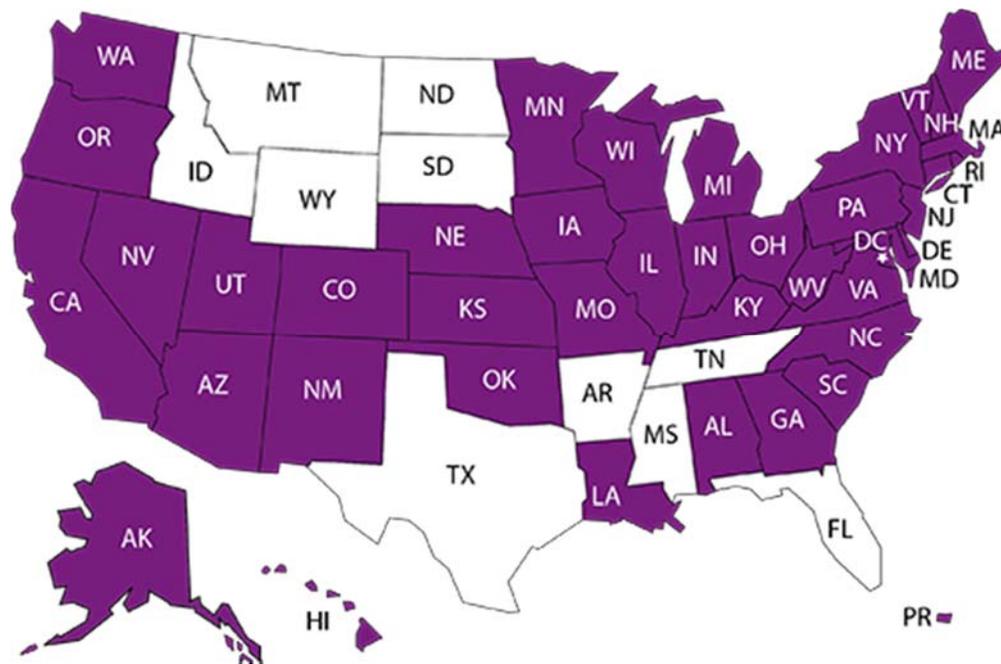
**Decedent Demographic Dataset** is data retrieved from the Pathology Unit. It includes data points such as: name, race, ethnicity, age, date of birth, gender, home address, past medical history, medications, allergies, cause and manner of death. A unique identifier can be assigned to each decedent.

**Forensic Toxicology Dataset** is data retrieved from the Forensic Toxicology Unit. It includes data related to toxicology results of decedents. This data set takes an estimated 30-60 days for the casework to be completed and released by the Chief Toxicologist.

**Forensic Chemistry Dataset** is data retrieved from the Forensic Chemistry Unit. It includes data related to drug testing and may take up to 90 days to complete casework before the dataset can be populated.

### National Violent Death Reporting System

DFS is a key partner in the National Violent Death Reporting System (NVDRS), managed by epidemiology researchers with the Delaware Division of Public Health; Delaware Violent Death Reporting System (DVDRS). This funded project was approved in 2016 and is ongoing. Created by the Centers for Disease Control and Prevention (CDC) in 2002, the NVDRS is a surveillance system that pulls together data on violent deaths in 40 states, including Delaware and the surrounding states (see map below).



(Borrowed from CDC, NVDRS State Profiles, 2018)

The National Violent Death Reporting System (NVDRS) provides states and communities with a clearer understanding of violent deaths. This information guides decisions by policy makers regarding efforts to

prevent violence and track progress over time. NVDRS is the only state-based surveillance system that gathers data on violent deaths from multiple sources. The NVDRS is incident-based system that links victims and alleged perpetrators with a given incident in one record. This work requires abstractors to collect key data from the DFS for the purposes of supporting effective prevention strategies to reduce violent deaths in Delaware.

### **Centers for Disease Control Biorepository Program**

Since 2016 DFS has continued to partner with the Child Death Review Commission for the collection of biological samples as part of the funded sudden death in the youth (SDY) CDC reporting project. DFS works with the SDY Registry to submit certain cases for DNA sampling as part of the grant requirement. DNA samples are then shipped to the University of Michigan SDY Biorepository. Forensic Investigators work with family members to obtain consent so that the DNA sample will be available for sudden child death research, and also to provide valuable information for the health and well-being of surviving siblings. The data and samples are used to create a resource that will be used by the National Institute of Health funded researchers to investigate SDY. An overhaul of the Child Death Review program was performed in late 2015, and as a result Delaware has seen improvements in data surveillance. These efforts are continuously monitored for efficiency and improvement. This vital work is being conducted through the collaborative efforts of the staff at the Child Death Review Commission and DFS to identify causes of sudden death in our Delaware Children.

### **Delaware Drug Monitoring Initiative**

In 2016 a team of individuals from the State of Delaware were selected to participate in a learning lab with the National Governors Association (NGA) in Washington DC. Delaware was one of only four states chosen to receive grant funding to examine methods for information sharing across state departments and divisions. The Division of Forensic Science collaborated with the Office of Emergency Medical Services (OEMS), the Delaware Information & Analysis Center (DIAC) and the Division of Substance Abuse and Mental Health (DSAMH). The result of this collaborative effort produced a report that is now being distributed quarterly to stakeholders both statewide and federally.

The Delaware Drug Monitoring Initiative (DMI) utilizes data derived from the Delaware Forensic Science Reporting System (DFSRP), Delaware Emergency Medical Reporting System (DEMRS), Delaware Information and Analysis Center (DIAC), and the Delaware Division of Substance Abuse and Mental Health (DSAMH) to be used for situational awareness. The purpose of this initiative is to share consistent, actionable information to address the issues related to the drug epidemic affecting Delaware. The data provided in this report is aimed at assisting multiple agencies across Delaware in an effort to

identify those in jeopardy of addiction and/or overdose. These efforts will help inform both law enforcement and public health officials as they work to identify additional treatment needs or programs. While all the data is housed under the respective agencies, the DMI report is created collaboratively within the DIAC for broader reach to key stakeholders. This work has opened the door for collaborative reporting statewide.

## **Disaster Preparation**

In 2016 the Division of Forensic Science worked with partners at the Division of Public Health Emergency Medical Services and Preparedness Section to finalize a statewide Mass Fatality Plan. This plan was finalized and executed in September of 2016. As part of this ongoing effort to be prepared, the Division of Forensic Science has participated in table-top disaster drills and on-scene disaster drills. The purpose of these exercises was to identify areas of strength and weakness, and to test the Mass Fatality Plan before the occurrence of a state disaster. As part of this work, DFS has developed internal Critical Incident Standard Operating Guidelines (SOG). These guidelines provide DFS staff with a framework for emergency operations that falls within the scope of other statewide disaster plans.

The second step of disaster preparation is the development of a statewide Family Assistance Center (FAC) plan. This plan is being modeled after the National Transportation & Safety Board efforts to promote a centralized location for multiple agencies to assist families during a disaster. This plan is in the final stages and should be completed and ready for a testing in 2019.

## **Overall Reporting & Collaboration**

One of the efforts that the Division of Forensic Science encourages is the sharing of information with stakeholders and government agencies in Delaware. This is accomplished by successful collaboration, and participation on commissions and other data analysis efforts across State departments and agencies. We work closely with the Department of Health & Social Services, the Division of Public Health, the Department of Justice, DIAC, and other law enforcement organizations statewide to accomplish this mission.

The Division has also increased our academic interface with the Delaware academic community by opening our doors to tours, promoting forensic internship programs, and participating in quality data collection and research. The Division firmly believes these efforts will promote interest in forensic science disciplines among Delaware students and lead to stronger information sharing projects.

Overall, these external relationships have two goals: to promote confidence in the Division of Forensic Science by demonstrating transparency in forensic principles and processes and to establish the Division

as a key contributor across state agencies for the development of policies and initiatives to safeguard the health and safety of all Delawareans.

## Community Engagement

One of the goals of the Division is to engage community partners by providing informational resources and encouraging scientific learning. In 2018 DFS staff members gave presentations to multiple government and private organizations, attended several high school events, gave university lectures, conducted facility tours, and provided agency-based education related to the work of this Division. In all, thirty-eight community-based outreach events were offered or attended by DFS staff, plus an additional two professional conference poster presentations and one published manuscript. The professional staff of the Division of Forensic Science is committed to promoting scientific knowledge and community collaborations.

## Assessment, Accreditation, and Quality Assurance

Accreditation is a key component of the quality assurance program at the DFS. To be accredited means that the various units within the DFS are routinely inspected by outside organizations who ensure that the policies, procedures, and/or practices within the Division adhere to strict national or international standards. Standards followed by the DFS include those set forth by the International Organization for Standardization (ISO), the American National Standards Institute National Accreditation Board (ANAB), the American Board of Forensic Toxicology (ABFT), the National Association of Medical Examiners (NAME), and the Quality Assurance Standards (QAS) established by the Federal Bureau of Investigation (FBI).

### *ISO 17025:2005 Accreditation*

The International Organization for Standardization is the world's largest developer and publisher of international standards. Laboratories use ISO 17025 to implement a quality system aimed at improving their ability to consistently produce valid results. Since the standard is about competence, accreditation is a formal recognition of the demonstration of that competence.

The DFS was originally ISO 17025 accredited in 2004 and has continually achieved the highest level of quality standard competency for testing with annual re-accreditation. The current ISO 17025 accreditation was provided by ANAB, which also publishes additional standards that must be adhered to for accreditation, and is scheduled to expire on June 30, 2020.

*American Board of Forensic Toxicology Accreditation*

ABFT is dedicated to enhancing and maintaining standards of practice in the field of forensic toxicology.

The toxicology laboratory at the DFS received a Certificate of Laboratory Accreditation in Forensic Toxicology by the ABFT on July 1, 2018, which will expire on July 1, 2020.

*National Association of Medical Examiners Accreditation*

The purpose of the NAME accreditation standards is to improve the quality of the medicolegal investigation of deaths in this country. NAME accreditation is an endorsement by NAME that the Division provides an adequate environment for medical examiners to practice their profession and offers reasonable assurances that the ME office serves its jurisdiction well.

The DFS has been NAME accredited since 1980 and continues to be in good standing with this organization. The current NAME accreditation expires July 16, 2019.

*FBI Quality Assurance Standards*

The FBI's Quality Assurance Standards (FBI QAS) describe the requirements that laboratories performing forensic DNA testing or utilizing the Combined DNA Index System (CODIS) shall follow to ensure the quality and integrity of the data generated by the laboratory. The DFS has been compliant with the FBI QAS since 1997.

## Medical Examiner Unit

### Overview

The duties of death investigation for the State of Delaware fall to the Medical Examiner Unit (MEU), led by the Chief Medical Examiner (ME), Assistant MEs, Forensic Morgue Assistants, and Forensic Investigators. This Unit is responsible for investigating all suspicious and violent deaths in the State and performs postmortem examinations on cases that fall under its jurisdiction. The Unit operates out of three locations: the main office in Wilmington, the Tobin Building on the Stockley campus in Georgetown, and a satellite office in the Capitol Building in Dover (Kent County). The second half of 2018 saw a temporary closure of the Wilmington morgue facilities to allow for a major improvement project. This resulted in a temporary shift in operations, with all postmortem examinations being conducted in the Georgetown facility.

The number of deaths investigated by the MEU increased in 2018. This increase can be attributed to the increase in deaths related to drug use. Statewide, deaths from drug and alcohol intoxication increased by 14% from 348 in 2017 to 400 in 2018. In 2018, the MEU investigated 2294 reports of death and accepted jurisdiction of approximately 60% of these cases. In 2018 the MEU certified 1367 deaths, which represented 14% of all deaths registered by the State of Delaware.

	2015	2016	2017	2018
<b>Autopsies</b>	580	649	610	690
<b>Inspections</b>	331	329	307	296
<b>Total Examinations</b>	<b>911</b>	<b>978</b>	<b>917</b>	<b>986</b>
<b>Inquiries*</b>	245	305	386	381
<b>Total Deaths Certified</b>	<b>1156</b>	<b>1283</b>	<b>1303</b>	<b>1367</b>
<b>Non-Jurisdiction Investigations*</b>	902	816	875	927
<b>Total Medical Death Investigations</b>	<b>2058</b>	<b>2099</b>	<b>2178</b>	<b>2294</b>
<b>*Note that inquiries are cases under the ME jurisdiction which did not require an examination, and non-jurisdiction cases are investigated but determined not to be under ME jurisdiction.</b>				

An additional responsibility of the Medical Examiner is to approve all organ and tissue donations in Delaware. Of the multiple requests, there were 218 instances where either organ donation, tissue donation, or both organ and tissue donations occurred. Organs procured included heart, liver, kidneys, lungs, and pancreas. Tissues procured included cornea, skin, long bones, heart valves, and veins.

In July 2018 the Wilmington morgue was closed to facilitate major upgrades to the current infrastructure including a new morgue cooler, new HVAC, and a complete renovation of the autopsy suites with more

efficient autopsy work stations. The upgraded work stations will increase the space available for postmortem examination. The closure of the Wilmington morgue has created logistical challenges; however, despite the challenges, the MEU continues to meet its mission with minimal impact on the performance of autopsies or significant delays of loved ones being returned to their family members.

An additional improvement to the unit has been the purchase of a new set of cameras and photography equipment for use in death scene investigation and postmortem photography. Prior to the distribution of the new equipment, all of the Forensic Investigators and Forensic Morgue Assistants underwent a day of training in forensic photography and proper use and maintenance of the new equipment.

2018 saw the unit hiring two board-certified Forensic Pathologists, increasing our complement of board-certified Forensic Pathologists to three. Seven of the twelve Forensic Investigators maintain certification with the American Board of Medicolegal Death Investigators.

### Training and Outreach

The Division continues to promote education and training among the staff in the MEU. As part of our community involvement, several of our Forensic Investigators are actively involved in outreach educational activities with local police departments and police academies, fire and paramedic training programs, as well as hospital-based training programs. Our Forensic Investigators participated in in-house training provided by our pathologists, and many staff members have attended local and national conferences such as: The Annual Delaware State Police Homicide Conference, the Annual New England Seminar in Forensic Sciences, and the American Academy of Forensic Sciences Annual Conference. The pathologists maintain board certification by participating in educational activities geared toward physician best practices. Our physicians have attended conferences sponsored by the American Society of Clinical Pathology, National Association of Medical Examiners, and the International Homicide Investigators Association. The MEU is also active in our academic community by participating in presentations and providing internship and training opportunities to undergraduate students at University of Delaware and to residents of Delaware enrolled in other tertiary institutions.

In 2018 both investigative and physician staff presented posters and provided lectures at scientific conferences hosted by the National Association of Medical Examiners and American Academy of Forensic Sciences.

