Division of Forensic Science
2020 Annual Report

Revised June 29th, 2021

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

John Evans, Director

Melissa Newell, Deputy Director

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DEPARTMENT OF SAFETY AND HOMELAND SECURITY
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302-744-2680

The Honorable John Carney
Governor

The Honorable Nathaniel McQueen, Jr.
Cabinet Secretary

May 14, 2021

To the Citizens of Delaware:

I am honored to recognize the outstanding work of the men and women of the Division of Forensic Science (DFS) detailed in this year's annual report. While their dedication and professionalism has resulted in numerous accomplishments and partnerships, I will only highlight a few.

First, as our State grappled with the impacts on the pandemic and employers transitioned their staff to work remotely, our Medical Examiners Unit never wavered in its commitment to serve our citizens. Working in this Unit can be difficult, but the pandemic presented additional challenges. DFS implemented approved safety protocols and our forensic investigators, morgue technicians and pathologists continued to persevere.

Secondly, the excellent work of DFS was also demonstrated through its partnership with law enforcement during the investigation of a missing Smyrna girl. The DFS assisted in the case to create facial reconstruction photos and develop a DNA profile of the unknown skeletal remains, which ultimately led to the identification of the child and an arrest.

Third, the Division utilized multiple funding sources including grants to purchase new and much needed instrumentation and equipment for each of its Units improving the work environment and operations. DFS purchased new mobile x-ray units for the Wilmington and Georgetown locations. These new machines which provide enhanced digital quality images replaced older and outdated equipment. In addition, DFS obtained four new trucks for scene investigations and decedent transport. The vehicles feature updated safety features including rear-view camera and rear air suspension for loading and unloading decedents.

And finally, the DFS Units, including the Medical Examiner's Office, handled a record number of cases. Despite increases in caseloads and the unforeseen challenges presented by COVID, DFS continue to run an effective and efficient operation.

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.

Sincerely,

Secretary Nathaniel McQueen, Jr.

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
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Cabinet Secretary

To My Fellow Delawareans:

On behalf of the men and women of the Division of Forensic Science (DFS), I am happy to present the 2020 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.

I am proud to report that the DFS continued to meet the mission in 2020 despite the significant challenges presented by the COVID 19 pandemic, which is a testament to the commitment and professionalism of the team at DFS. Like many businesses, the DFS was forced to pivot day to day operations to protect the well-being of the staff and our stakeholders by allowing for social distancing, mask wearing, personal hygiene and other precautionary measures.

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 DFS recognizes the significance of data sharing and works together with the Department of Health & Social Services, the Division of Public Health, the Department of Justice, the Delaware Information and Analysis Center, Law Enforcement and other stakeholders to support the health and safety of the citizens and visitors of the state.

In 2020, the Division continued to pursue both state funding and grant opportunities, which allowed the DFS to purchase state-of-the-art instrumentation and equipment in each of the four units. You will read in the Annual Report how these purchases provide not only a safer and more efficient work environment but continue to increase our drug testing capabilities to combat the ongoing opioid epidemic.

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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 and the General Assembly, the forward momentum of the Division of Forensic Science will continue in 2021.

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. I remain confident that our staff will meet any challenge in order to fulfill our mission.

Sincerely,

John R. Evans, Direc

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. The Division is comprised of four units 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.

Division of Forensic Science, Wilmington, DE

During 2020, 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 meets the standards established by the American Board of Forensic Toxicology (ABFT). The dedicated staff at the DFS continues to demonstrate a professional commitment to providing accurate, timely, and responsive forensic science service to all members of the criminal justice community in Delaware.

2020 DFS Organizational Chart. (Note that vacant positions are included in totals.)

Divisional Initiatives, Collaboration, and Information Sharing

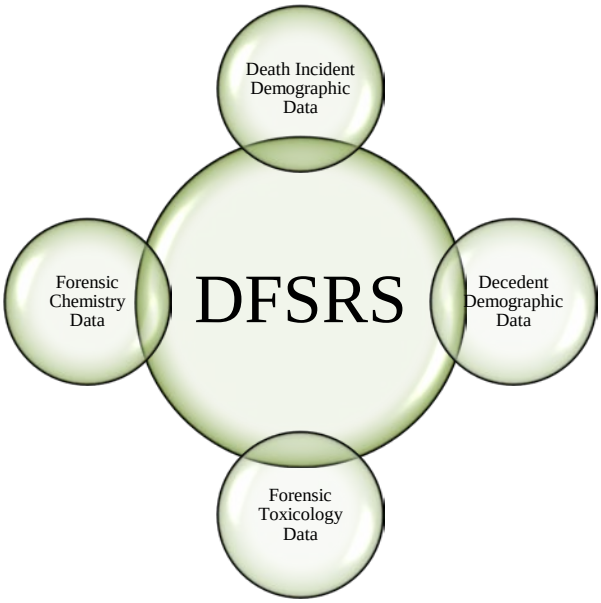
Overview

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 (DFSRP).

DFSRP- 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 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[1].

[1] 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 today is implemented in all 50 states, the District of Columbia, and Puerto Rico.

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 an 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 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

The statewide Mass Fatality Plan is an ongoing effort in collaboration with the Division of Public Health to be prepared for a disaster. 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.

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. We did have the opportunity to do some community outreach this year, including virtual lectures given to students at DSU, participating in virtual career days, and socially distanced facility tours. 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 November 30th, 2024.

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 is accredited to the ABFT standards, provided by ANAB and scheduled to expire on November 30th, 2024.

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 January 16, 2023.

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 Tatnall Building in Dover (Kent County).

For 2020 the MEU investigated 3201 deaths, which is a 19% increase in deaths investigated when compared with 2019. In 2020, the MEU accepted jurisdiction for and certified 1595 (or 49%) of the deaths investigated. The deaths certified by the MEU represents 14.5% of all deaths registered in the State of Delaware. The overall increase in deaths investigated was due to an increase in deaths where the jurisdiction was accepted as well as where the jurisdiction was declined. The largest increase in cases examined and certified was natural deaths, which saw an increase of 22% over natural deaths certified in 2019. Deaths from drug and alcohol intoxication increased by approximately 2% from 438 in 2019 to 449 in 2020.

	2017	2018	2019	2020
Autopsies	610	690	707	760
Inspections	307	296	289	331
Total Examinations	**917**	**986**	**996**	**1091**
Inquiries*	386	381	450	504
Total Deaths Certified	**1303**	**1367**	**1446**	**1595**
Non-Jurisdiction Investigations*	875	927	1239	1606
Total Medical Death Investigations	**2178**	**2294**	**2685**	**3201**
***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.**				

The MEU reviews and approves all requests for cremations for decedents expiring in the State. The MEU reviewed 6303 cremation requests in 2020, which represents a nearly 20% increase in cremation requests over 2019. The increase in cremation requests may be attributed to an increase in cremations due to the COVID pandemic.

The Medical Examiner collaborates with the Gift of Life Organ Donor Program to approve organ and tissue donations in Delaware. In 2020 the DFS-MEU recovered organs and tissues from 243 organs and

tissue donors. Organs procured included heart, liver, kidneys, lungs, and pancreas. Tissues procured included cornea, skin, long bones, heart valves, and veins.

COVID-19 Related Activities

Worldwide activities in 2020 were dominated by the COVID-19 pandemic. Prior to the widespread lockdowns that began in March 2020, the MEU was involved in planning activities to prepare for any increase in deaths due to COVID-19 fatalities. The DFS-MEU is pleased to report that there have been no COVID-19 infections in MEU personnel that were due to work-related exposure such as transmission between team members or from exposure to a COVID-19 victim, scene responses, or decedent transport.

In addition to the mask wearing and social distancing mandates, the MEU had established protocols for safe handling of suspected COVID victims. Activities established by the MEU as part of the COVID-19 response included:

- Educating MEU personnel and establishing protocols for investigating deaths suspected of being due to COVID-19 infection.
- Establishing protocols for judicious use of PPE and safe handling of decedents suspected of having COVID-19 infection with the emphasis on protecting the health and safety of DFS personnel and facilities and funeral home staff and the general public.
- Working closely with the State's Department of Public Health to have systems established for efficient testing of suspected COVID-19 deaths in the community.
- Information sharing via regular meetings and discussions with the Delaware Funeral Directors Association and funeral home representatives.
- Increasing the decedent storage capacity (by almost 100%) to accommodate any surge in deaths in the community due to COVID-19.
- Participating in regular voluntary COVID-19 testing for MEU personnel.

Other Unit-Specific Highlights:

In 2020 despite the pandemic-related restrictions the unit was able to make the improvements listed below:

- Purchase new mobile x-ray units for the Wilmington and Georgetown locations.
- Recruit a forensic pathologist for the Georgetown office.

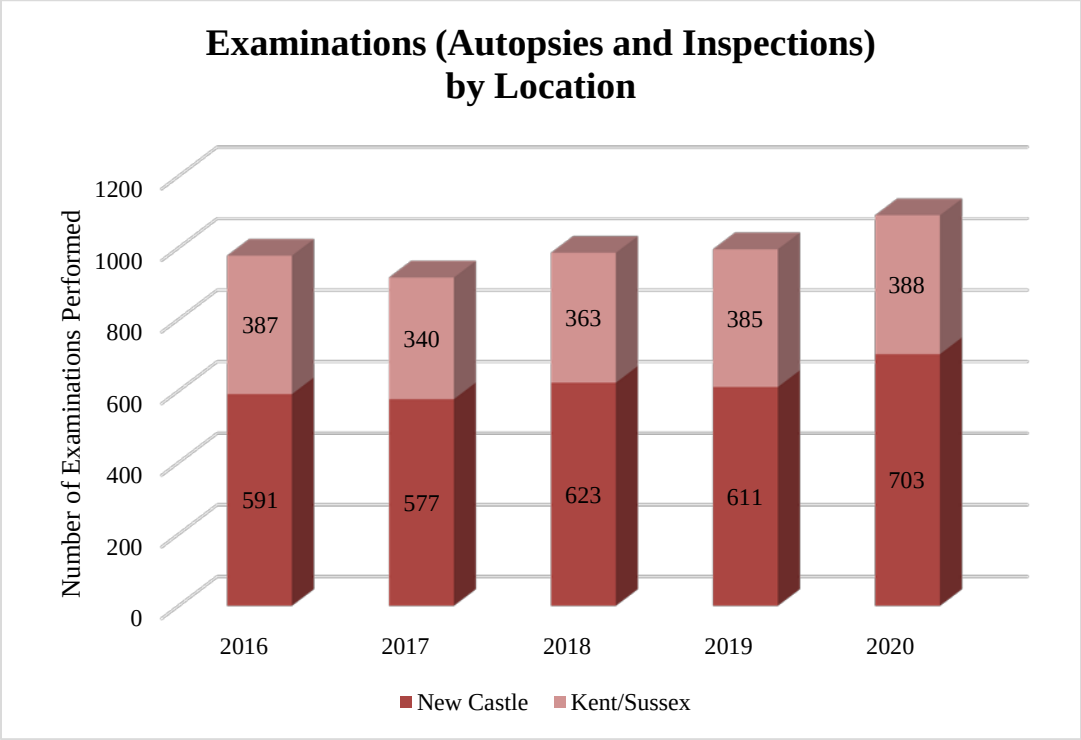
- Participate in online learning opportunities such as the National Association of Medical Examiner's Annual Conference.
- Obtain from fleet services four new trucks for scene investigations and decedent transport. These new trucks came loaded with updated safety features that included rear-view cameras and rear air suspension for loading and unloading heavy decedents.
- The DFS-MEU maintained accreditation with the National Association of Medical Examiners.