The unit continues to collaborate with other DFS staff in multiple mortality review committees and research projects. These projects utilize data collected from death investigations and other units to aid in disease and injury prevention, disease surveillance programs, health improvement programs, and addiction prevention and treatment programs. Some of the agencies and program collaborators include the

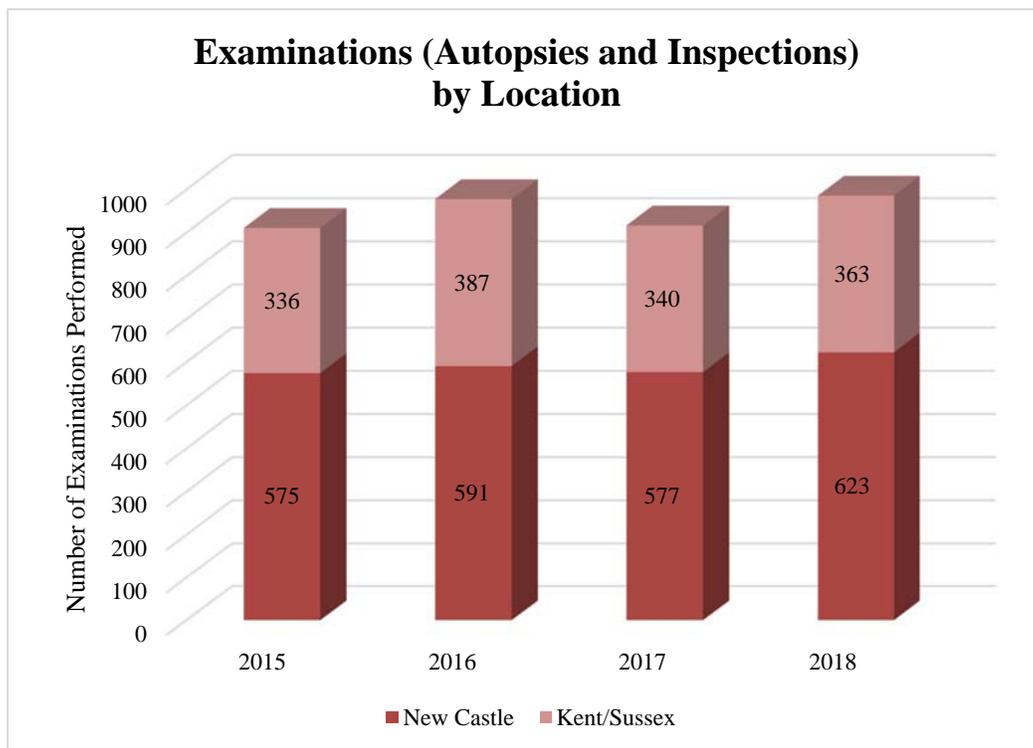
Division of Public Health, the CDC-funded Sudden Death in Youth (SDY) project, National Violent Death Reporting System, and the State of Delaware Child Death Review Panel and Maternal Mortality Review Panel. Other Federal agencies that have partnered with DFS include the Consumer Product Safety Commission (CPSC) and the Occupational Safety and Health Administration (OSHA).

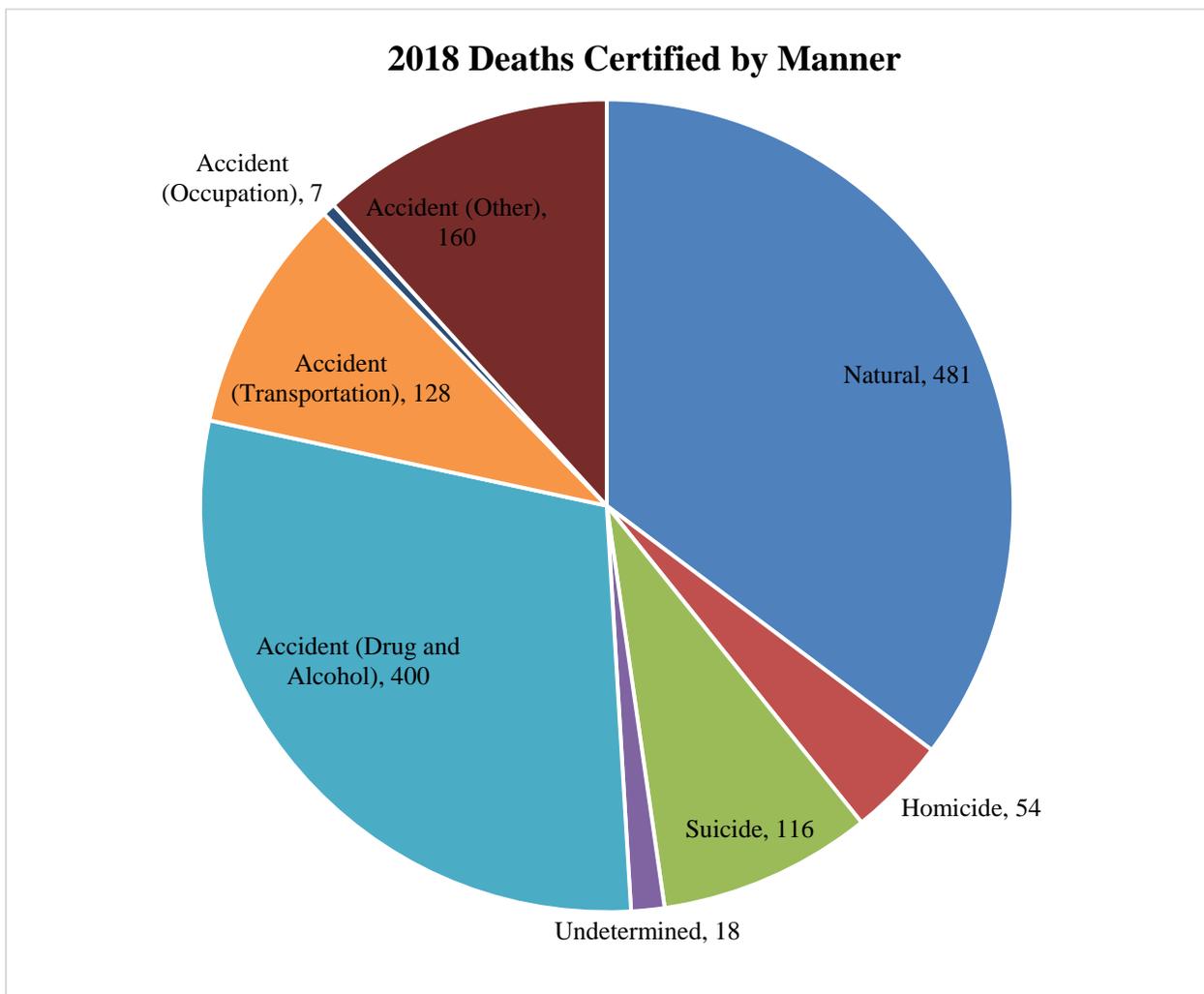
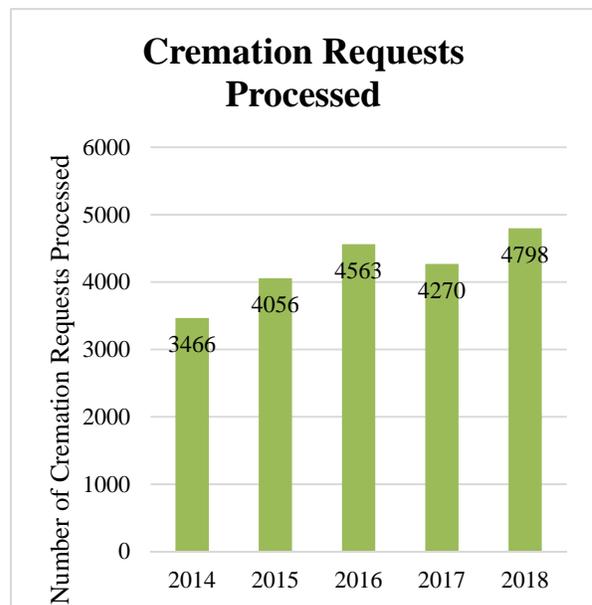
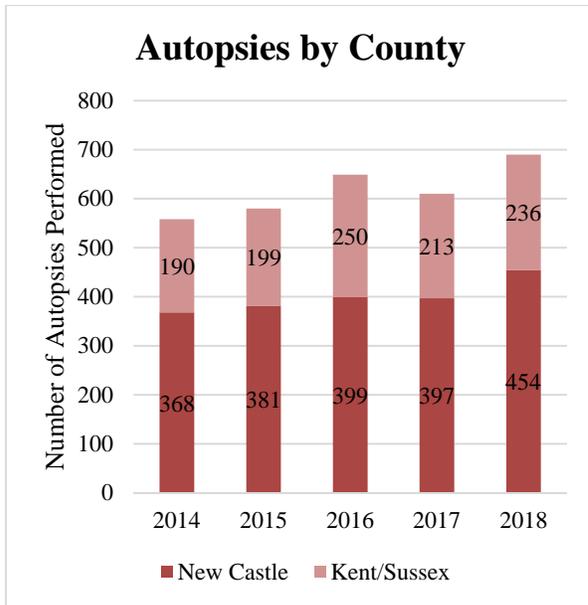
## Partners

The MEU could not accomplish our mission without the support of the Department of Safety and Homeland Security and the Delaware General Assembly. In addition, it is important to note the many agencies who assist in providing services to the MEU. These agencies include: Delaware law enforcement agencies, the Attorney General’s Office, Office of the Child Advocate, the staff of all our Delaware hospitals, the Delaware Funeral Directors Association, the Gift of Life Donor Program, the Office of Vital Statistics, and all the funeral homes and health care practices that work with the Division. The MEU and Division values our relationships with all of these agencies.

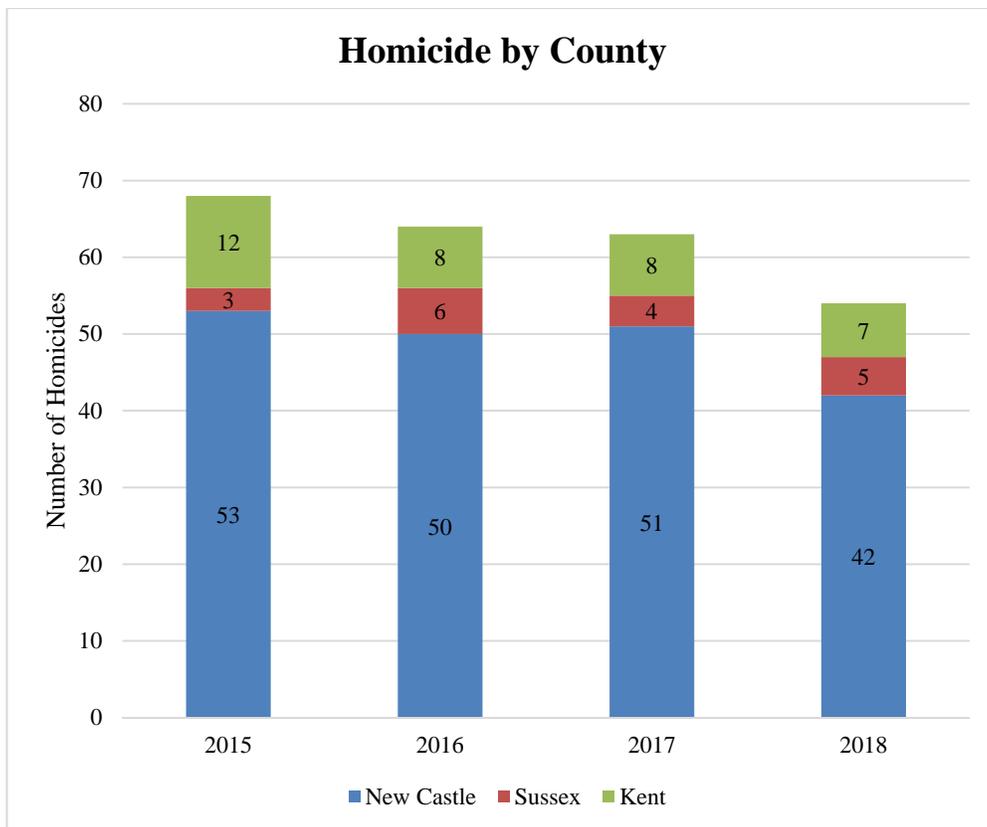
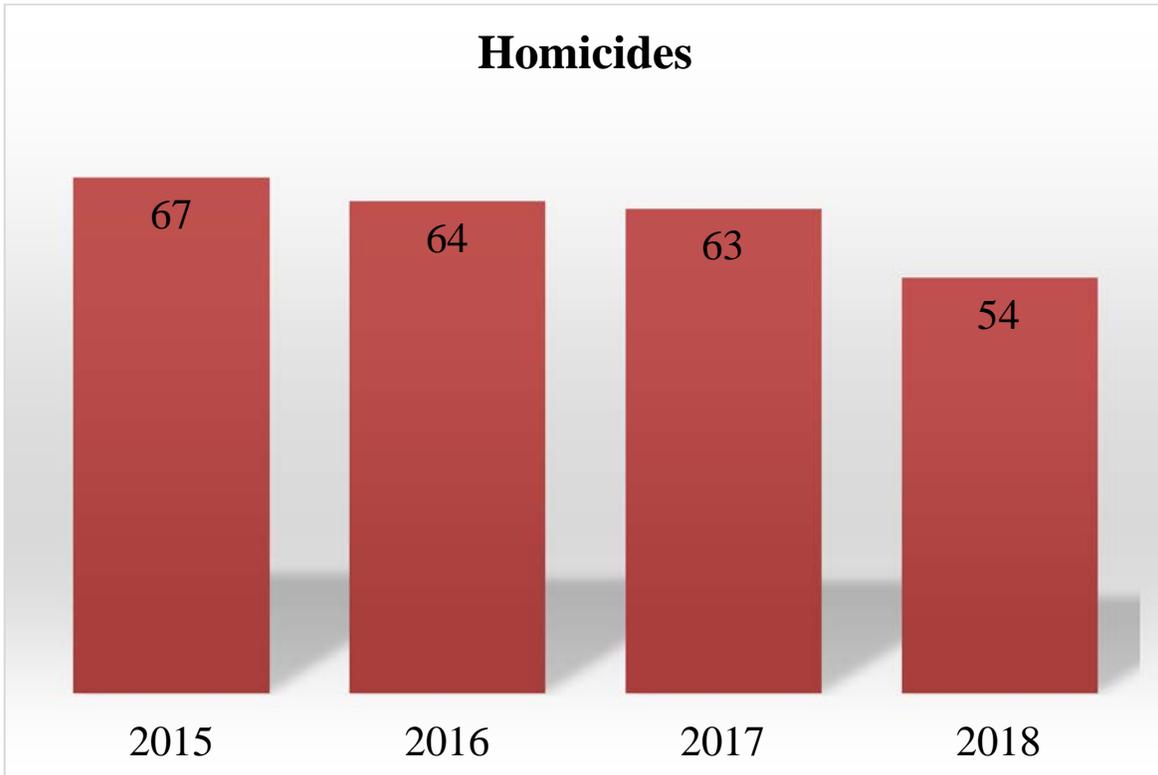
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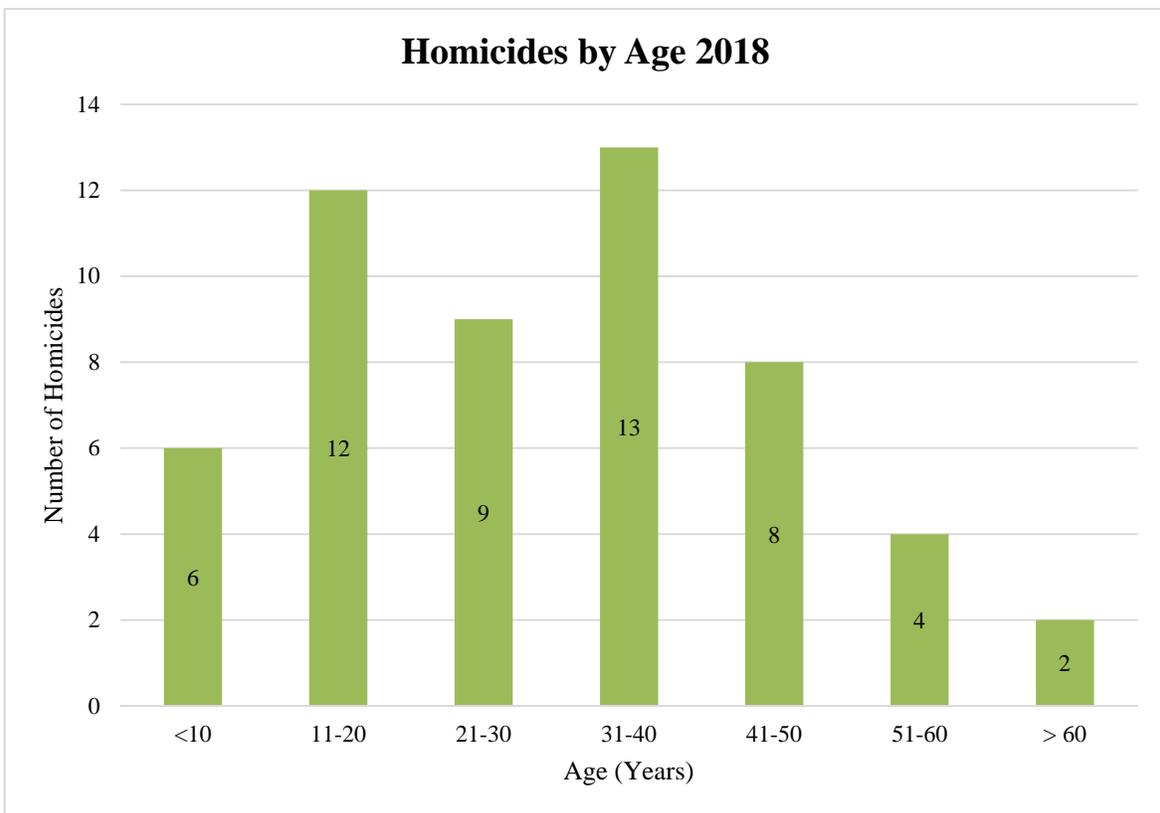
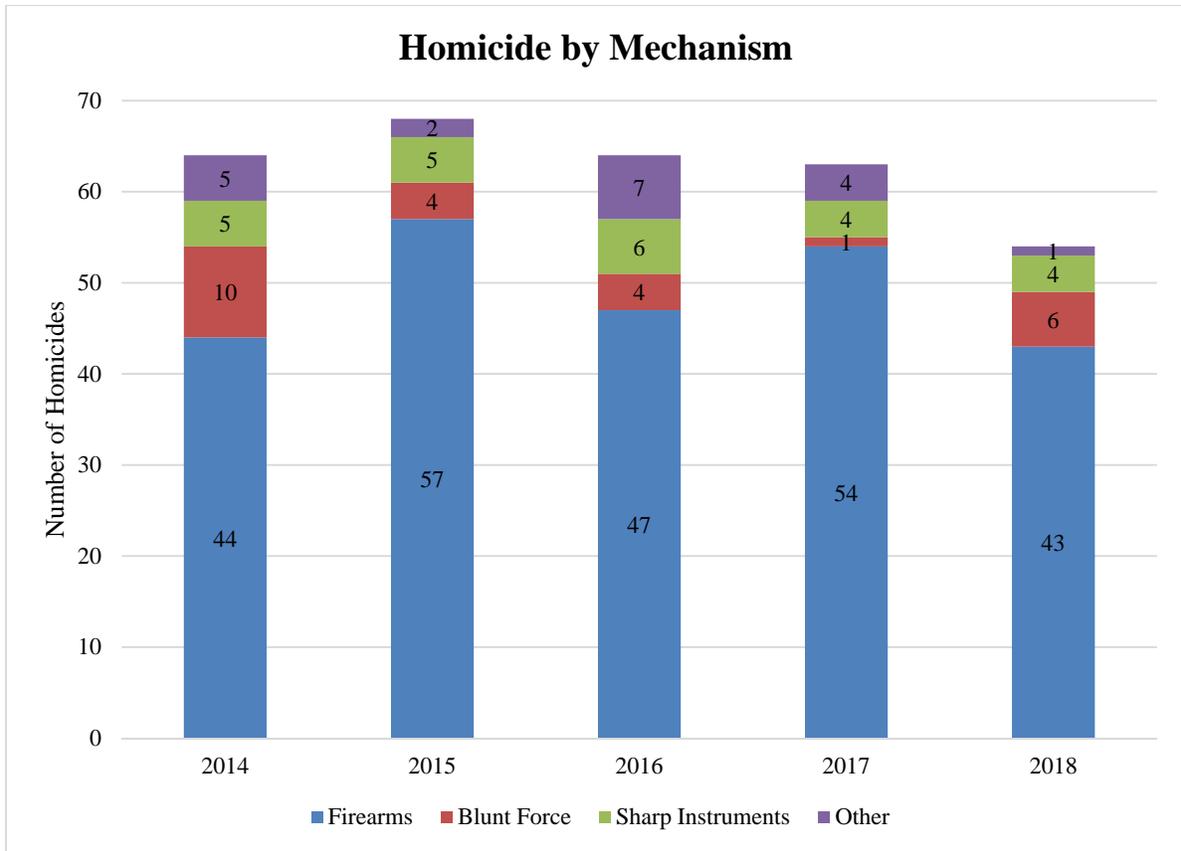
### Cases Reviewed

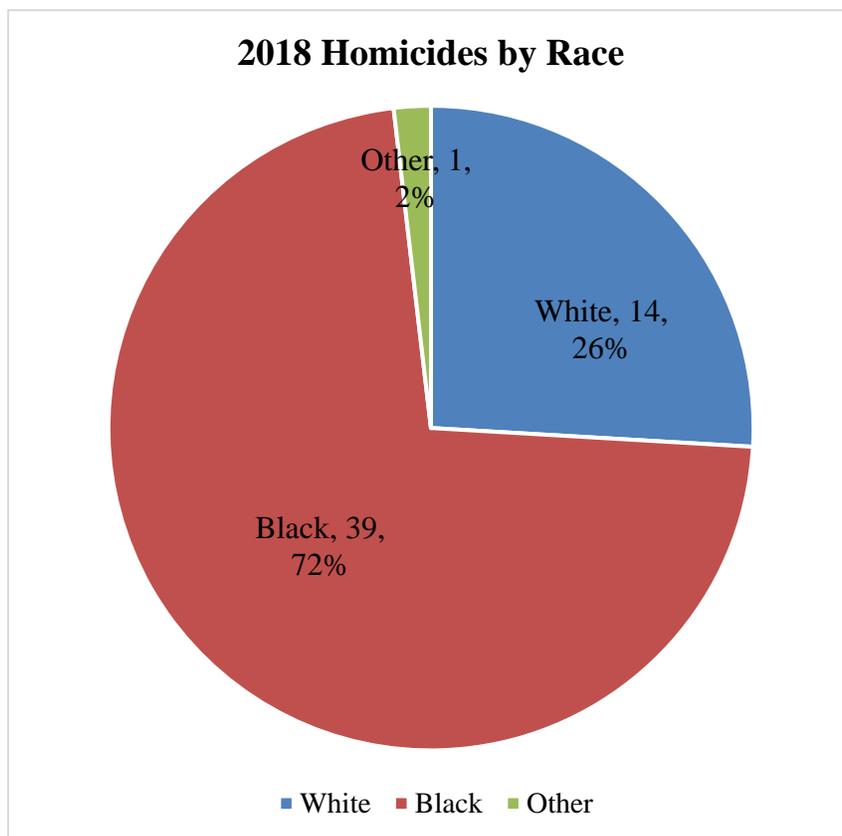
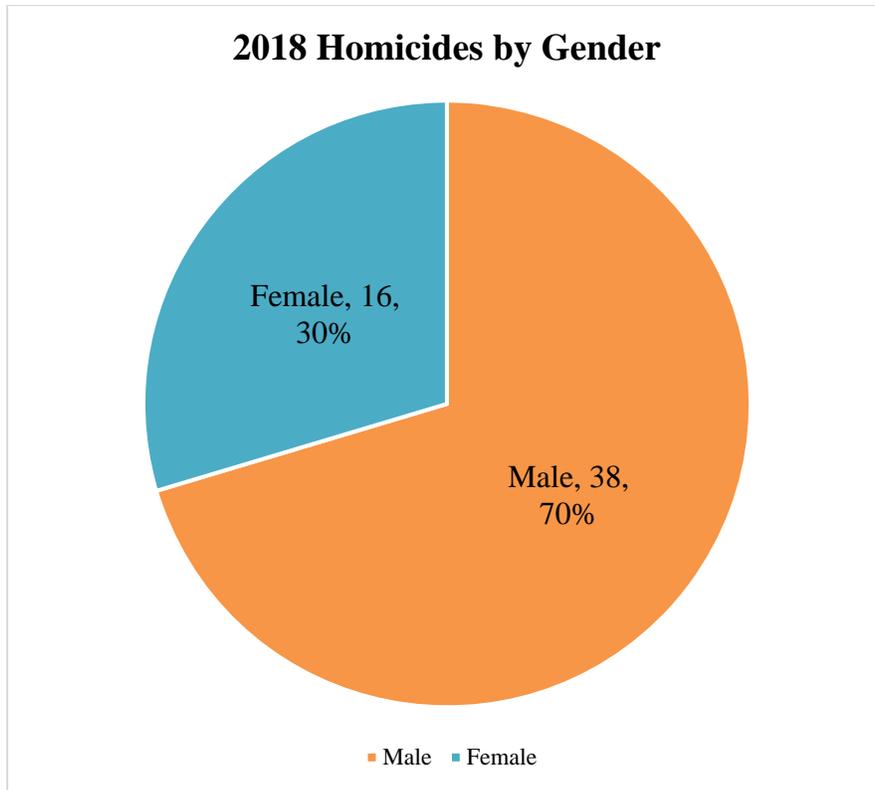




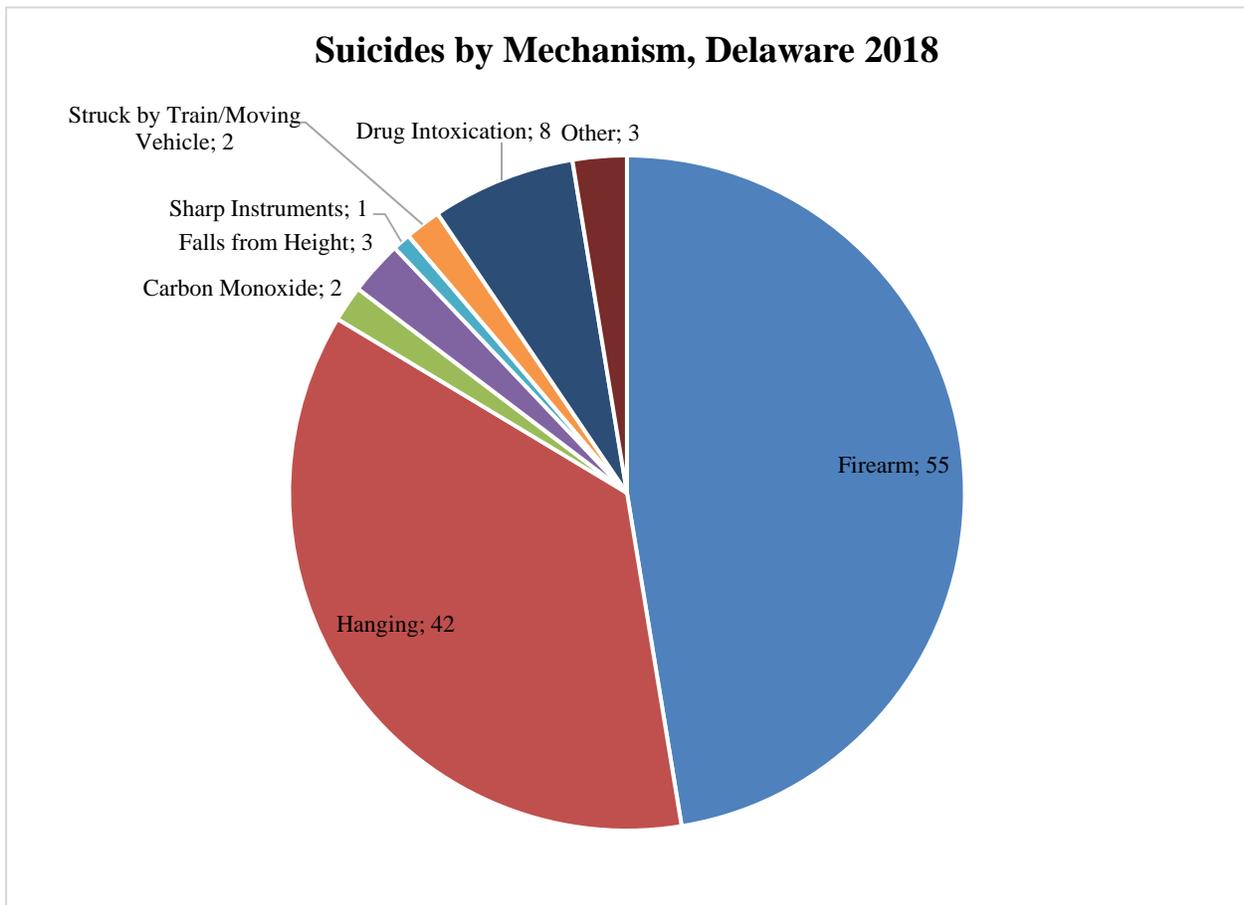
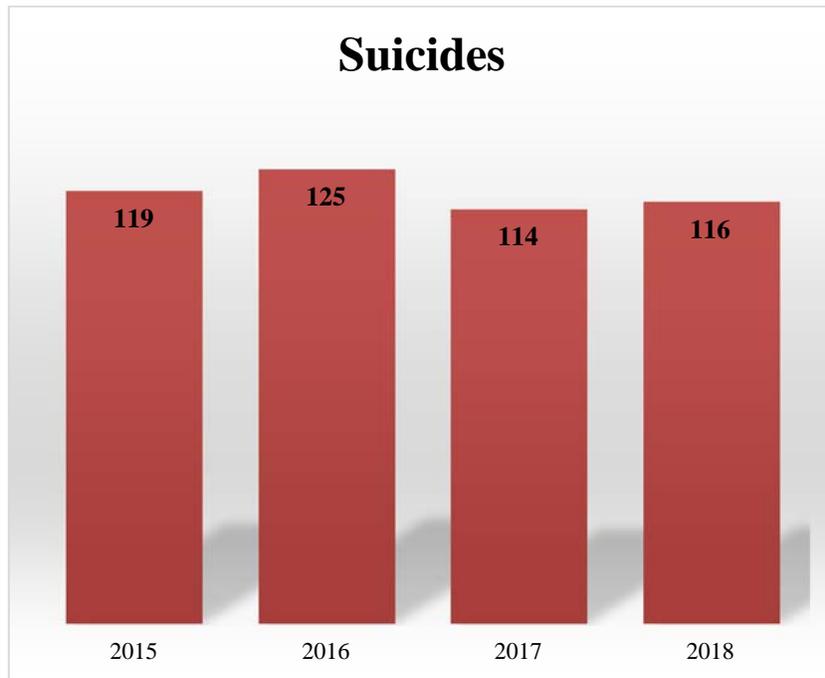
Homicides