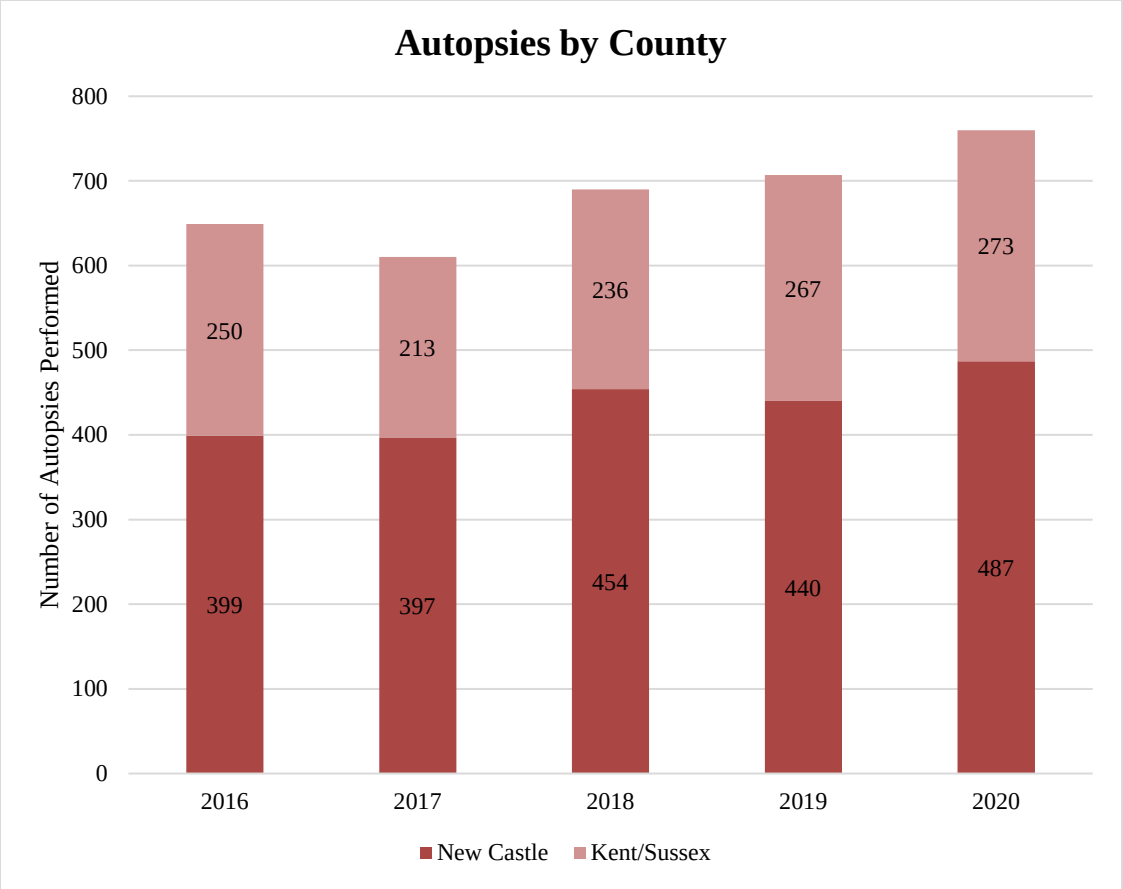
Partners

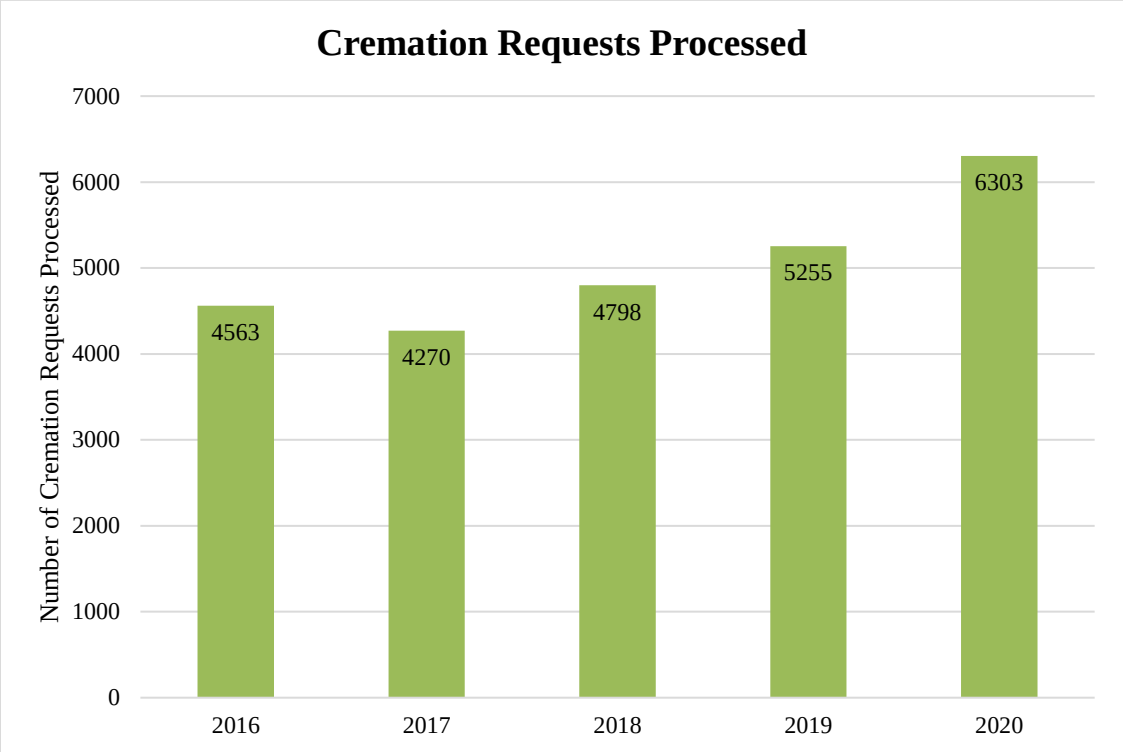
The MEU would not be able to accomplish our mission without the support of the Department of Safety and Homeland Security and the Delaware General Assembly. In addition, it is important to note the many agencies who assist in providing services to the MEU. These agencies include: Delaware law enforcement agencies, the Attorney General's Office, Fleet Services, 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 these agencies.