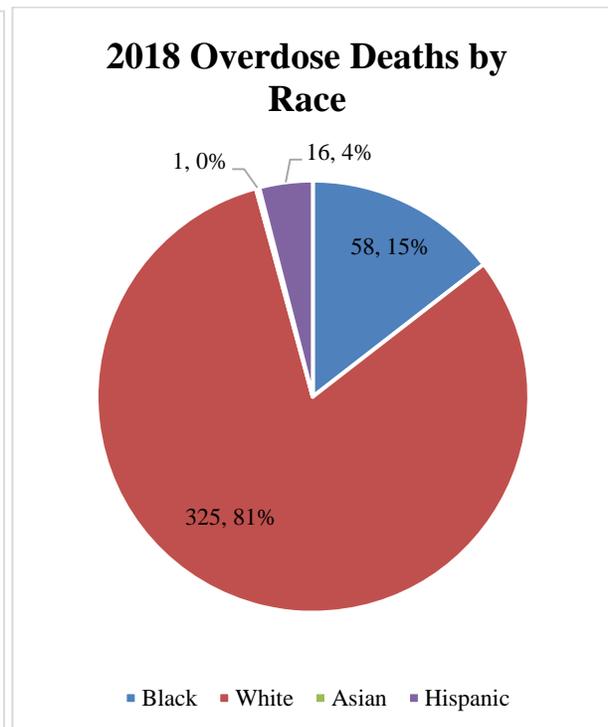
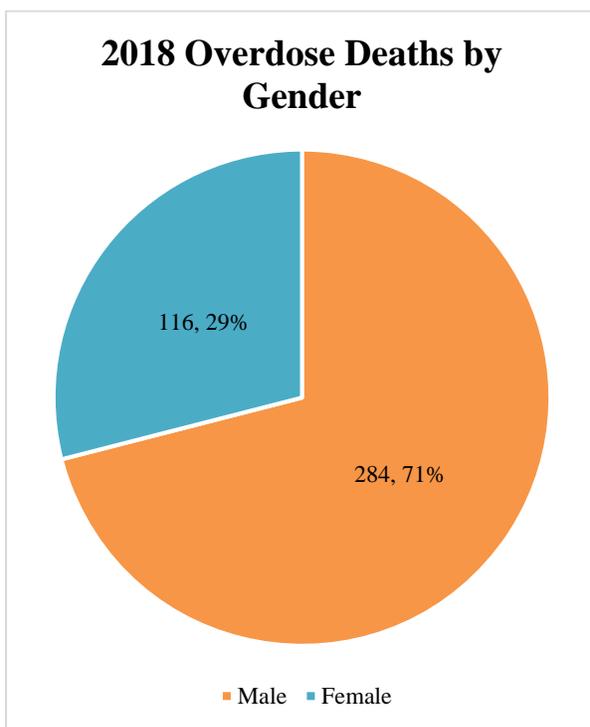
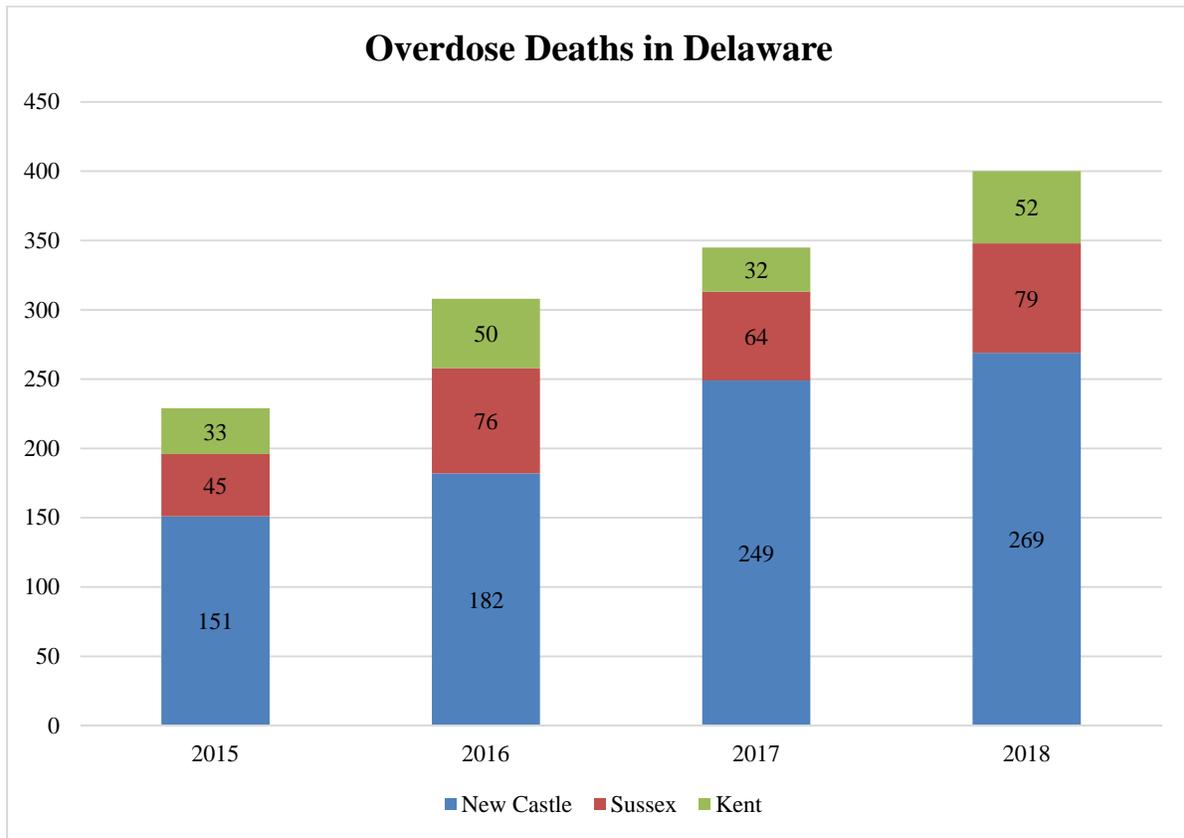


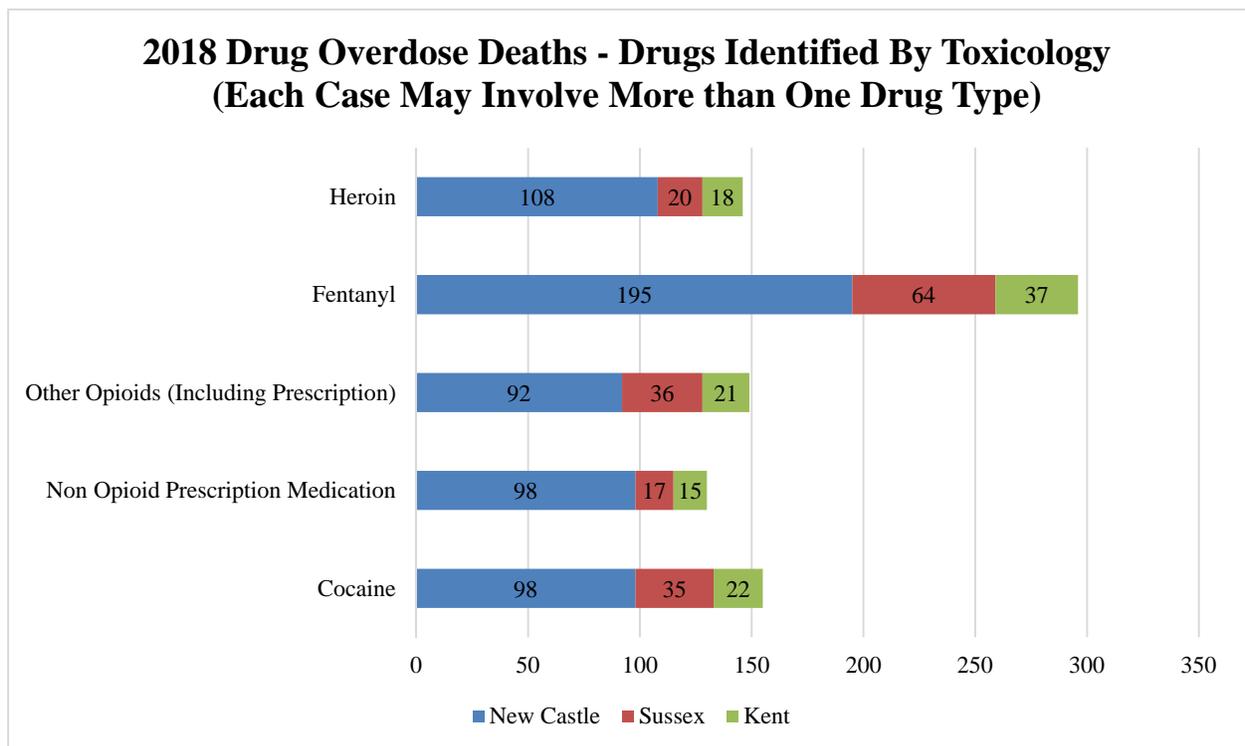
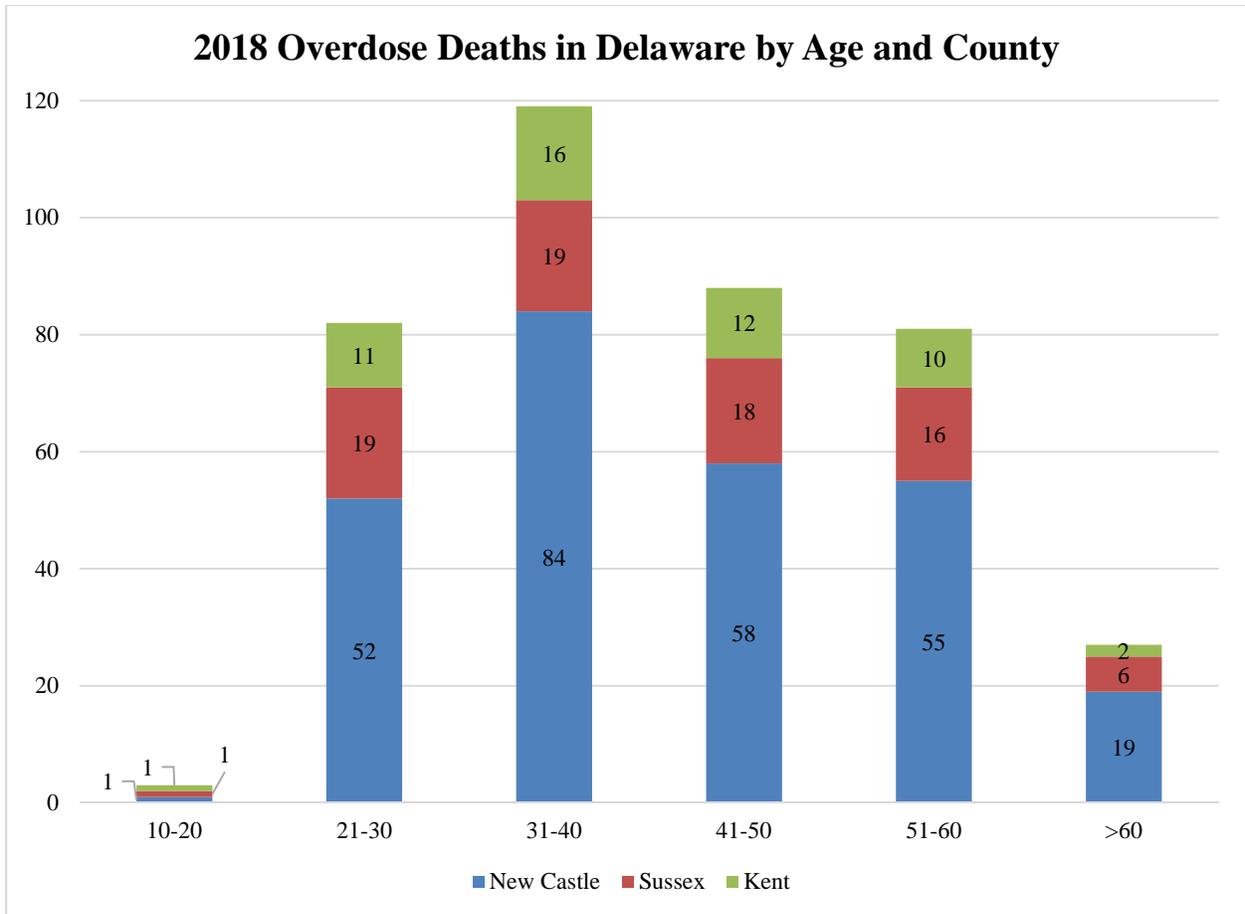


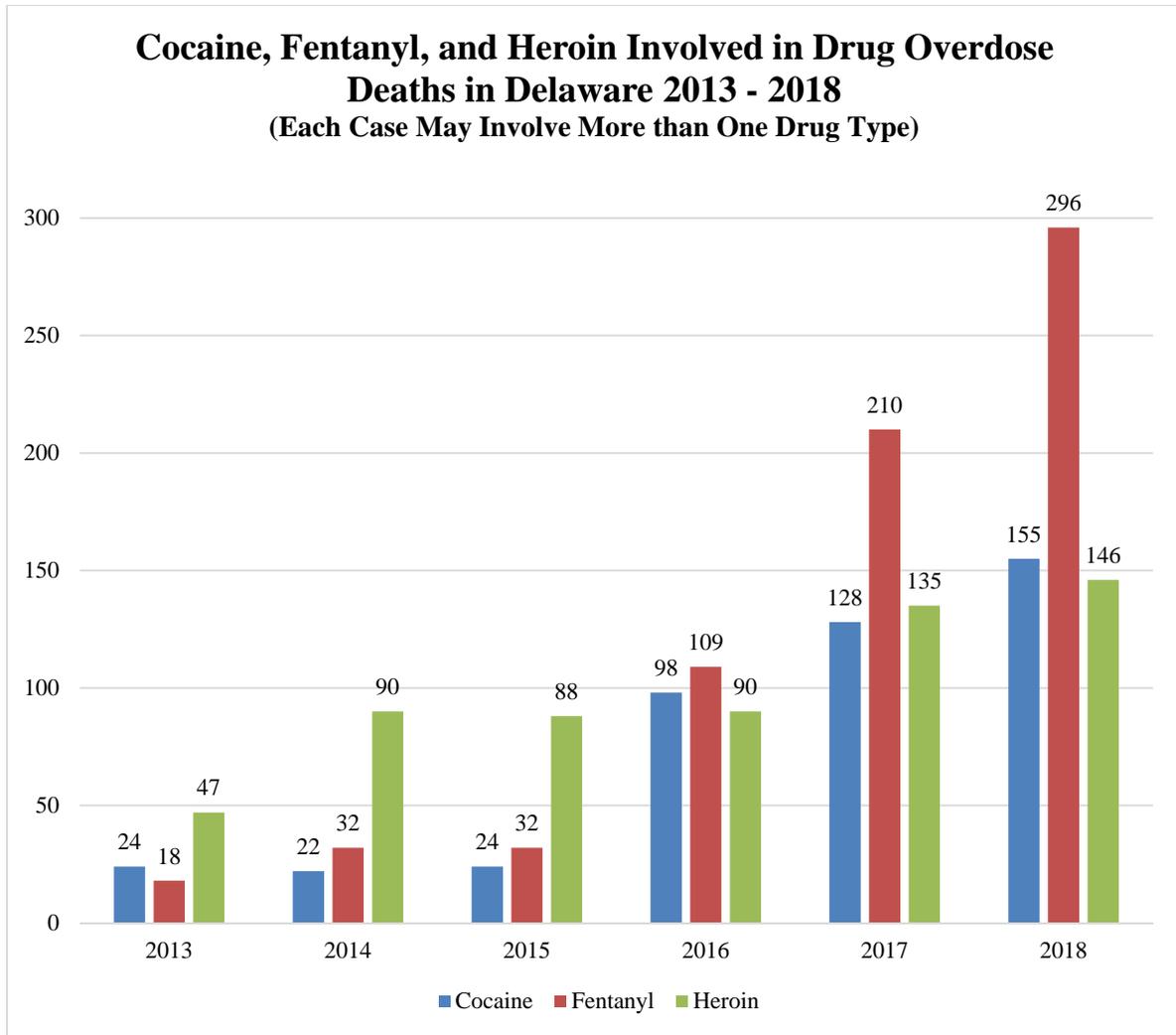
Suicides



Drug Overdose Deaths







## Toxicology

### Overview

The Toxicology (Tox) Unit of the State of Delaware Division of Forensic Science handles both postmortem and Driving Under the Influence (DUI)/Other cases. The unit is comprised of a staff of eight: the Chief Forensic Toxicologist, the Laboratory Supervisor, four Analytical Chemists, and two Laboratory Technicians (one full-time and one part-time). Most cases (including all DUIs) begin with a preliminary ELISA (Enzyme-linked Immunosorbent Assay) Drug Screen, which tests qualitatively for the following 18 drugs/drug classes<sup>2</sup>: Amphetamine, Methamphetamine, Opiates, Phencyclidine, Buprenorphine, Methadone, Benzodiazepines, Cocaine, Barbiturates, Cannabinoids, Oxycodone, Fentanyl, Carisoprodol, Diphenhydramine, Ketamine, Meperidine, Tramadol, and Zolpidem. Positives from this screen are entered for additional confirmatory testing. A Special Testing ELISA panel is also available, which includes Acetaminophen and Salicylates.

The Toxicology Unit has 11 confirmatory procedures for the following drug classes/drugs (and their metabolites), which provide quantitation (concentrations or amounts of drugs): Antidepressant (ADP), Cannabinoid, Cocaine, Fentanyl, Methadone, Opioid, Phencyclidine, and Alkaline Drugs (Benzodiazepines, Cyclobenzaprine, Diphenhydramine, and Tramadol). All confirmatory procedures utilize Gas Chromatography-Mass Spectrometry (GC-MS) except the ADP method, which uses Liquid Chromatography-MS/MS (LC-MS/MS).

In addition to the ELISA Drug Screen, the Toxicology Unit has two confirmatory (but qualitative) drug screens. The Alkaline Drug Screen (ALKDS) procedure covers approximately 200 different compounds, and the Acidic/Neutral Drug Screen (ANDS) covers another approximately 20 compounds.

Alcohol/Volatiles Analysis using Headspace Gas Chromatography with Flame Ionization Detection (GC-FID) is another routine procedure used by the unit. In addition to ethanol, this procedure provides quantitation of acetone, isopropanol, and methanol and qualitative identification of acetaldehyde and 1,1-difluoroethane.

### Staffing and Accreditation

The Toxicology Unit had some staffing changes in 2018. Our most senior Analytical Chemist III resigned, and the position was filled by a part-time Laboratory Technician III, which was subsequently filled with a new hire. The unit was able to take on two interns from the University of Delaware (UD) for

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<sup>2</sup> Note that this screen was expanded in 2018.

five weeks each during 2018—one in January and one in July. The summer intern worked on a project, which will be briefly detailed later.

The Tox Unit is a dually accredited laboratory—both with the standards set by ISO/IEC 17025:2005 and by the American Board of Forensic Toxicology (ABFT). The unit had an onsite inspection with ABFT in May 2018. The unit fulfilled the laboratory accreditation requirements and was granted a Certificate of Laboratory Accreditation in Forensic Toxicology for the period July 1, 2018 to June 30, 2020.

## Data

The below statistics have been hand-gathered and hand-tallied.

### **Total Cases Received, Total Tests Performed (and Thus Workloads), and Average Number of Tests Per Chemist Per Year All Increased**

In 2018, the Toxicology Unit received **783 DUI/Other cases** and 994 postmortem cases, of which **878 postmortem cases** required testing. This equated to a total of **1661 total cases received that were tested** and **7985 total tests run in 2018**. This is a further increase in our unit's workload compared to recent years as follows:

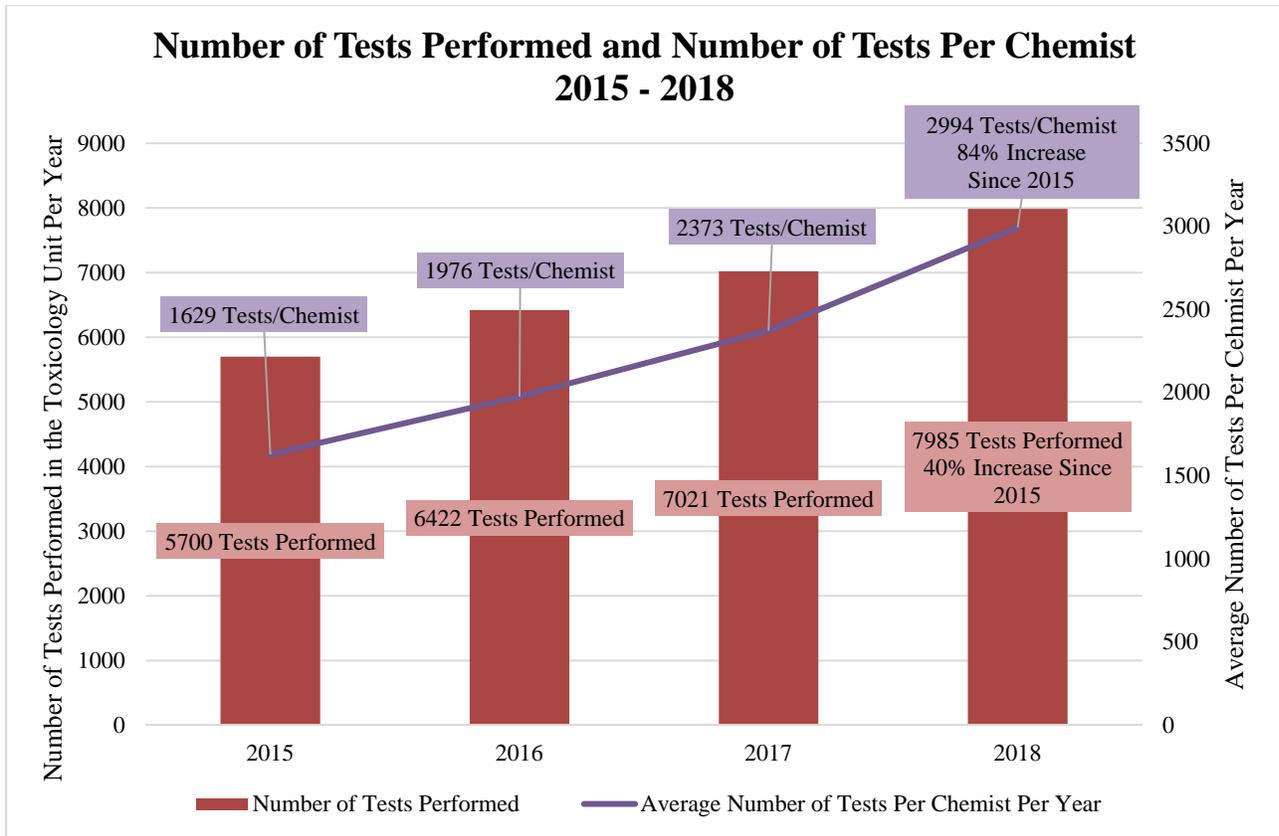
- **14% increase since 2017** (when 7021 tests were run)
- **24% increase since 2016** (when 6422 tests were run)
- **40% increase since 2015** (when 5700 tests were run)

The bar graph shows how the number of cases received has steadily increased since 2014.

Because each case may have multiple samples and/or require more than one test, and because the unit also runs 40+ proficiency test samples each year (as well as verifications and sometimes repeat samples), the number of tests performed exceeds the number of cases received each year. For example, in 2018 there were 7985 tests performed in the Tox Unit, a 40% increase since 2015 (when 5700



tests were performed). Taking actual staffing levels into consideration, the average number of tests per chemist rose 84% over the same time period (2994 tests/chemist in 2018; 1629 in 2015). The following graph illustrates the number of tests performed and number of tests per chemist over the last four years.

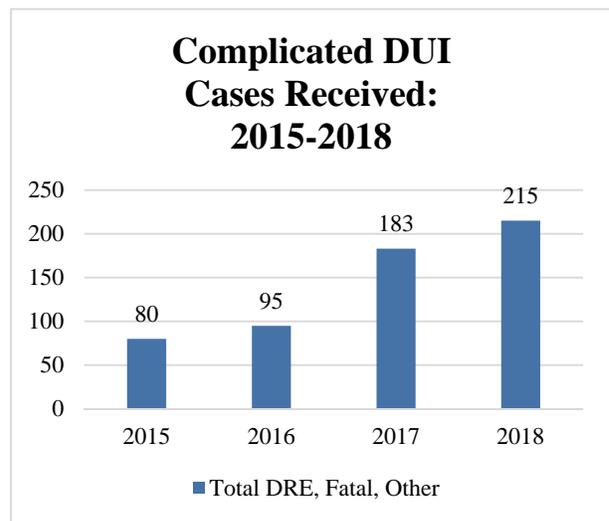


Despite these increases, and without an increase in staffing, the Tox Unit continued to effectively manage caseload in 2018.

### Increase in Complicated Cases

#### **DUI DRE, Fatal, and Other Cases**

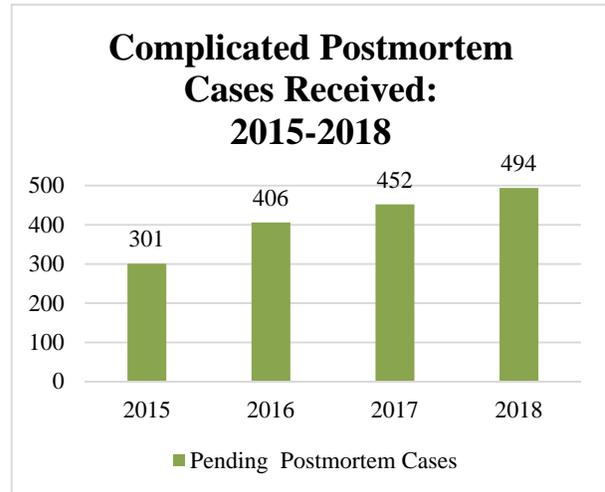
To really get a handle on the amount of work being done in the unit, one needs to examine the number and type of tests that are being completed. DUI cases received from Drug Recognition Experts (DREs), for example, generally require significantly more testing than non-DRE cases. The same is true for fatal and “Other” cases such as inquiries into child death or endangerment (including children who have died while caregivers were drug-impaired and children consuming drugs themselves). As the chart shows, the number of DRE, Fatal, and Other cases is



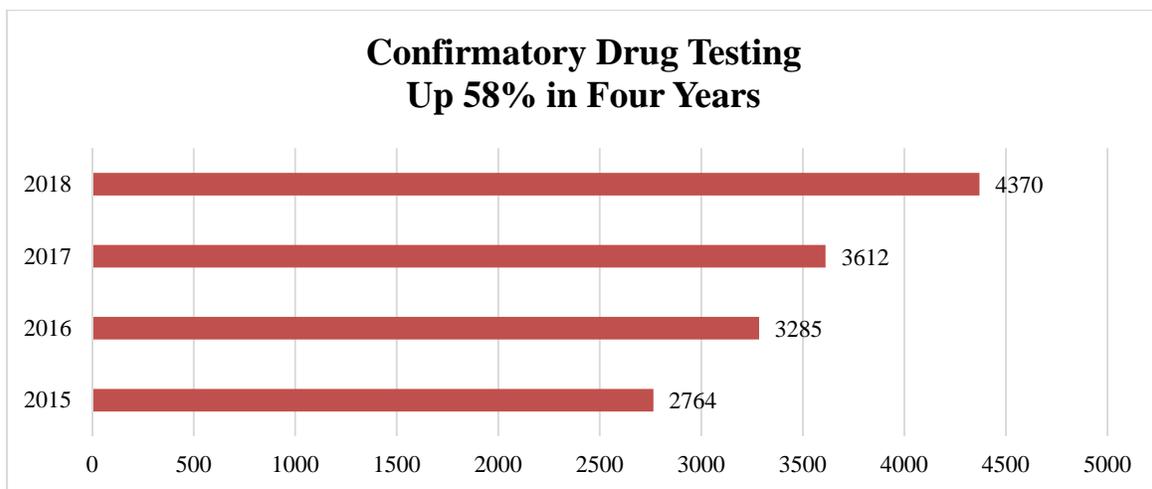
rising precipitously, up 169% from 2015. This may directly relate to the rise in the number of DRE-certified officers, which has increased more than tenfold over the last five years.