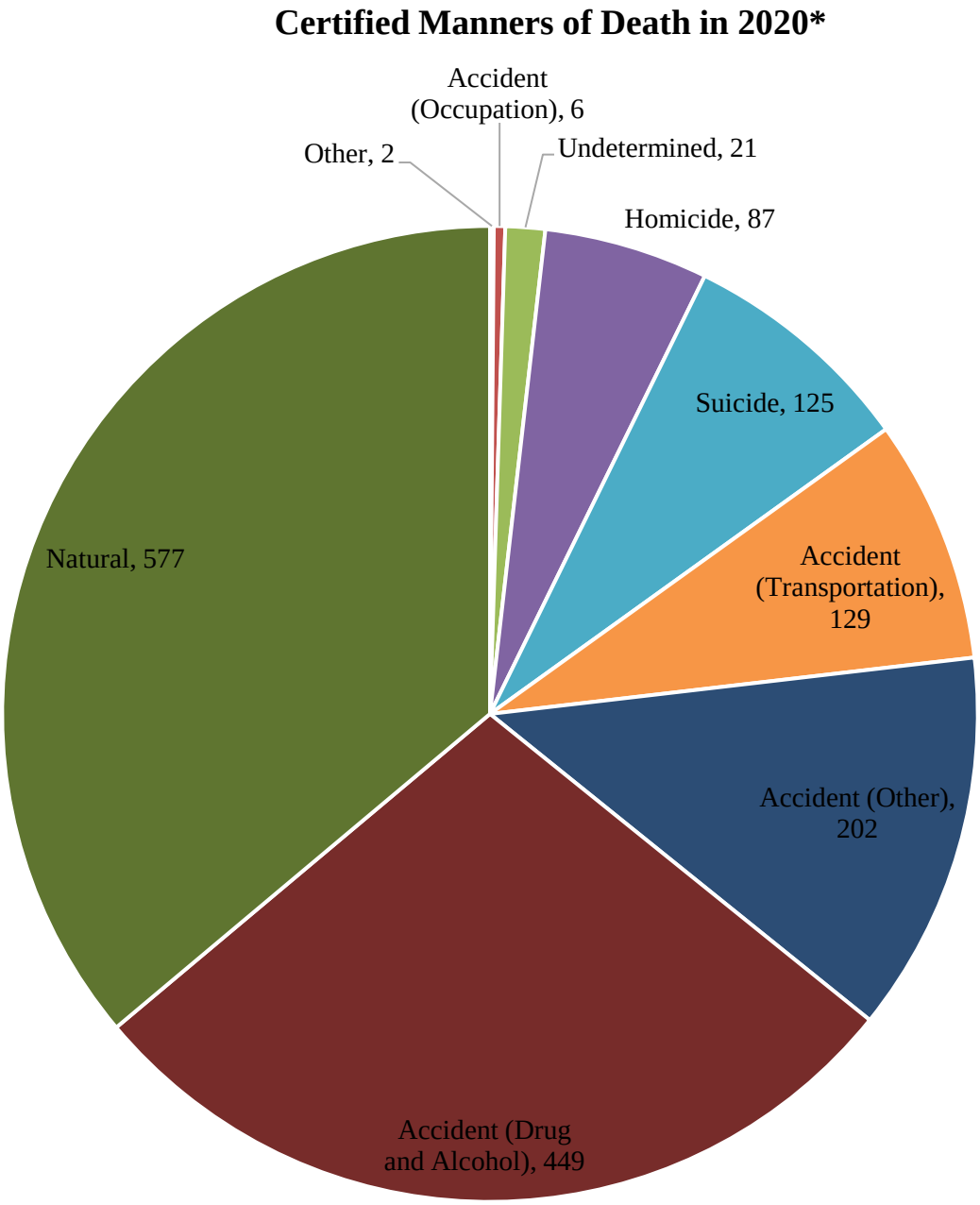
Data

Cases Reviewed



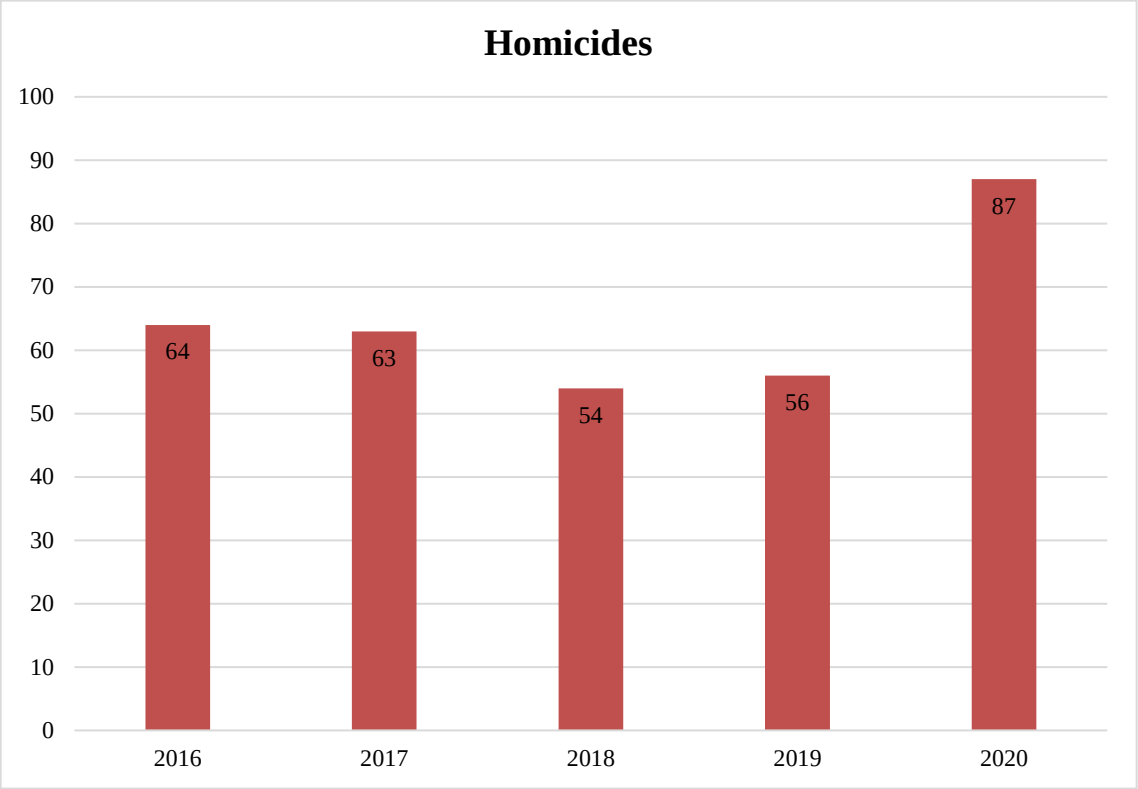

Autopsies by County
Number of Autopsies Performed
800
700
600
500
400
300
200
100
0
250
213
236
267
273
399
397
454
440
487
2016
2017
2018
2019
2020
New Castle
Kent/Sussex

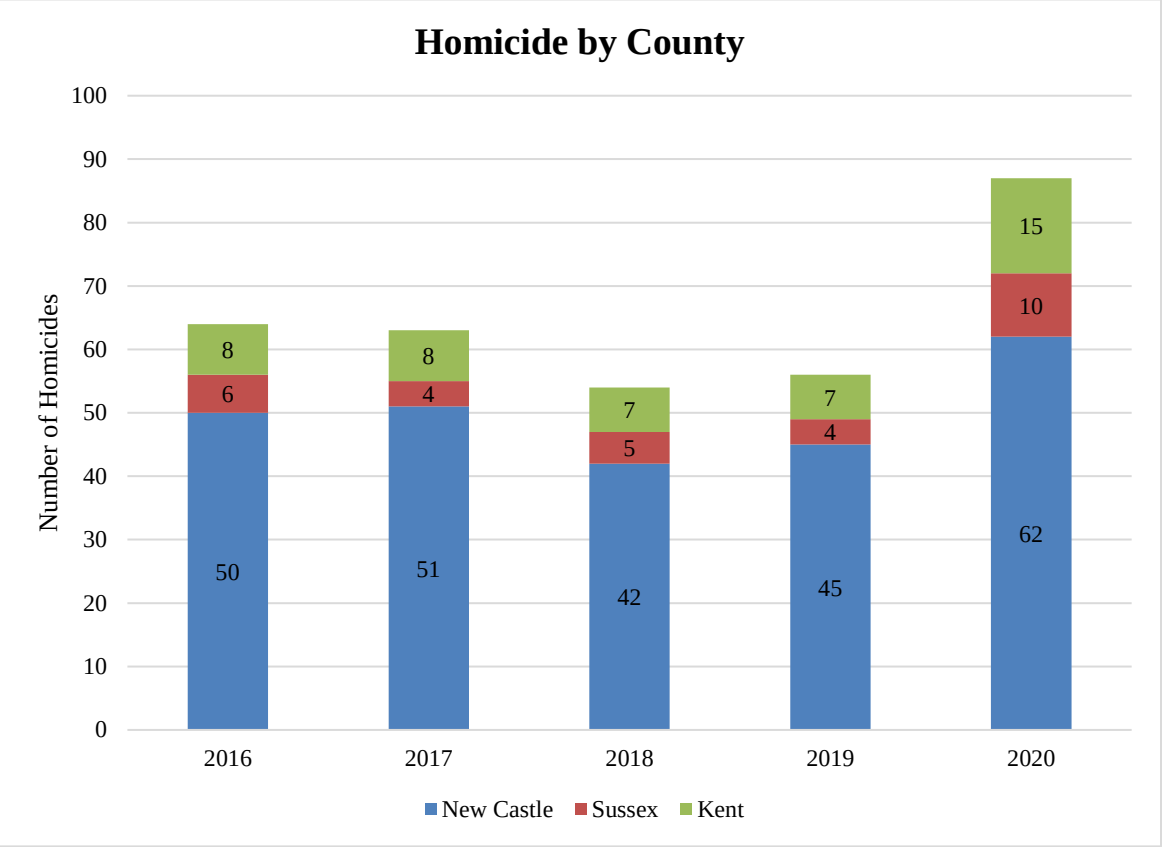

Cremation Requests Processed
Number of Cremation Requests Processed
7000
6000
5000
4000
3000
2000
1000
0
4563
4270
4798
5255
6303
2016
2017
2018
2019
2020

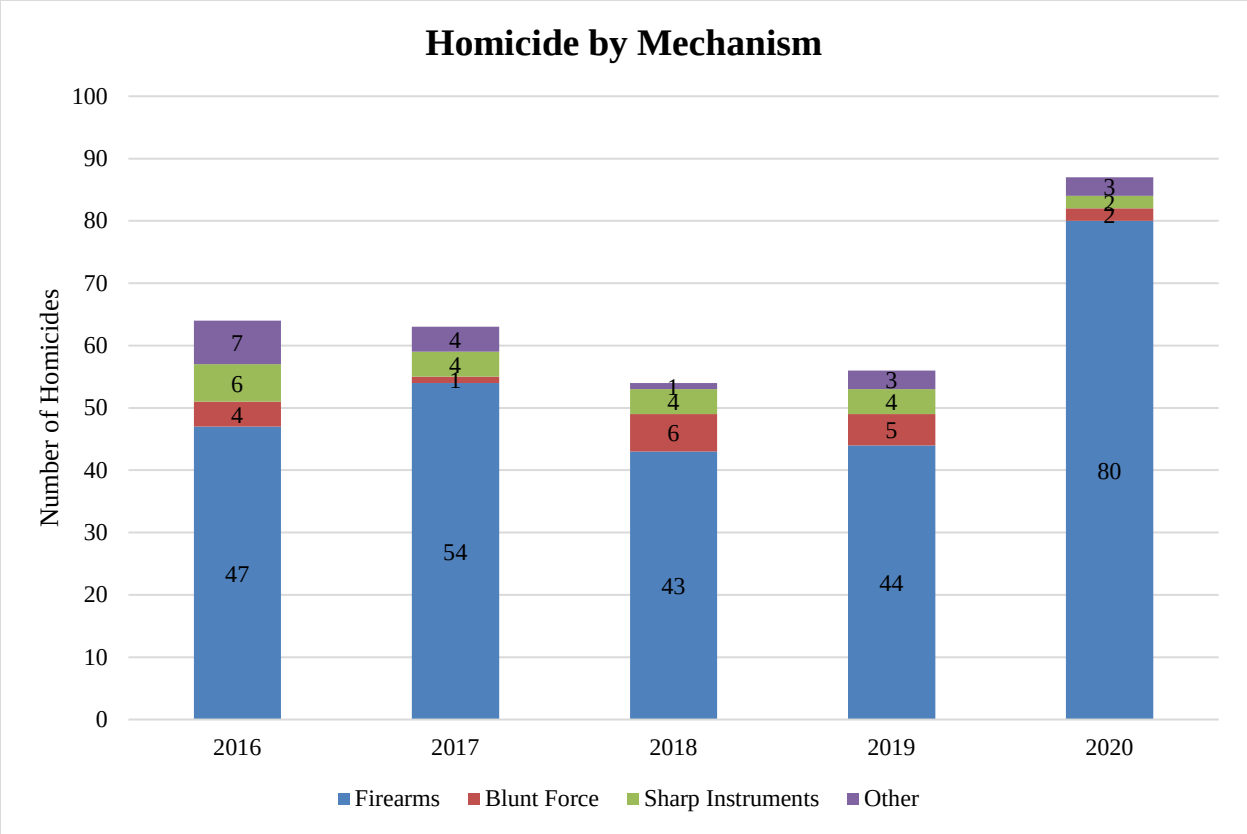


*Note that some deaths were certified with more than one manner.