**Pending Postmortem Cases**

Similarly, different types of postmortem cases require varying amounts of time to complete. Pending cases, so named because the cause and/or manner of death is/are pending further investigation, for example, often require multiple tests, including time-consuming ALKDS procedures and/or advanced quantitative confirmations. The number of postmortem pending cases is up 64% since 2015. The Tox Unit often receives hospital samples from drug overdose deaths for complete testing.



To show how increases in caseload, especially DRE and pending cases, has affected the actual workload, the “Confirmatory Drug Testing” chart illustrates the number of drug confirmations performed over the last four years. As shown, the total number of samples (both Postmortem and DUI/Other) processed for confirmatory testing has increased substantially, up 58% between 2015 and 2018.



**ELISA Drug Screening Data**

The below tables display the ELISA Drug Screen results to show the number of positives for each drug/drug class for all cases as percentages of the total cases received. It is important to note that this is screening data, so these are strictly preliminary results.

Fentanyl now has the greatest percentage of postmortem cases screening positive (35.8%), as can be seen in the below table. More than one out of three postmortem cases is screening positive for fentanyl. In 2017, the greatest percentage (29.5%) of postmortem case ELISA results were negative (None Detected), followed by cannabinoids (28.0%). Postmortem cases screening positive for opiates also increased in 2018, from 20.6% in 2017 to 27.9% in 2018.

**Postmortem Cases:**

Drug/Drug Class (Cross-Reactives) on ELISA	Percentage of Postmortem Cases that Screened Positive		
	2018	2017	2016
<b>Fentanyl</b>	<b>35.8%</b>	<b>27.8%</b>	<b>14.7%</b>
<b>Opiate</b>	27.9%	20.6%	18.4%
<b>Cannabinoids</b>	25.9%	28.0%	24.3%
<b>None Detected</b>	24.6%	29.5%	34.5%
<b>Cocaine</b>	21.5%	20.8%	17.7%
<b>Diphenhydramine</b>	14.5%	N/A	N/A
<b>Benzodiazepine</b>	14.0%	10.9%	13.6%
<b>Amphetamine</b>	10.4%	8.6%	9.8%
<b>Oxycodone</b>	8.5%	9.5%	11.3%
<b>Methadone</b>	4.8%	4.1%	4.3%
<b>Methamphetamine</b>	3.4%	1.9%	1.6%
<b>Buprenorphine</b>	2.4%	N/A	N/A
<b>Tramadol</b>	1.6%	N/A	N/A
<b>Phencyclidine</b>	1.4%	1.2%	0.5%
<b>Barbiturate</b>	0.8%	1.6%	1.2%
<b>Ketamine</b>	0.8%	N/A	N/A
<b>Zolpidem</b>	0.8%	N/A	N/A
<b>Carisoprodol</b>	0.3%	0.5%	0.7%
<b>Meperidine</b>	0.0%	N/A	N/A
<b>Methylphenidate</b>	0.0%	N/A	N/A

Nearly half of the DUI/Other cases received in 2018 (49.3%) were positive for cannabinoids (marijuana). Fentanyl, opiates, and cocaine are now the next top three categories; in 2017, they were cocaine, fentanyl, and opiates, and in 2016, they were benzodiazepines, cocaine, and opiates. This again shows that nearly one-third of our DUI/Other population is screening positive for fentanyl. This population of fentanyl positives on ELISA was at a low 5.1% just four years ago in 2015.

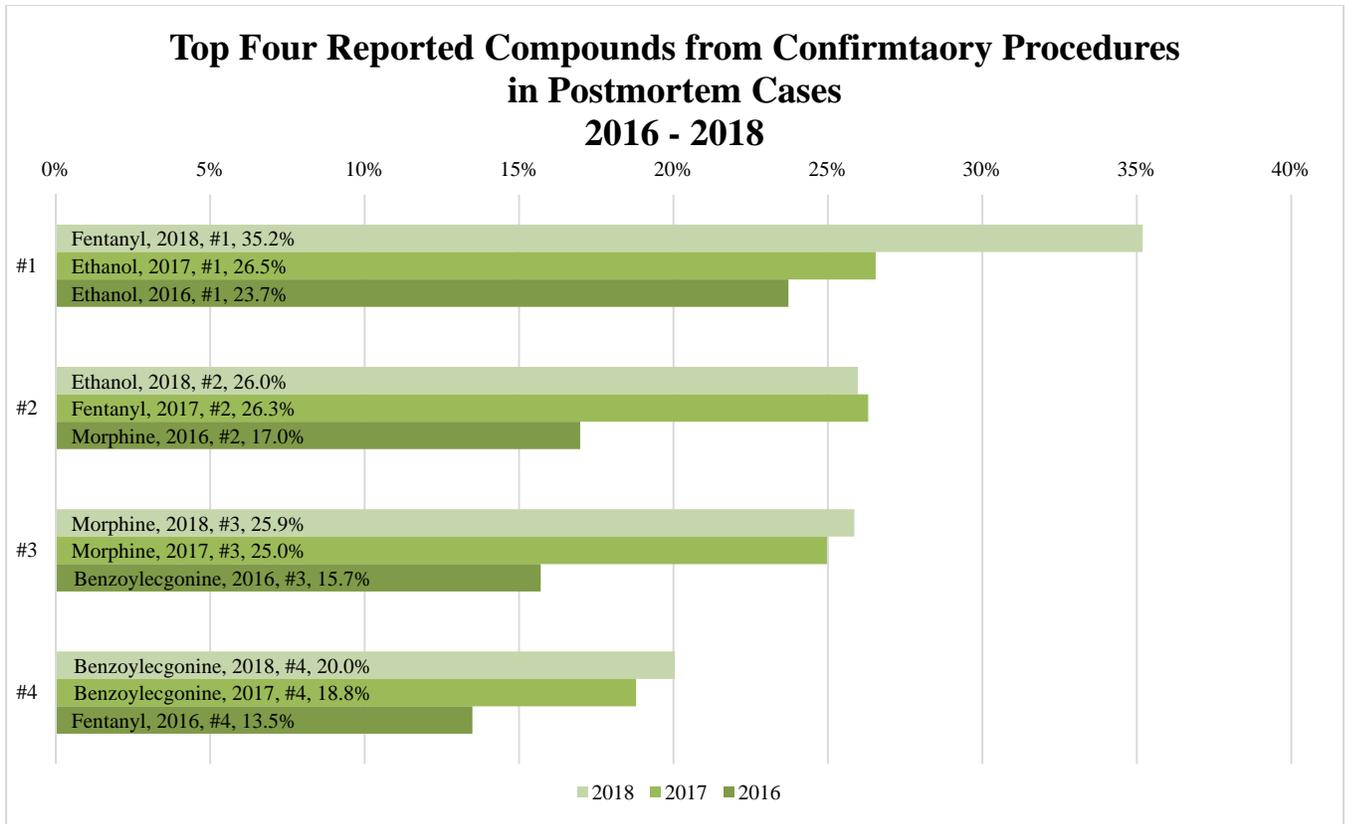
**DUI/Other Cases:**

<b>Drug/Drug Class (Cross-Reactives) on ELISA</b>	<b>Percentage of DUI/Other Cases that Screened Positive</b>			
	<b>2018</b>	<b>2017</b>	<b>2016</b>	<b>2015</b>
<b>Cannabinoids</b>	49.3%	53.1%	55.2%	56.9%
<b>Fentanyl</b>	<b>32.8%</b>	<b>22.7%</b>	<b>12.9%</b>	<b>5.1%</b>
<b>Opiate</b>	24.8%	21.7%	20.6%	22.0%
<b>Cocaine</b>	24.4%	25.3%	21.5%	16.9%
<b>Benzodiazepine</b>	21.1%	20.9%	22.9%	28.0%
<b>Methadone</b>	7.8%	8.2%	6.1%	7.7%
<b>Oxycodone</b>	7.8%	9.7%	13.2%	11.2%
<b>Phencyclidine</b>	7.8%	6.4%	6.5%	6.6%
<b>None Detected</b>	7.7%	9.1%	7.7%	8.7%
<b>Diphenhydramine</b>	6.6%	N/A	N/A	N/A
<b>Amphetamine</b>	5.6%	4.3%	4.6%	5.1%
<b>Buprenorphine</b>	4.5%	N/A	N/A	N/A
<b>Methamphetamine</b>	4.2%	3.8%	3.9%	2.2%
<b>Zolpidem</b>	1.5%	N/A	N/A	N/A
<b>Barbiturate</b>	1.3%	0.7%	1.0%	1.1%
<b>Tramadol</b>	0.6%	N/A	N/A	N/A
<b>Carisoprodol</b>	0.4%	1.1%	2.8%	2.7%
<b>Ketamine</b>	0.3%	N/A	N/A	N/A
<b>Meperidine</b>	0.0%	N/A	N/A	N/A
<b>Methylphenidate</b>	0.0%	N/A	N/A	N/A

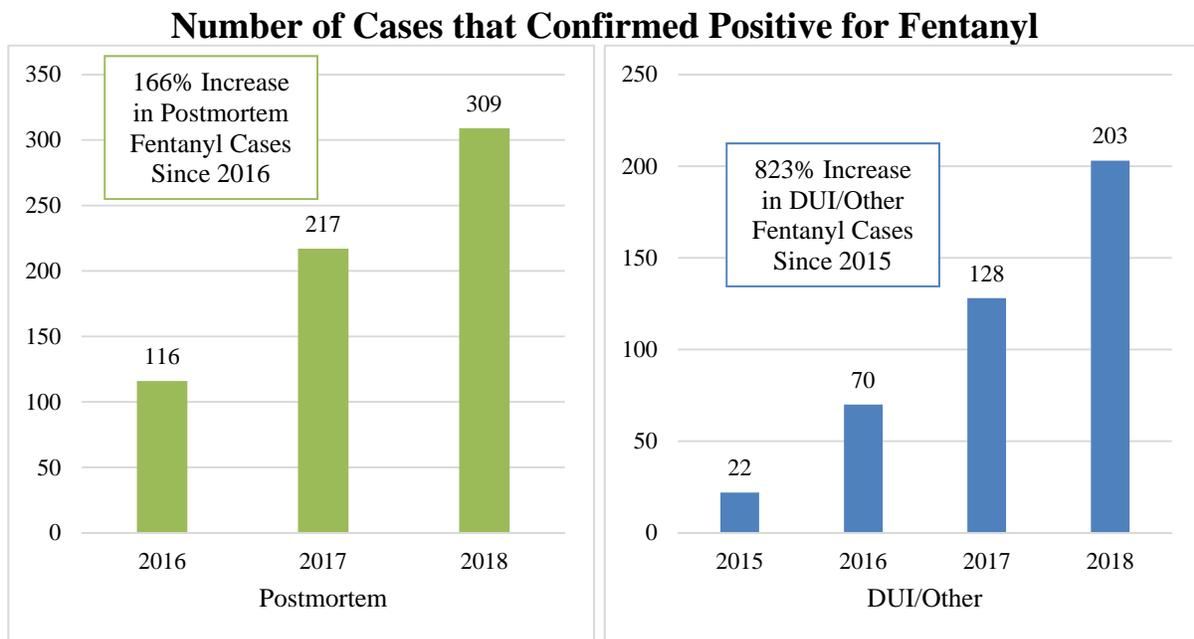
**Top Four Reported Compounds from Confirmatory Procedures**

The inactive marijuana metabolite, delta-9-carboxy-tetrahydrocannabinol, was confirmed positive in 36.1% of the DUI/Other cases received, and the active parent compound of marijuana, delta-9-tetrahydrocannabinol (THC), was confirmed positive in 26.3% of DUI/Other casework. Fentanyl was the third top reported compound for DUI/Other cases at 25.9%, and benzoylecgonine (an inactive metabolite of cocaine) was fourth (20.9%).

The below graphs show confirmatory results. For postmortem cases, fentanyl moved to the #1 spot as the top reported compound from confirmatory procedures in 2018, as the below table shows, now followed by ethanol, which was in the #1 spot in 2017 and 2016, and then morphine.



In fact, fentanyl confirmations in the Tox Unit have increased **166% for postmortem cases since 2016** and **823% for DUI/Other cases since 2015**, as the below charts illustrate. This shows how the opioid/fentanyl epidemic is escalating at an alarming rate.



## Projects and Grants

The Toxicology Unit has continued working on several projects in 2018. In April, the expansion of the ELISA Drug Screen panel was completed. The panel was expanded to 18 drugs/drug classes, thereby increasing it by 50%, with the addition of the following: Buprenorphine, Diphenhydramine, Ketamine, Meperidine, Tramadol, and Zolpidem. We are now able to detect five additional drugs/drug classes on the initial ELISA drug screen which, prior to the expansion, would not have been screened unless the case was run for ALKDS, and one (buprenorphine) which we previously had no way of detecting in-house. While expanding our ELISA panel, we also completely revalidated the procedure to follow the SWGTOX (Scientific Working Group for Forensic Toxicology) validation guidelines. Revalidating the whole method also gave us the opportunity to reconsider and lower/update our cutoff levels for some of the assays, which has also led to more positives. The Tox Unit would again like to recognize and thank the Office of Highway Safety (OHS) for providing grant funds, making this project possible.

Another project, one which began with our summer UD intern, was to lower our limits of quantitation (LOQs) for our Alcohol/Volatiles Analysis by Headspace GC-FID method to 0.010 g/dL for all analytes. This was a recommendation from the May 2018 ABFT audit. This project is being validated per the SWGTOX guidelines and is ongoing. The third project that made great headway in 2018 was the amphetamine panel on LC-MS/MS. Our Research Analytical Chemist and the Chief Forensic Toxicologist worked with a consultant from Agilent on this project, and again, the unit would like to thank OHS for grant funds to support this.