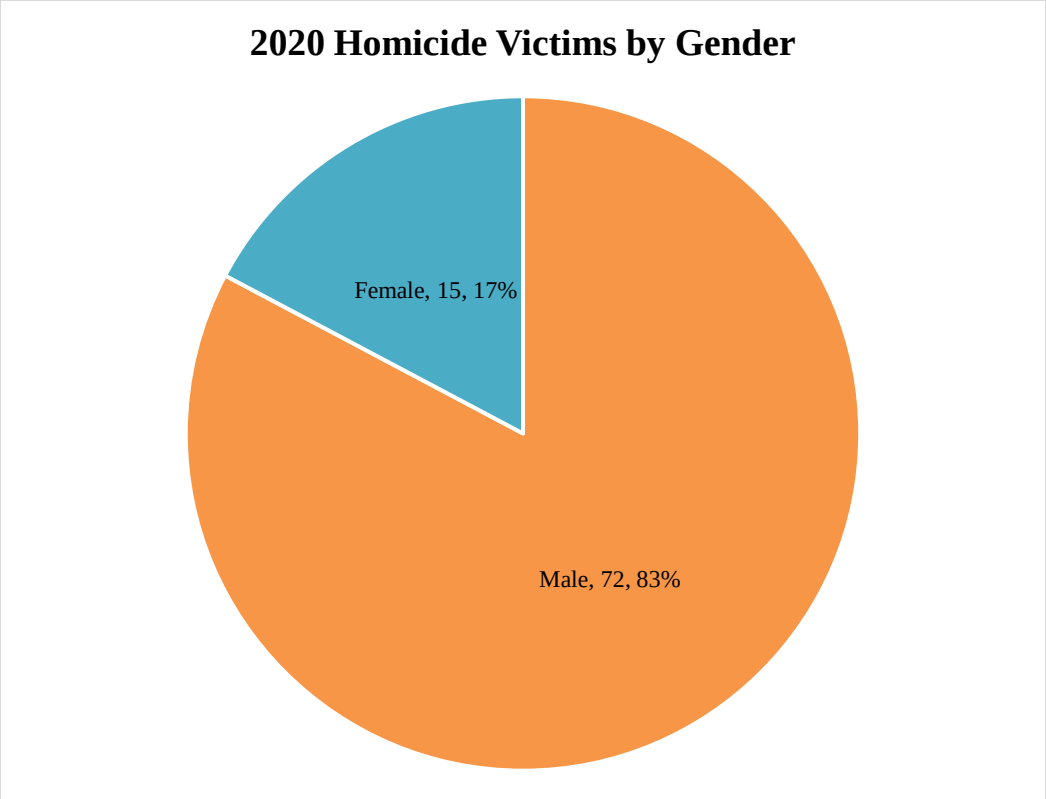
Homicides

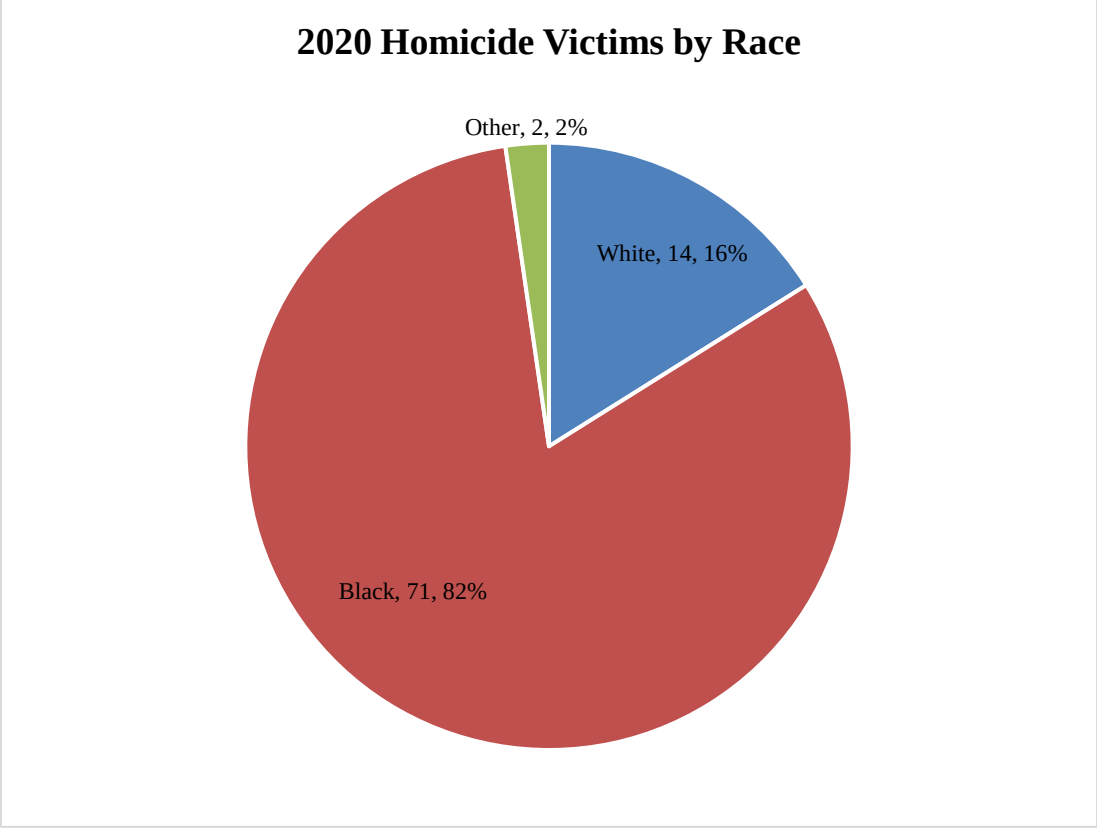

Homicides
100
90
80
70
60
50
40
30
20
10
0
64
63
54
56
87
2016
2017
2018
2019
2020


Homicide by County
Number of Homicides
100
90
80
70
60
50
40
30
20
10
0
8
6
50
8
4
51
7
5
42
7
4
45
15
10
62
2016
2017
2018
2019
2020
New Castle
Sussex
Kent

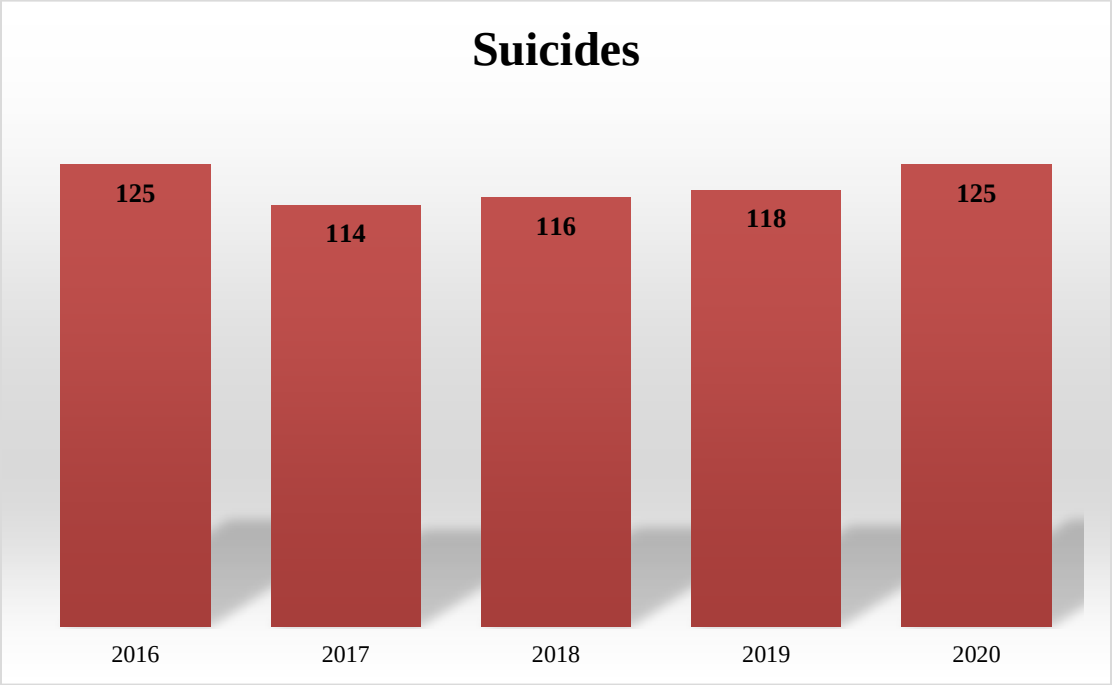

Homicide by Mechanism
Number of Homicides
100
90
80
70
60
50
40
30
20
10
0
2016
2017
2018
2019
2020
47
4
6
7
54
1
4
4
43
6
4
1
44
5
4
3
80
2
2
3
Firearms
Blunt Force
Sharp Instruments
Other

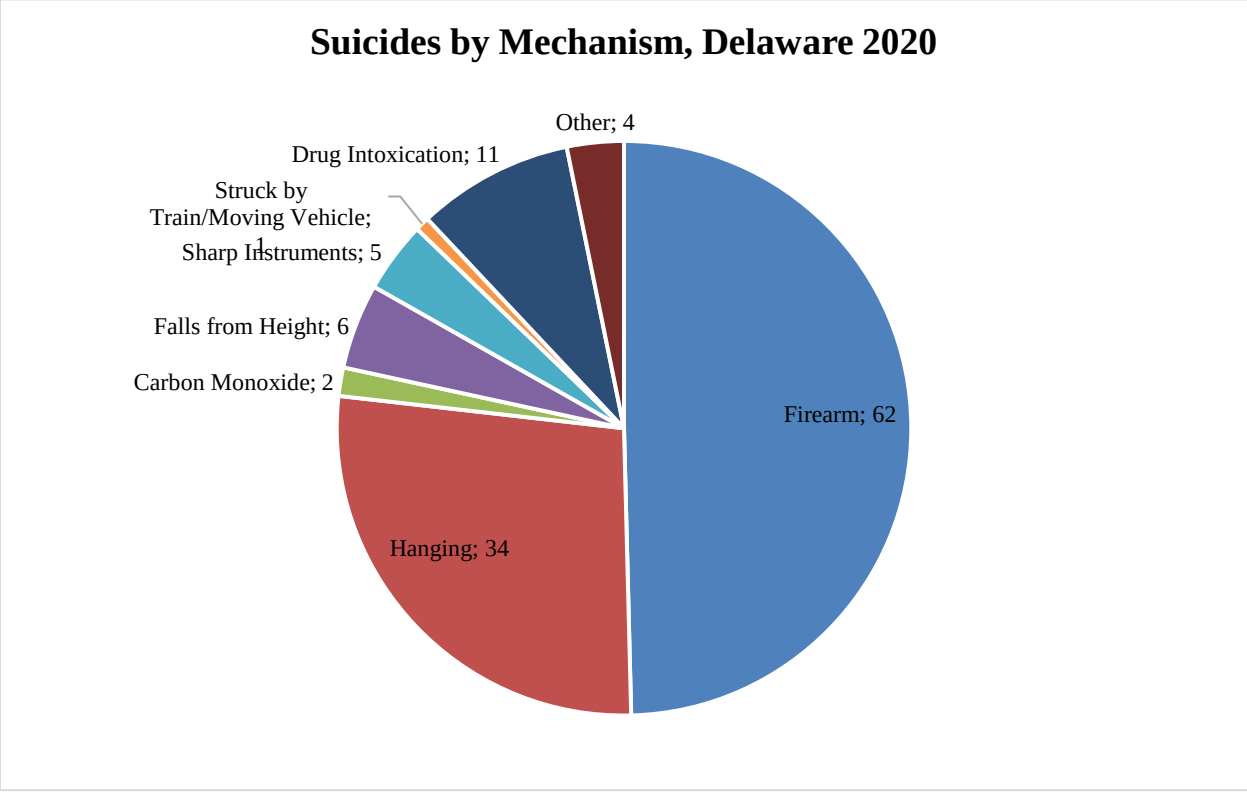

Homicides Victims by Age 2020
Number of Homicides
25
20
15
10
5
0
0
19
39
19
5
2
3
<10
11-20
21-30
31-40
41-50
51-60
> 60
Age (Years)