Lastly, the Toxicology Unit was fortunate to receive federal grant funds in 2018 connected to the opioid overdose epidemic. Funding for the Enhanced State Opioid Overdose Surveillance (ESOOS) through the Centers for Disease Control and Prevention enabled the Tox Unit to purchase the following: consultation sessions with Agilent for development of an expanded fentanyl and synthetic opioid panel on LC-MS/MS, two new evaporators, 27 new electronic pipettes, two safety hoods, and four new positive pressure manifolds, in addition to analytical standards, reagents, and glassware, which are all necessary for fentanyl and opioid analyses.

## DNA

### Overview

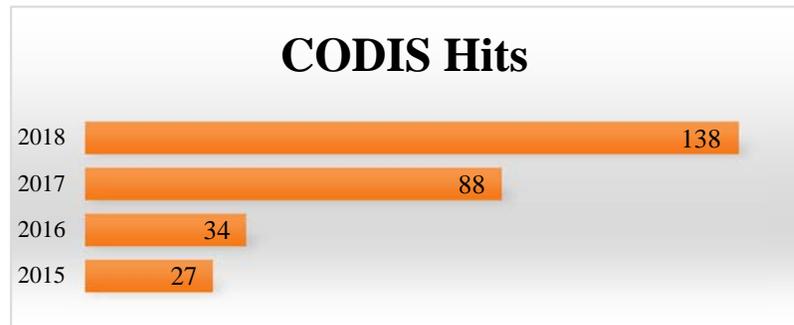
The DNA laboratory consists of two sections, the CODIS (COmbined DNA Index System) section and the Casework section. The CODIS section processes all of the convicted offender samples submitted to the laboratory from the Delaware State Police/State Bureau of Identification (DSP/SBI) and the Department of Corrections (DOC), and uploads the DNA profiles generated into the National database. The Casework section examines evidence, conducts preliminary testing for body fluids, performs DNA testing, and interprets data derived from the tests to draw and support conclusions. The laboratory accepts all cases ranging from theft and property crimes to homicides and sexual assaults. The DNA profiles generated from processing casework may also be entered into the State and National CODIS databases.

### CODIS

The backlog of convicted offender samples at the beginning of 2018 was approximately 98. During 2018, the CODIS section received an additional 1209 offender samples, which is 49% fewer samples than were received in 2017 (2363 samples received). The decrease in the number of samples received in 2018 vs. 2017 relates to the fact that, in 2017, the DOC began collecting samples at intake instead of at release. In doing so, they also collected samples from offenders serving long sentences. That backlog of collection had been eliminated and the number of samples received in 2018 was similar to previous years.

The turn-around-time (TAT) for uploading offender samples into the national database decreased about 42% from an average of 43 total days (31 working days) in 2017 to an average of 25 total days (18 working days) in 2018. This decrease can be attributed to the decreased number of samples received. This allowed the CODIS unit to revisit older offender samples which previously did not give usable results. With the new testing system that was brought on-line, some of the older samples were able to give more complete DNA profiles. We continue to work with DOC when samples are not complete.

In 2018, 1207 offender samples and 381 casework samples were uploaded into the State and National databases. Offender samples were processed on a monthly basis and by the end of 2018, the backlog was reduced to 26 samples for an approximate reduction of 73% from 2017. All of the remaining convicted offender samples are on-schedule to



be processed during the first quarter of 2019. In 2018, the DNA laboratory had 138 CODIS hits or “matches” from either the State or National databases.

Delaware has received Sexual Assault Kit Initiative (SAKI) Grant funds for testing sexual assault kits that were collected prior to April 30, 2015. These kits are being tested by a private laboratory, but any kit that results in a DNA profile foreign to the victim is reviewed by a DNA Analyst for upload into CODIS. We began receiving profiles from the laboratory in May 2017. In 2018, the DNA staff uploaded 190 unknown profiles into CODIS. Those profiles have resulted in 63 hits in the state database and 25 hits in the national database. Additionally, there have been 12 cases from Pennsylvania, Maryland, and Washington D.C. that have hit on a Delaware convicted offender. These hits have included cases such as burglary, home invasion, sexual assault, and homicide.

The table below reflects the types of cases that have hit in CODIS for 2018.

CODIS Hits	Type of Case	CODIS Hits	Type of Case
14	Burglary	4	Robbery
4	Homicides	106	Sexual Assaults
2	Home Invasion	4	Theft
1	Carjacking	1	Criminal Mischief
1	Skimming Device	1	Other State

## Casework

In the beginning of 2018, the case backlog was 103 (the backlog is defined as cases that have been assigned but not completed, as well as any unassigned cases). The 29 unassigned cases included both those with suspects and unknown suspect cases. In 2018, the DNA unit received 580 new case submissions and 42 subsequent submissions for a total of 622 submissions. Subsequent submissions are defined as those cases requiring additional testing after a report has been issued or those cases where a report was held until additional evidence had been submitted and tested. There was a 13% increase in the total number of submissions from the previous year. By the end of 2018, the backlog was 79 cases, a 23% decrease from the previous year. The number of unassigned cases was 30 (a 3% increase from the previous year). These numbers are due to the increase in the number of cases that were submitted. The table provides a breakdown of the types of cases received during 2018.

Types of Cases Received in 2018	New Submissions	Supplemental Submissions
Homicide / Att. Homicide	43	13
Sexual Assault	227	11
Assault	23	2
Burglary	47	7
Robbery	38	1
Missing Person	1	0
Death Investigation	2	0
Miscellaneous	58	5
Possession of Firearms	123	3
Proficiency Tests	18	0

Although, we had an increase in the number of cases we received, our average turn-around-time (TAT) decreased from 66 total days to 57 total days.

As with previous years, there was an increase in the number of cases received in 2018. In 2016 and 2017, new procedures were put into place that would help streamline casework processing. These procedures reduced the amount of time needed to amplify and analyze samples. In 2018, the challenges with going paperless were significantly reduced which increased the efficiency of the laboratory, allowing time for work to begin on validation projects not previously completed in 2017. Validation is a critical part of forensic DNA work and, despite not having staff dedicated solely to validation (i.e. it is the DNA Analysts who perform the validations), significant validation progress was made in 2018.

In 2018, the validation on the thermal cyclers instruments was completed; with all policies, SOPs, and worksheets updated. All Analysts completed the required competency tests on those instruments, and now the thermal cyclers are in use for casework.

The Armed Xpert software validation is underway but incomplete. Several of the necessary studies are finished, but a few still remain. As with any validation, the studies must be completed, policies must be in place, and laboratory staff must be trained before these procedures can be used in casework.

Validation studies and training are also required to maintain the DNA laboratory accreditation. During annual audits, validation study documentation is reviewed to determine the sufficiency of evaluative work performed and how it is used to support casework. Training documentation is also reviewed during annual audits.

We continue to use a testing system that examines 27 DNA markers, which is 7 more markers than the FBI CODIS requirement. The DNA laboratory had an external audit based on the FBI's Quality Assurance Standards in July 2018, and the DNA Unit was determined to be in compliance with the FBI Director's Quality Assurance Standards.

To take a proactive approach in the audit process, all DNA quality control documents can be accessed in Qualtrax. This allows auditors to access documentation more efficiently.

The following chart provides a comparative analysis of casework for 2016, 2017, and 2018 (the percentages in parenthesis show year-over-year changes):

	2016	2017	2018
<b>Total Case completions</b>	475 (+32%)	526 (+11%)	646 (+23%)
<b>Turnaround Time (Total days submission to completion)</b>	83 (-31%)	66.4 (-20%)	56.9 (-14%)
<b>Case submissions</b>	448 (+24%)	549 (+23%)	622 (+13%)
<b>Staffing (full-time casework)</b>	5.25(+22%)	5 (-5%)	6 (+20%)

## DNA

In summary, during 2018, the DNA laboratory received 13% more cases than were submitted in 2017. In the past 2 years, there has been a 39% increase in the number of cases the DNA laboratory has received.

The DNA laboratory has also increased the number of cases completed, to keep up with the increase in case submission. The DNA laboratory has reduced overall TATs for casework. With the increased demands in casework and the needed validations, we hope to keep our backlog manageable in the next year.

## Grants

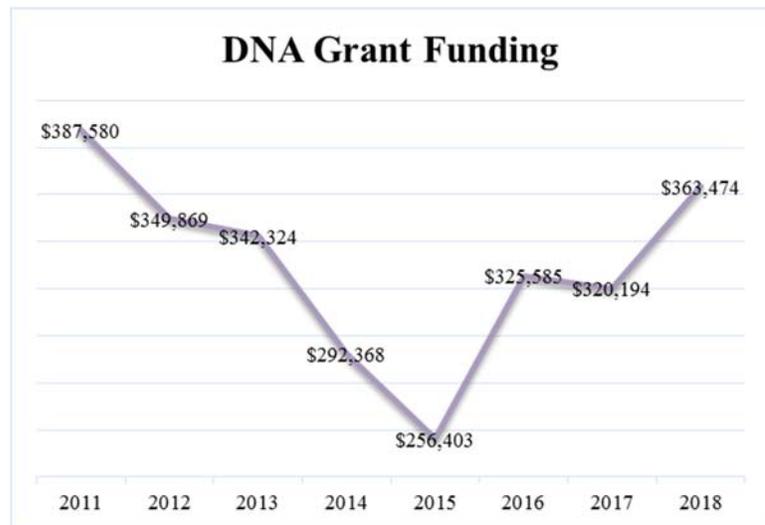
The Casework Manager continues to handle the Federal DNA Backlog Reduction Grants. In September, the DNA Backlog Reduction Grant FY2016 ended. The closeout documentation by the laboratory was due to NIJ by January 31, 2019. The laboratory is currently managing the DNA Backlog Reduction Grant for FY 2017, which closes in December 31, 2019. In October, the DNA unit was awarded a DNA Backlog Reduction Grant for FY 2018.

Grant funds have allowed the DNA unit to remain current with advancements and improvements in the field of Forensic DNA testing.

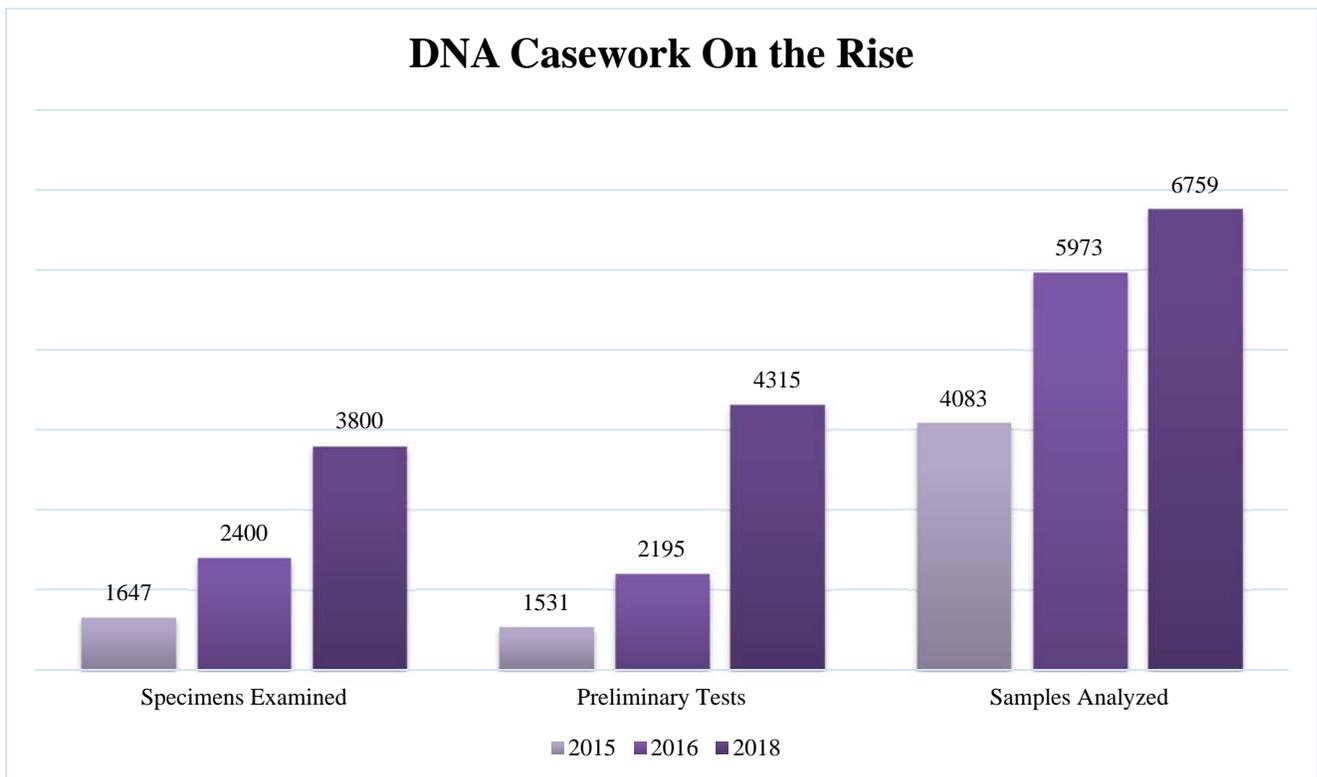
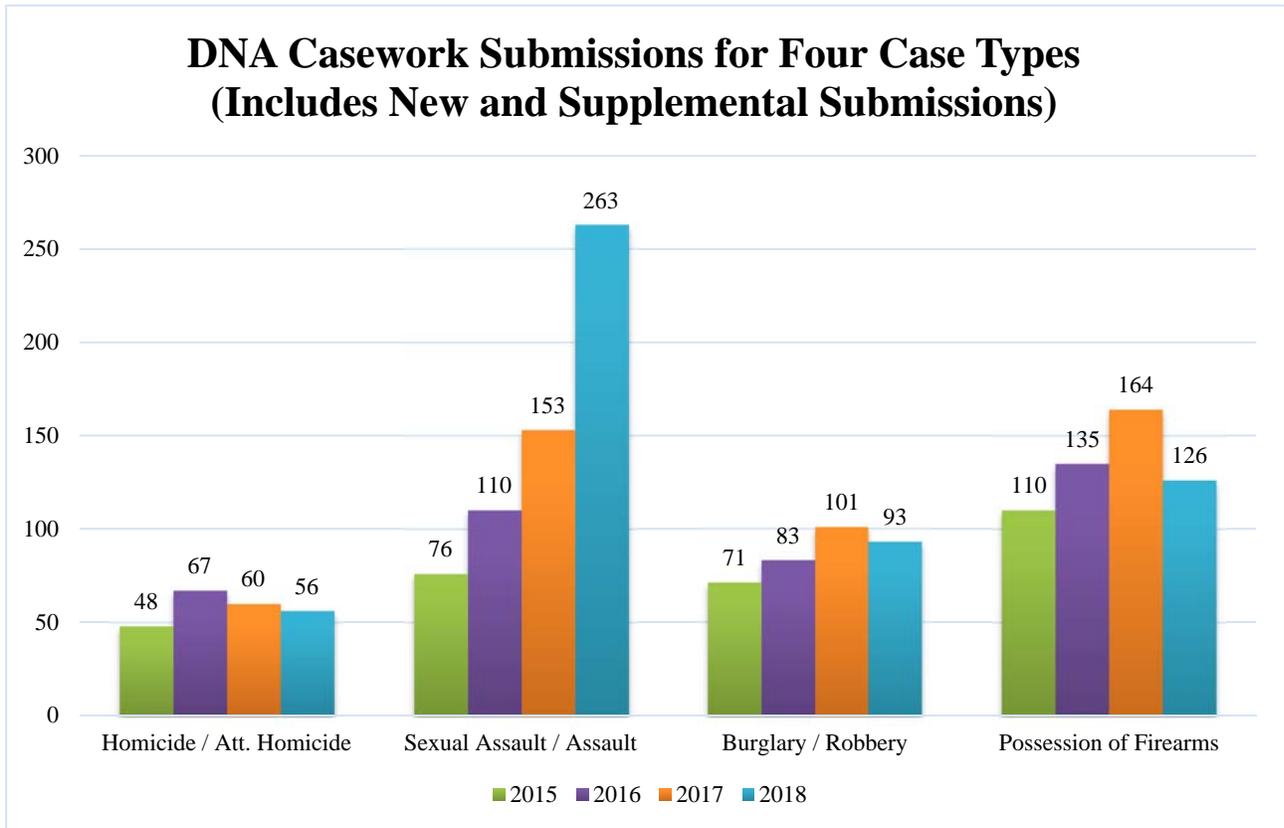
Grant funding had increased when compared to 2017 but the funding is less than the amount received in 2011.