2020 Homicide Victims by Gender
Female, 15, 17%
Male, 72, 83%

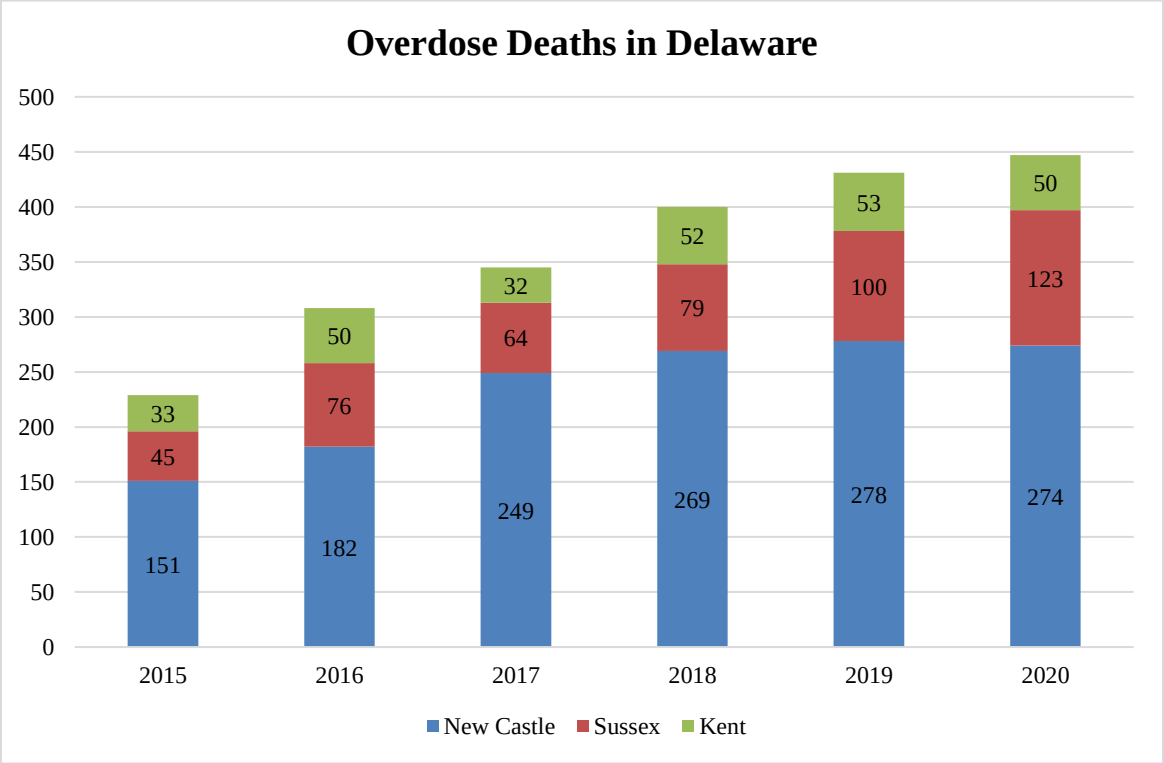

2020 Homicide Victims by Race
Other, 2, 2%
White, 14, 16%
Black, 71, 82%

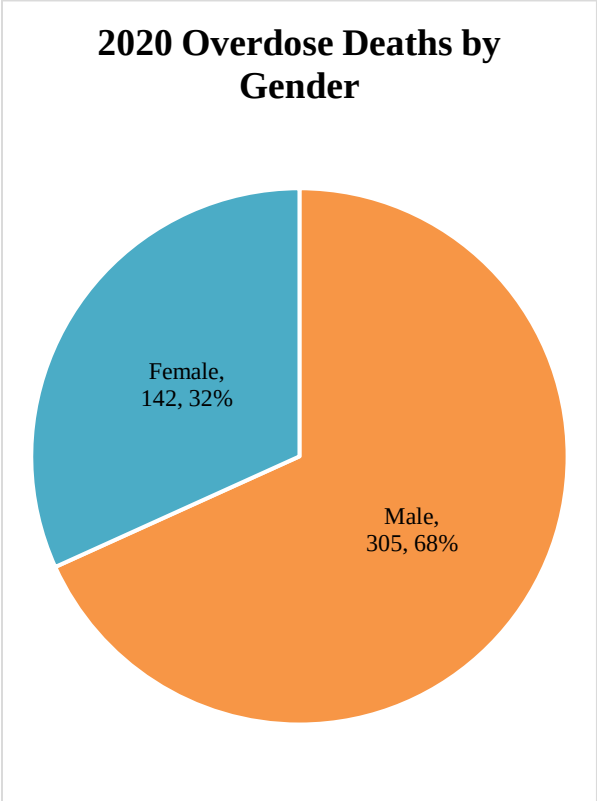
Suicides

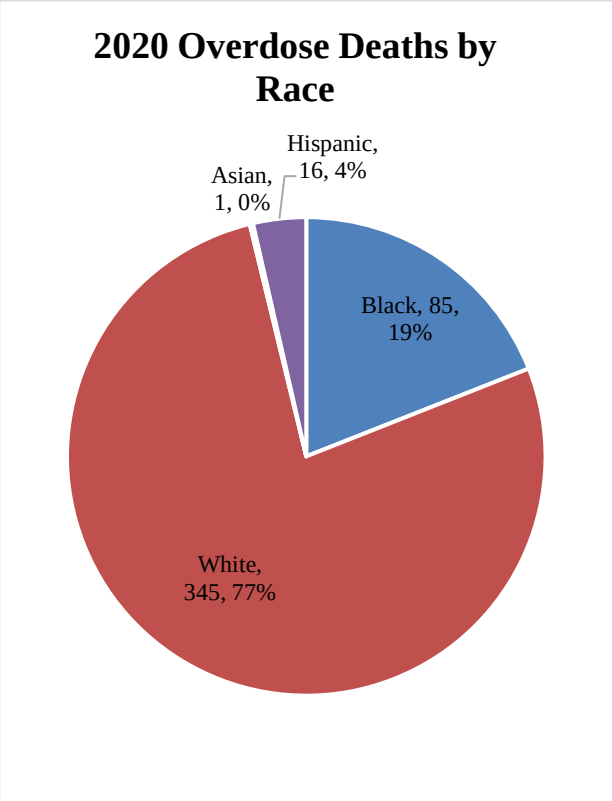

Suicides
125
114
116
118
125
2016
2017
2018
2019
2020

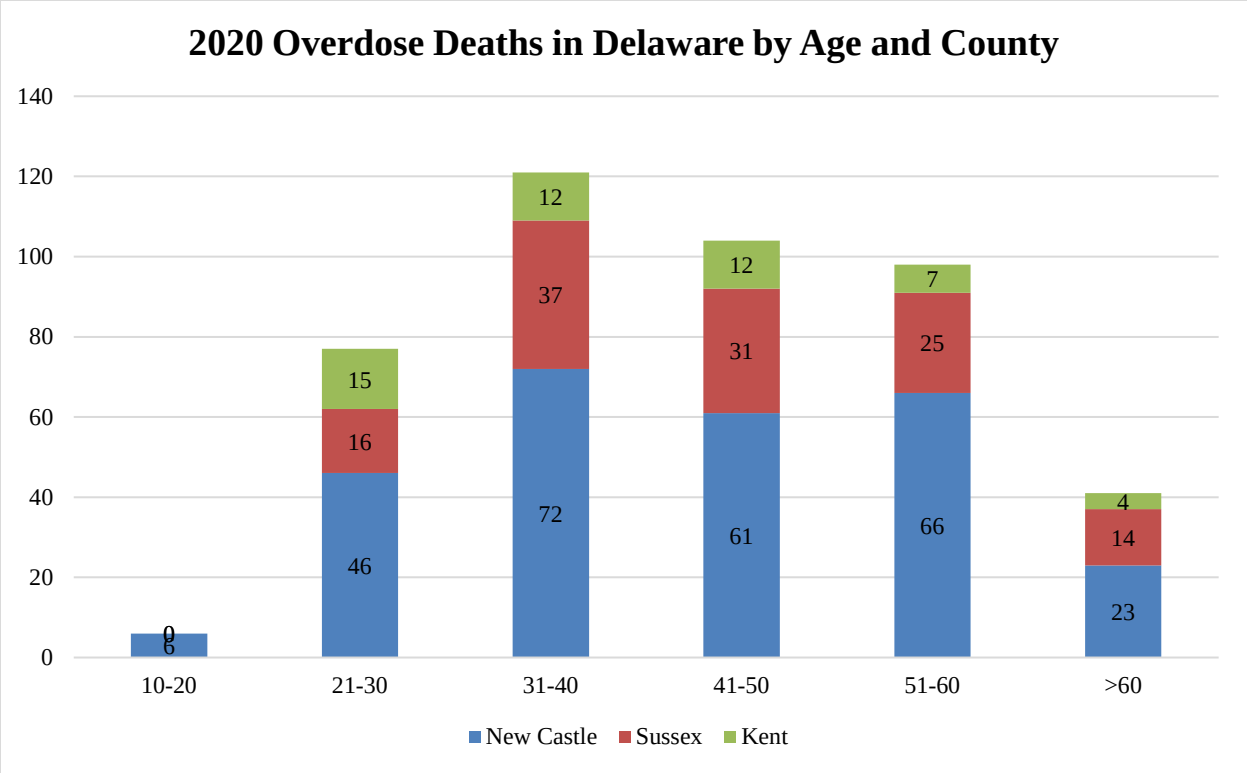

Suicides by Mechanism, Delaware 2020
Other; 4
Drug Intoxication; 11
Struck by Train/Moving Vehicle; 1
Sharp Instruments; 5
Falls from Height; 6
Carbon Monoxide; 2
Firearm; 62
Hanging; 34

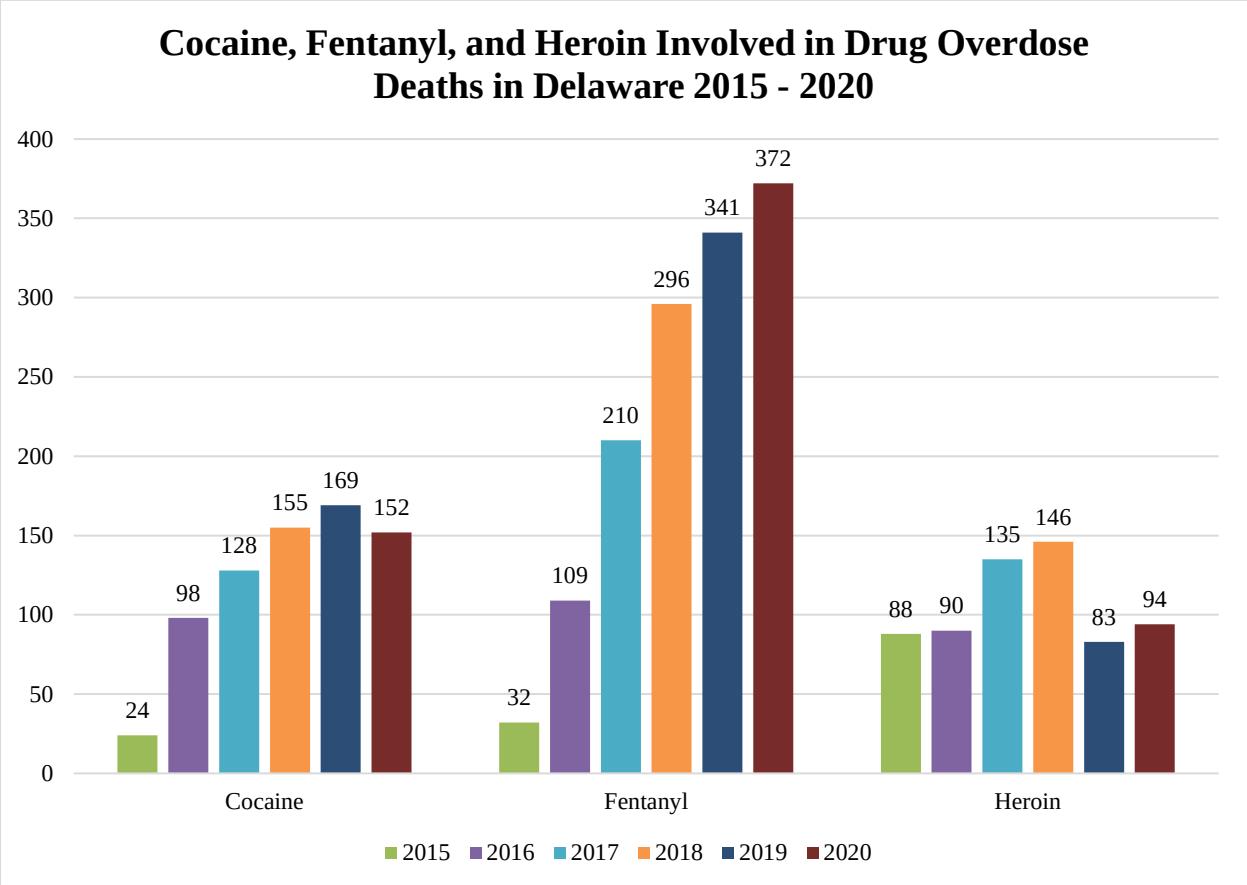
Drug Overdose Deaths








2020 Overdose Deaths in Delaware by Age and County
140
120
100
80
60
40
20
0
0
6
46
16
15
72
37
12
61
31
12
66
25
7
23
14
4
10-20
21-30
31-40
41-50
51-60
>60
New Castle
Sussex
Kent


Cocaine, Fentanyl, and Heroin Involved in Drug Overdose Deaths in Delaware 2015 - 2020
400
350
300
250
200
150
100
50
0
24
98
128
155
169
152
32
109
210
296
341
372
88
90
135
146
83
94
Cocaine
Fentanyl
Heroin
2015
2016
2017
2018
2019
2020

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 ten: the Chief Forensic Toxicologist, the Laboratory Supervisor, seven Analytical Chemists (five for casework and two for research), and one Laboratory Technician. 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: 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 12 confirmatory procedures for the following drug classes/drugs (and their metabolites), which provide quantitation (concentrations or amounts of drugs): Amphetamine-type Stimulants and Bupropion (AMP); Benzodiazepine, Z-drug, and Quetiapine (BENZ)[2]; Antidepressant (ADP); Cannabinoid; Cocaine; Fentanyl, Fentanyl Analog, and Synthetic Opioid (FENT)[2]; Methadone; Opioid; Phencyclidine; and Alkaline Drugs (Cyclobenzaprine, Diphenhydramine, and Tramadol). All confirmatory procedures utilize Gas Chromatography-Mass Spectrometry (GC-MS) except the AMP, BENZ, ADP, and FENT methods, which use 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 maintained a rather steady staff in 2020, losing just their Laboratory Technician who retired in November after 10.5 years of State service with our office. The Tox Unit took on one

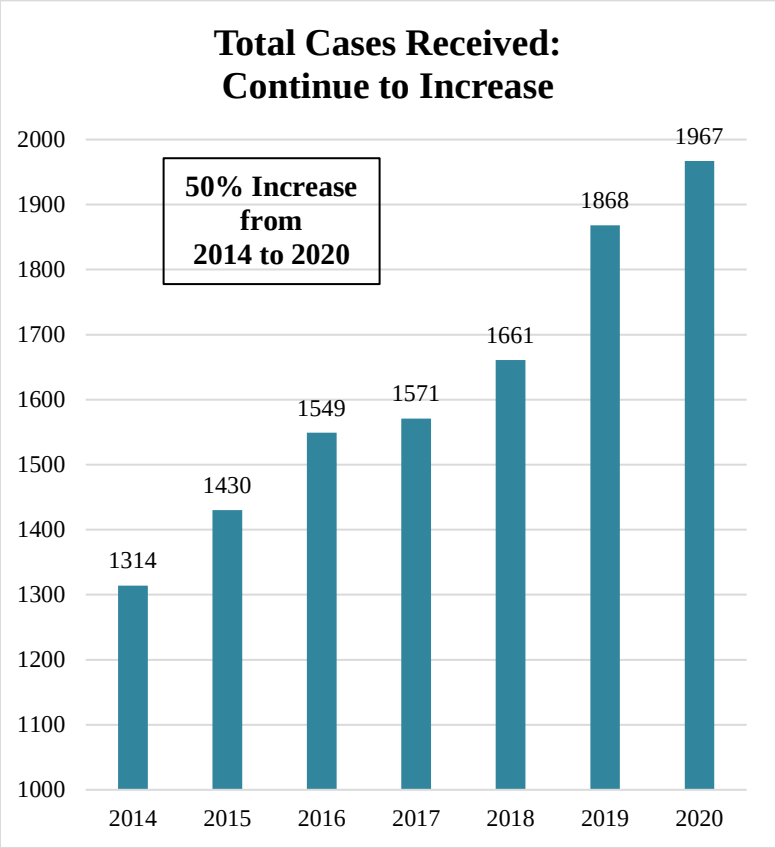
[2] Note that the validations of these methods were completed in February 2020 and their implementations for casework were for all 2020 cases, as will be detailed later.

intern from the University of Delaware (UD) who worked with our research team. The internship was halted shortly after it began in March due to the Coronavirus (COVID-19) pandemic but resumed in June and went through October.

The Tox Unit is a dually accredited laboratory—both to the standards set by ISO/IEC 17025:2017 and by the American Board of Forensic Toxicology (ABFT). The unit had a full accreditation inspection audit for both sets of standards in July and had its first finding-free audit.

Data

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

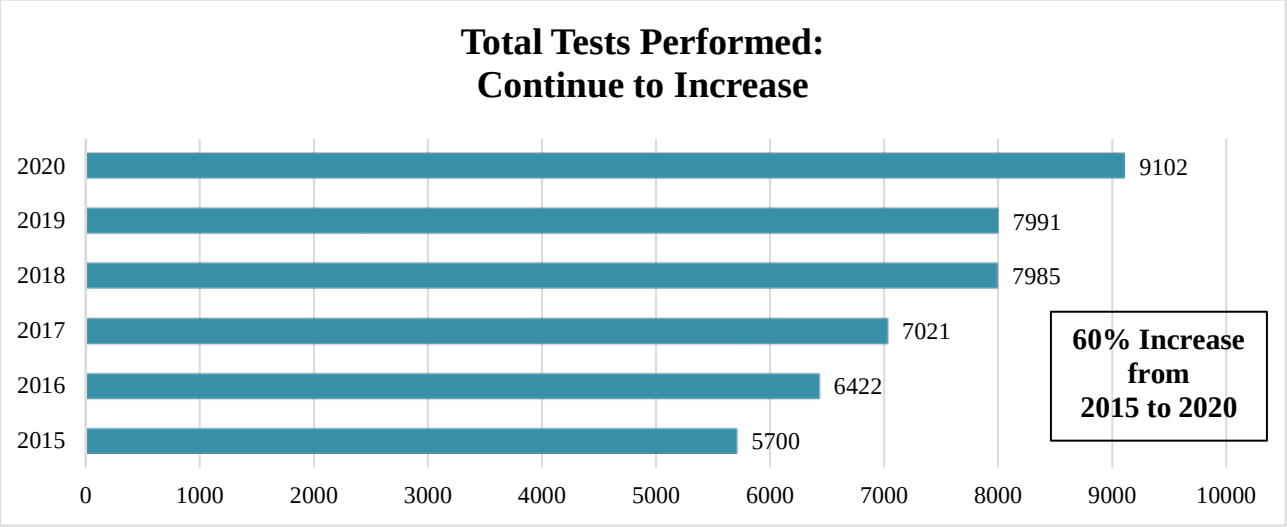


Total Cases Received, Total Tests Performed, and Average Number of Tests Per Chemist Per Year

In 2020, the Toxicology Unit received **885 DUI/Other cases** and **1082 postmortem cases**[3] for testing. This equated to a total of **1967 total cases received** and **9102 total tests run in 2020**. This bar graph shows how the number of cases received has steadily increased since 2014—**up 50% in just the past seven years**.

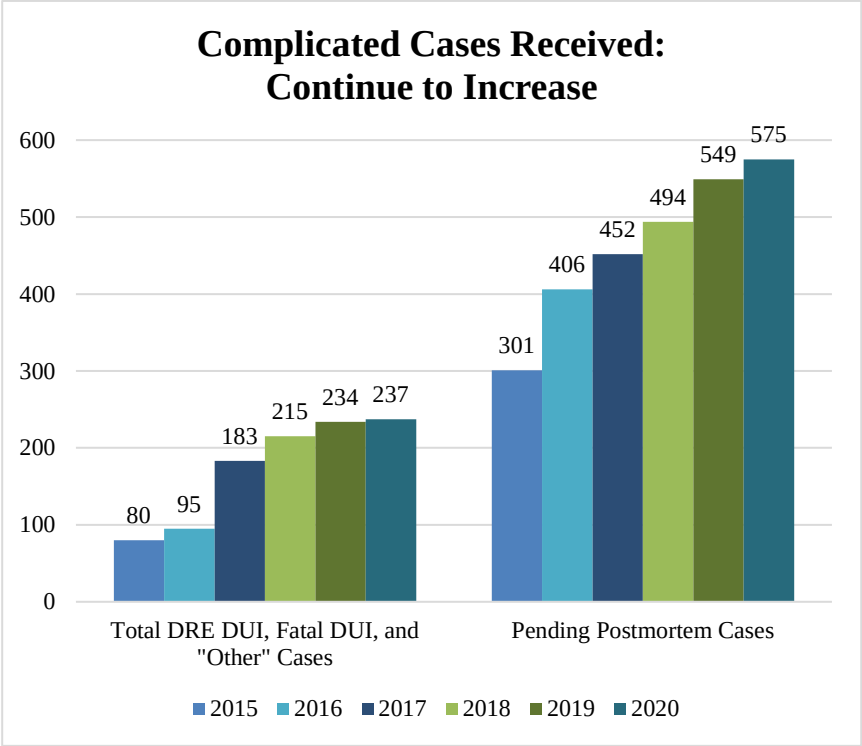
Because each case may have multiple samples and/or require more than one test, and because the unit also runs 40+ proficiency test samples each year (as well as verifications and sometimes repeat samples), the number of tests performed far exceeds the number of cases received each year. For example, in 2020, there were 9102 tests performed in the Tox Unit—a **60% increase since 2015** (when 5700 tests were performed). Despite increases in caseloads for both case types in 2020 and also challenges presented by the COVID-19 pandemic, the Tox Unit managed to keep turnaround times at acceptable levels.

[3] Note that this total does not include an additional 80 cases that were received by the Tox Unit as "Save Only" cases and for which no testing was completed.



Increase in Complicated Cases

DRE DUI, Fatal DUI, 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 are rising precipitously, **up 196% since 2015**.

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 (and which

include suspected drug deaths), comprised more than half (53%) of the postmortem cases received. These pending cases often require multiple tests, including time-consuming ALKDS procedures and/or advanced quantitative confirmations. The number of postmortem pending cases is **up 91% since 2015**. The Tox Unit often receives hospital samples from drug overdose deaths for complete testing.

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 remains the drug on ELISA with the greatest percentage of postmortem cases screening positive (39.1%), as can be seen in the below table; this percentage grew another 1.3% since 2019 when the percentage was 37.8%. The next highest percentages, which were all greater than 20%, were as follows: cannabinoids, None Detected, and opiates.