With the DNA FY2016 and 2017 grant funds, the laboratory continued to purchase reagents for casework and convicted offender samples, provided required continuing education training for each DNA Analyst, replaced aging

biological safety hood, and purchased additional instrumentation that would allow robotic separation of sperm from non-sperm cells in sexual assault case samples.



Data



## Forensic Chemistry

### Overview

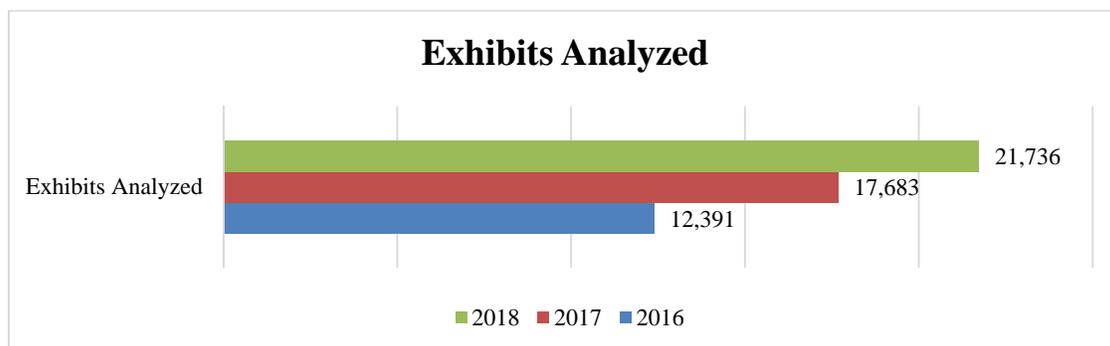
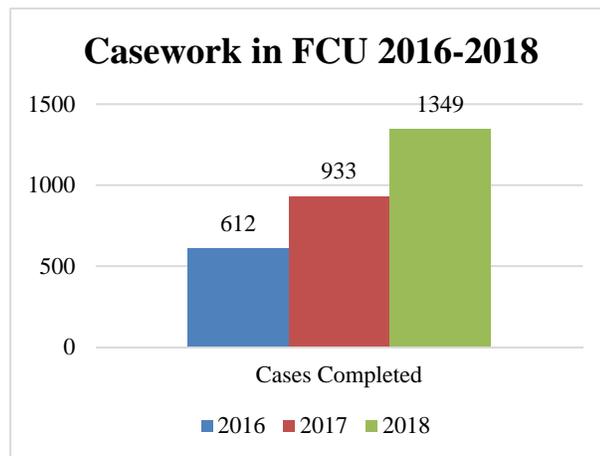
The Forensic Chemistry Unit (FCU) is responsible for analyzing evidence submitted by Delaware law enforcement agencies for the presence of controlled substances. Controlled substances may be present in substrates such as powders, liquids, food products, oils, waxes, plant material, as well as commercially produced pharmaceuticals and clandestine tablets or capsules. The FCU follows the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) recommendations for confirmation of controlled substances by utilizing color tests, microscopy, logo identification, and Gas Chromatography/Mass Spectrometry (GC/MS). The FCU also follows an internationally accepted statistical sampling plan that allows the chemist to make an inference about a population by testing a sampling of exhibits with a 95% level of confidence. This scientific sampling method increases case processing efficiencies while providing sound and conclusive results.

### Casework and Accomplishments

Chemists in the FCU completed 1,349 cases in 2018, which is a 44.6% increase from 2017 (933 completed). In addition to a rise in number of cases completed, there was also a 22.9%

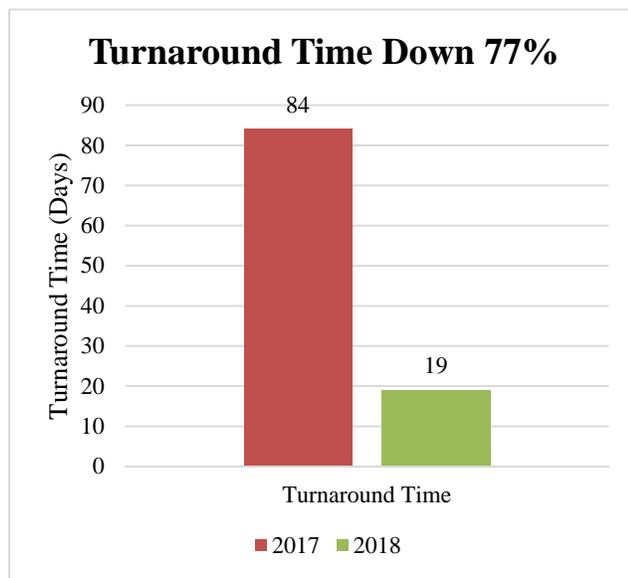
increase in the number of exhibits analyzed; all of which have to be inventoried, counted, and photodocumented. (2017: 17,683 analyzed; 2018: 21,736 analyzed). The complexity of casework continued in 2018, with 30 cases of 1000+ exhibits, 6 cases of 5,000+ exhibits and 2 cases of 10,000+

exhibits. These large cases require greater resources and significant increases in analyst and reviewer time.



The Forensic Chemistry Unit's biggest casework accomplishment of 2018 was a decrease in turnaround time from 84 days in 2017 to 19 days in 2018 (a 77% decrease).

In addition to timely and efficient case processing, members of the FCU worked diligently with the Division of Public Archives on the DFS Archives Project, inventorying and archiving 69 boxes of files in an effort to make use of valuable storage space. The FCU also actively participated in the DFS Internal Audit, volunteering to audit the DNA Unit, Toxicology Unit, and DFS policies and procedures. Significant progress has also been made in bringing the Fire Debris section on-line. With the continuing support of the State



Fire Marshal, policies and procedures have been drafted, training was conducted, a new Intuvo GC/MS has been validated, and an external accrediting audit has been scheduled for March, 2019.

## Staffing

The full complement of the Forensic Chemistry Unit consists of a Laboratory Manager II, Laboratory Manager I, twelve Forensic Analytical Chemists, and two Forensic Evidence Specialists. One chemist and one laboratory manager are also cross-trained in both controlled substances analysis and fire debris analysis.

The FCU underwent significant staffing changes in 2018. The Laboratory Manager II retired from state service and the Laboratory Manager I was promoted to this position, while a Forensic Analytical Chemist III was promoted into the vacated Laboratory Manager I position. Five chemists with the title of Forensic Analytical Chemist I were promoted to Forensic Analytical Chemist II, while two chemists with the title of Forensic Analytical II were promoted to Forensic Analytical Chemist III. The FCU also brought on three additional chemists, two of which began casework in August, 2018, and one who was in training in 2018.

Despite changes in leadership, the FCU staff was able to continue efficiently processing cases from all Delaware Law Enforcement agencies. Fire Debris casework was outsourced to private labs, but will be returning to DFS in 2019.

## Data

The following data provides a visual for analyses completed by the Forensic Chemistry Unit in 2018. The FCU processed cases of varying complexity; with cases from one exhibit to thousands of exhibits. It is important to note that even though a case may only have one exhibit, it still may contain multiple controlled substances or not contain any identifiable controlled substances. The tables below include results from exhibits that were tested and included in the final case report.

As the table outlines, 2018 saw some significant increases in the number of exhibits for the following substances:

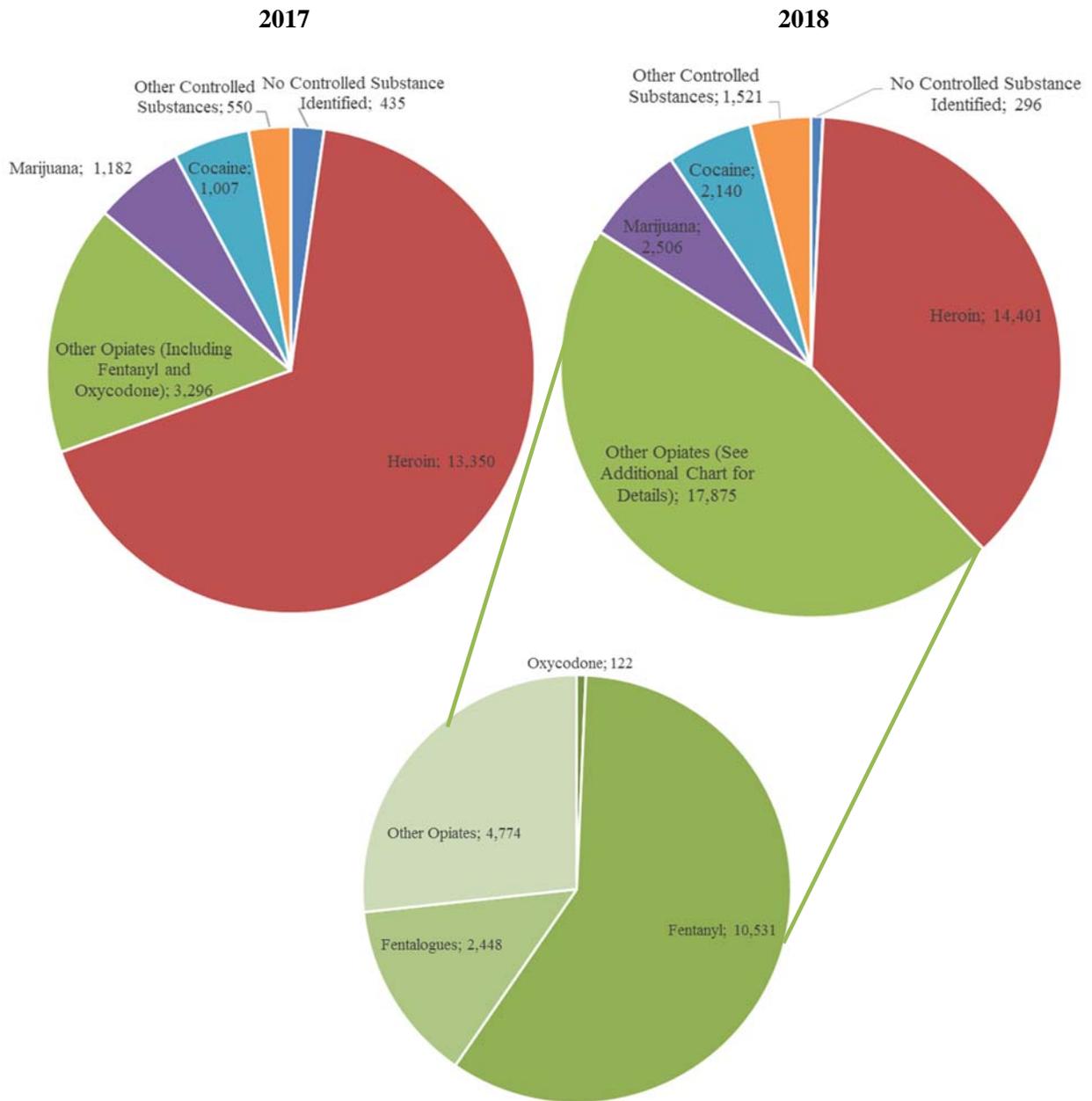
Exhibits Analyzed					
		2017	2018	Increase	
Drugs Tested and Confirmed Positive (Exhibits may contain more than one drug.)	Heroin	13,350	14,401	8%	
	Oxycodone	82	122	49%	
	Other Opiates	3,214	4,774	49%	
	Other Controlled Substances	115	188	63%	
	Marijuana	1,182	2,506	112%	
	Cocaine	1,007	2,140	113%	
	Synthetic Cathinones	62	187	202%	
	PCP	7	20	186%	
	Amphetamine	19	57	200%	
	Methamphetamine	202	808	300%	
	LSD	5	27	440%	
	Synthetic Cannabinoids	2	141	6950%	
	Fentanyl (Tracked as "Other Opiates" in 2017)			10,531	
	Fentalogues (Not Tracked in 2017)			2,448	

In 2018, the FCU also began tracking fentalogues, which are substances that have substitutions to the structure of Fentanyl molecule. In 2018, 2448 fentalogues were reported, including Acetylfentanyl, 4'-methyl Fentanyl, Fluorofentanyl, Valeryl fentanyl, and many others.

The following substances saw a decrease in submitted case findings in the FCU in 2018:

	2017	2018	Decrease
No Controlled Substance(s) Identified	435	296	-32%
MDMA (Ecstasy), etc.	44	7	-84%
Benzodiazepines (Xanax, etc.)	94	86	-9%

**Drugs Confirmed Positive**  
 (Note that each exhibit may contain more than one drug.)



## Conclusion

For answers to further questions, please see the DFS Website at <https://forensics.delaware.gov/>. Note that emails have also changed from “@state.de.us” to “@delaware.gov.”