Postmortem Cases:

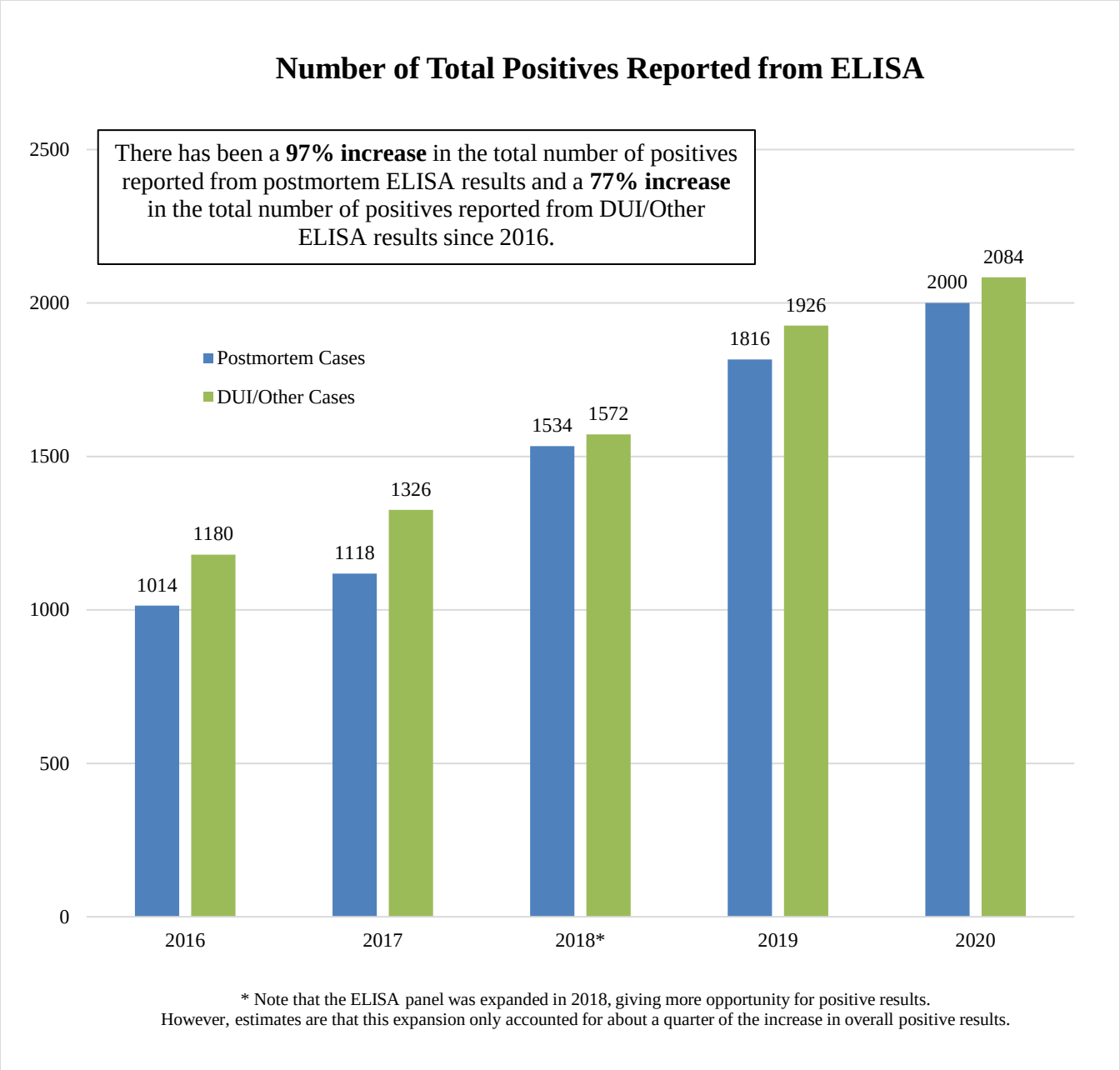
Drug/Drug Class (Cross-Reactives) on ELISA	Percentage of Postmortem Cases that Screened Positive				
Result	**2020**	**2019**	**2018**	**2017**	**2016**
Fentanyl	**39.1%**	**37.8%**	**35.8%**	**27.8%**	**14.7%**
Cannabinoids	32.6%	26.0%	25.9%	28.0%	24.3%
None Detected	24.2%	25.6%	24.6%	29.5%	34.5%
Opiate	21.3%	25.0%	27.9%	20.6%	18.4%
Cocaine	18.2%	21.0%	21.5%	20.8%	17.7%
Diphenhydramine	17.8%	16.5%	14.5%	0.0%	0.0%
Amphetamine	12.7%	11.6%	10.4%	8.6%	9.8%
Benzodiazepine	11.9%	13.1%	14.0%	10.9%	13.6%
Methamphetamine	7.8%	5.1%	3.4%	1.9%	1.6%
Oxycodone	7.4%	9.0%	8.5%	9.5%	11.3%
Methadone	6.2%	4.0%	4.8%	4.1%	4.3%
Buprenorphine	3.7%	4.4%	2.4%	0.0%	0.0%
Tramadol	1.7%	2.7%	1.6%	0.0%	0.0%
Zolpidem	1.2%	1.5%	0.8%	0.0%	0.0%
Ketamine	1.1%	0.8%	0.8%	0.0%	0.0%
Phencyclidine	1.0%	0.8%	1.4%	1.2%	0.5%
Barbiturate	0.8%	0.6%	0.8%	1.6%	1.2%
Carisoprodol	0.3%	0.4%	0.3%	0.5%	0.7%
Meperidine	0.1%	0.0%	0.0%	0.0%	N/A

Of the DUI/Other cases received in 2020, 55.3% screened positive for cannabinoids (marijuana). Fentanyl, benzodiazepines, and opiates are the next top three categories, as they were in 2019. This again shows that more than 40% of our DUI/Other population is screening positive for fentanyl, and this percentage grew an alarming 28.6% over just the last five years (from 12.9% in 2016 to 41.5% in 2020).

DUI/Other Cases:

Drug/Drug Class (Cross-Reactives) on ELISA	Percentage of DUI/Other Cases that Screened Positive				
Result	**2020**	**2019**	**2018**	**2017**	**2016**
Cannabinoids	55.3%	57.1%	49.3%	53.1%	55.2%
Fentanyl	**41.5%**	**37.7%**	**32.8%**	**22.7%**	**12.9%**
Benzodiazepine	26.3%	24.7%	21.1%	20.9%	22.9%
Opiate	24.5%	24.1%	24.8%	21.7%	20.6%
Cocaine	20.8%	20.8%	24.4%	25.3%	21.5%
Methadone	13.2%	11.9%	7.8%	8.2%	6.1%
Amphetamine	12.2%	8.4%	5.6%	4.3%	4.6%
Methamphetamine	11.8%	9.7%	4.2%	3.8%	3.9%
Phencyclidine	7.7%	4.9%	7.8%	6.4%	6.5%
Oxycodone	6.6%	8.8%	7.8%	9.7%	13.2%
None Detected	6.4%	5.6%	7.7%	9.1%	7.7%
Diphenhydramine	6.3%	7.2%	6.6%	N/A	N/A
Buprenorphine	5.4%	4.4%	4.5%	N/A	N/A
Ketamine	1.4%	0.6%	0.3%	N/A	N/A
Zolpidem	1.1%	1.5%	1.5%	N/A	N/A
Tramadol	0.8%	0.7%	0.6%	N/A	N/A
Carisoprodol	0.5%	0.8%	0.4%	1.1%	2.8%
Barbiturate	0.2%	0.8%	1.3%	0.7%	1.0%
Meperidine	0.0%	0.0%	0.0%	N/A	N/A

As the below chart shows, the number of total positives reported from the ELISA Drug Screen has risen sharply in the last five years—**up 97% for postmortem cases and up 77% for DUI/Other cases**.



Top Ten Reported Compounds from Confirmatory Procedures

The below tables show confirmatory results. For postmortem cases, fentanyl stayed in the #1 spot as the top reported compound from confirmatory procedures in 2020 (at 37.4% of all postmortem cases received, unchanged from 2019), followed by norfentanyl (27.3%) and then ethanol (26.5%), which was in the #1 spot in 2017 and 2016.

Postmortem Cases:

Top Ten Order	Confirmatory Method	Compound	As a Percentage of Total Postmortem Cases Received
1	Fentanyl	Fentanyl	**37.4%**
2	Fentanyl	Norfentanyl	**27.3%**
3	ALC/VOLS	Ethanol	**26.5%**
4	Cocaine	Benzoylecgonine	**17.0%**
5	Cocaine	Ecgonine Methyl Ester	**14.2%**
6	Cocaine	Cocaine	**14.2%**
7	Fentanyl	4-ANPP*	**13.6%**
8	Opiates	Morphine	**12.8%**
9	Cannabinoids	Delta-9 tetrahydrocannabinol	**6.8%**
10	Cannabinoids	Delta-9-Carboxy-Tetrahydrocannabinol	**6.8%**

* Note that this percentage is actually higher, as there were several batches for which this compound could not be reported.

The inactive marijuana metabolite, delta-9-carboxy-tetrahydrocannabinol, was confirmed positive in 38.0% of the DUI/Other cases received, and the active parent compound of marijuana, delta-9-tetrahydrocannabinol (THC), was confirmed positive in 26.0% of DUI/Other casework. Fentanyl moved into the second top reported compound for DUI/Other cases at 27.8%, and norfentanyl (a metabolite of fentanyl) was third (26.1%).

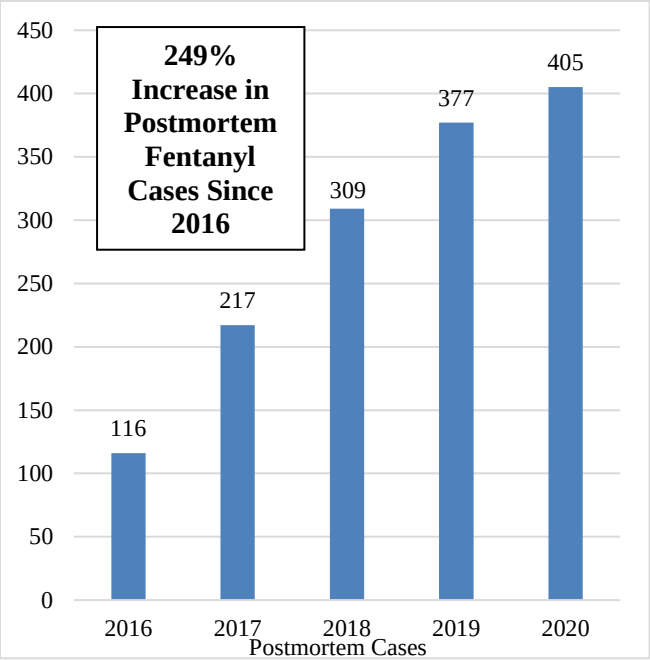
DUI/Other Cases:

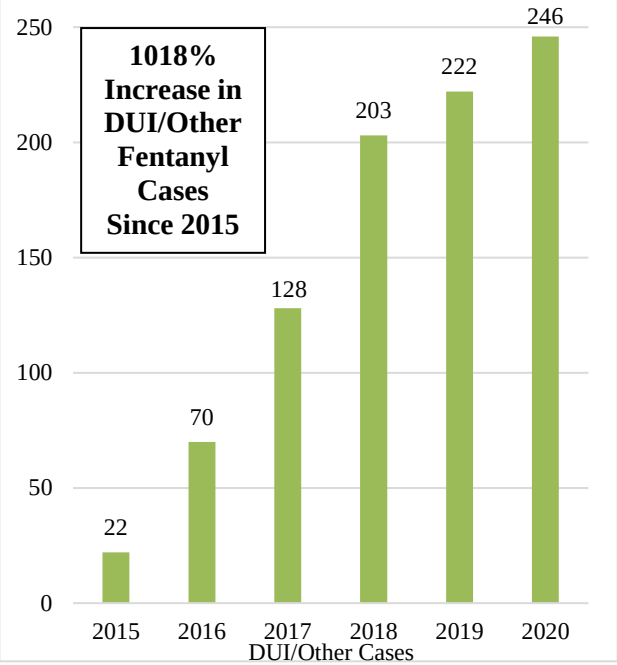
Top Ten Order	Confirmatory Method	Compound	As a Percentage of Total DUI/Other Cases Received
1	Cannabinoids	Delta-9-Carboxy-Tetrahydrocannabinol	**38.0%**
2	Fentanyl	Fentanyl	**27.8%**
3	Fentanyl	Norfentanyl	**26.1%**
4	Cannabinoids	Delta-9-Tetrahydrocannabinol	**26.0%**
5	Cocaine	Benzoylecgonine	**16.0%**
6	Amphetamine	Amphetamine	**11.1%**
7	Amphetamine	Methamphetamine	**11.0%**
8	Methadone	Methadone	**8.7%**
9	Fentanyl	4-ANPP*	**8.2%**
10	Cocaine	Cocaine	**8.0%**

* Note that this percentage is actually higher, as there were several batches for which this compound could not be reported.

Fentanyl confirmations in the Tox Unit have increased **249% for postmortem cases since 2016** and **1018% for DUI/Other cases since 2015**, as the below charts illustrate. This shows how the opioid/fentanyl epidemic continues to escalate.

Number of Cases that Confirmed Positive for Fentanyl





Projects and Grants

The Toxicology Unit completed two major projects in early 2020, which both went live for all 2020 casework, showing that 2020 was a very successful year for the unit. Not only did the unit handle more casework than ever, but they also greatly expanded their scope of testing, and this was all during a global pandemic, which in and of itself brought many challenges.

The first validation project—*Fentanyl, Fentanyl Analog, and Synthetic Opioid Confirmation and Quantitation by LC-MS/MS* (FENT)—was completed by an external consulting company but still required time and work in-house. With this expanded panel, the unit went from being able to confirm and quantitate just one analyte (fentanyl on GC-MS) to now 28 analytes (on LC-MS/MS), shown below. Another improvement of this newly validated method is that the unit doubled their reporting limits at both ends—going from 1.0-50 ng/mL with the old method to now 0.5-100 ng/mL. This method comprises 50 total analytes when including the 22 internal standards.

Expanded FENT Panel Analytes

1. Fentanyl
2. Norfentanyl
3. 4-ANPP
4. Acetyl Fentanyl
5. Acetyl Norfentanyl
6. Methoxyacetyl Norfentanyl
7. Butyryl Norfentanyl
8. Methoxyacetyl Fentanyl
9. Ocfentanyl
10. beta-Hydroxythiofentanyl
11. U-47700
12. meta-methyl Methoxyacetyl Fentanyl
13. para-Fluorofentanyl
14. Tetrahydrofuran Fentanyl
15. Acryl Fentanyl
16. U-49900
17. U-51754
18. Carfentanil
19. Cyclopropyl Fentanyl
20. Butyryl Fentanyl
21. U-50488
22. Sufentanil
23. Valeryl Fentanyl
24. W-15
25. W-18
26. FIBF
27. para-Fluorobutyryl Fentanyl
28. Furanyl Fentanyl

The second validation project—*Benzodiazepine, Z-drug, and Quetiapine Confirmation and Quantitation by LC-MS/MS* (BENZ)—was completed entirely in-house. With this expanded panel, the unit went from being able to confirm and quantitate just three analytes (alprazolam, diazepam, and nordiazepam on GC-MS) to now 30 analytes (on LC-MS/MS), shown below. The reporting range is 5.0-750 ng/mL for all analytes except the last three shown below, which have a reporting range of 1.0-150 ng/mL. This method comprises 49 total analytes when including the 19 internal standards.

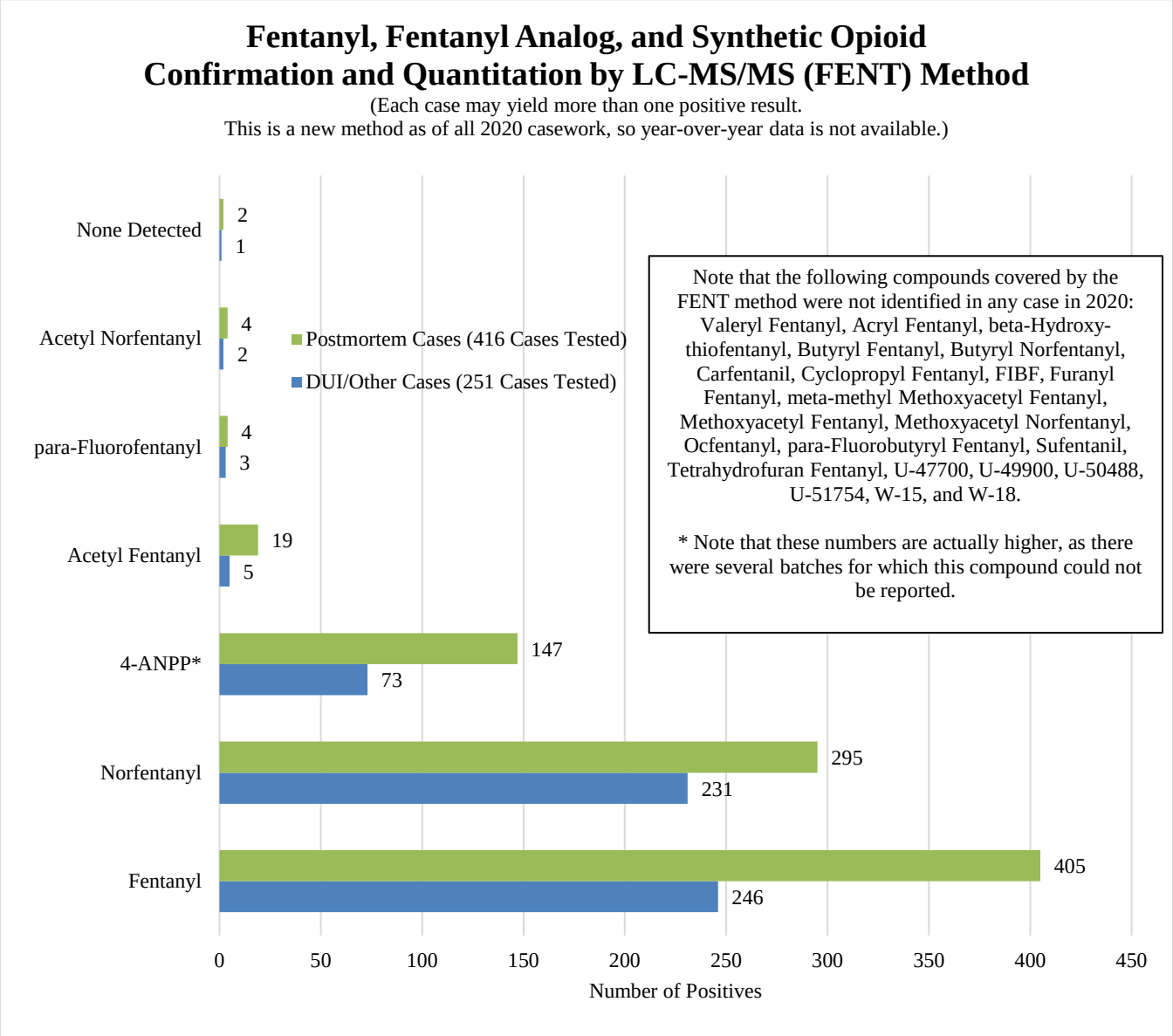
Expanded BENZ Panel Analytes

1. 7-Aminoclonazepam
2. 7-Aminoflunitrazepam
3. Chlordiazepoxide
4. alpha-Hydroxymidazolam
5. Midazolam
6. alpha-Hydroxyalprazolam
7. alpha-Hydroxytriazolam
8. Nitrazepam
9. Estazolam
10. Oxazepam
11. Nordiazepam
12. Alprazolam
13. Lorazepam
14. 2-Hydroxyethylflurazepam
15. Flubromazolam
16. Clonazepam
17. Triazolam
18. Desalkylflurazepam
19. Etizolam
20. Flunitrazepam
21. Flubromazepam
22. Temazepam
23. Clobazam
24. Phenazepam
25. Diazepam
26. Zopiclone
27. Zaleplon
28. Zolpidem
29. Flurazepam
30. Quetiapine

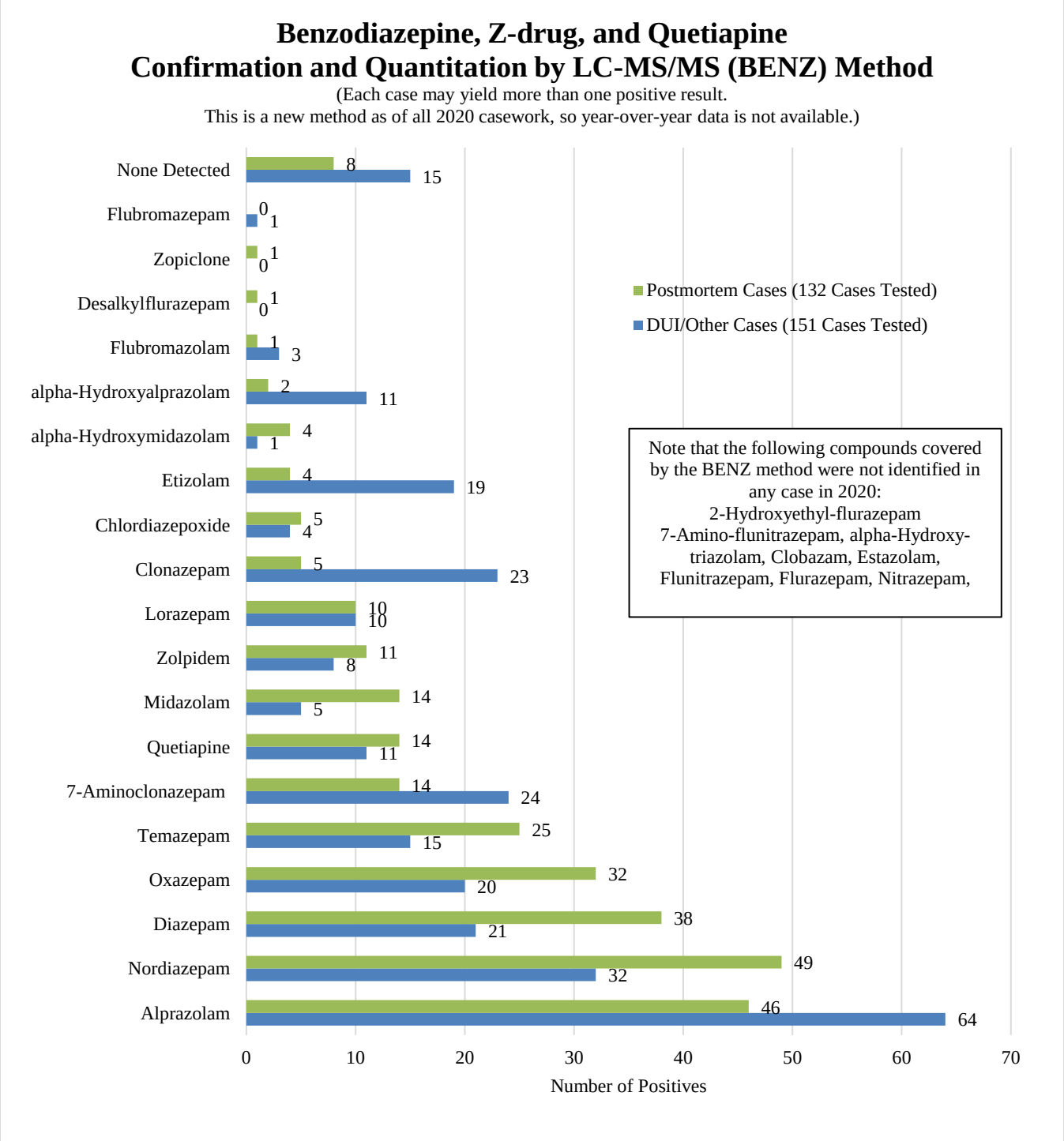
Much time and effort went into the BENZ project, from the design and development, to the validation runs, and all the way through to the data review. The Chief Forensic Toxicologist would like to recognize

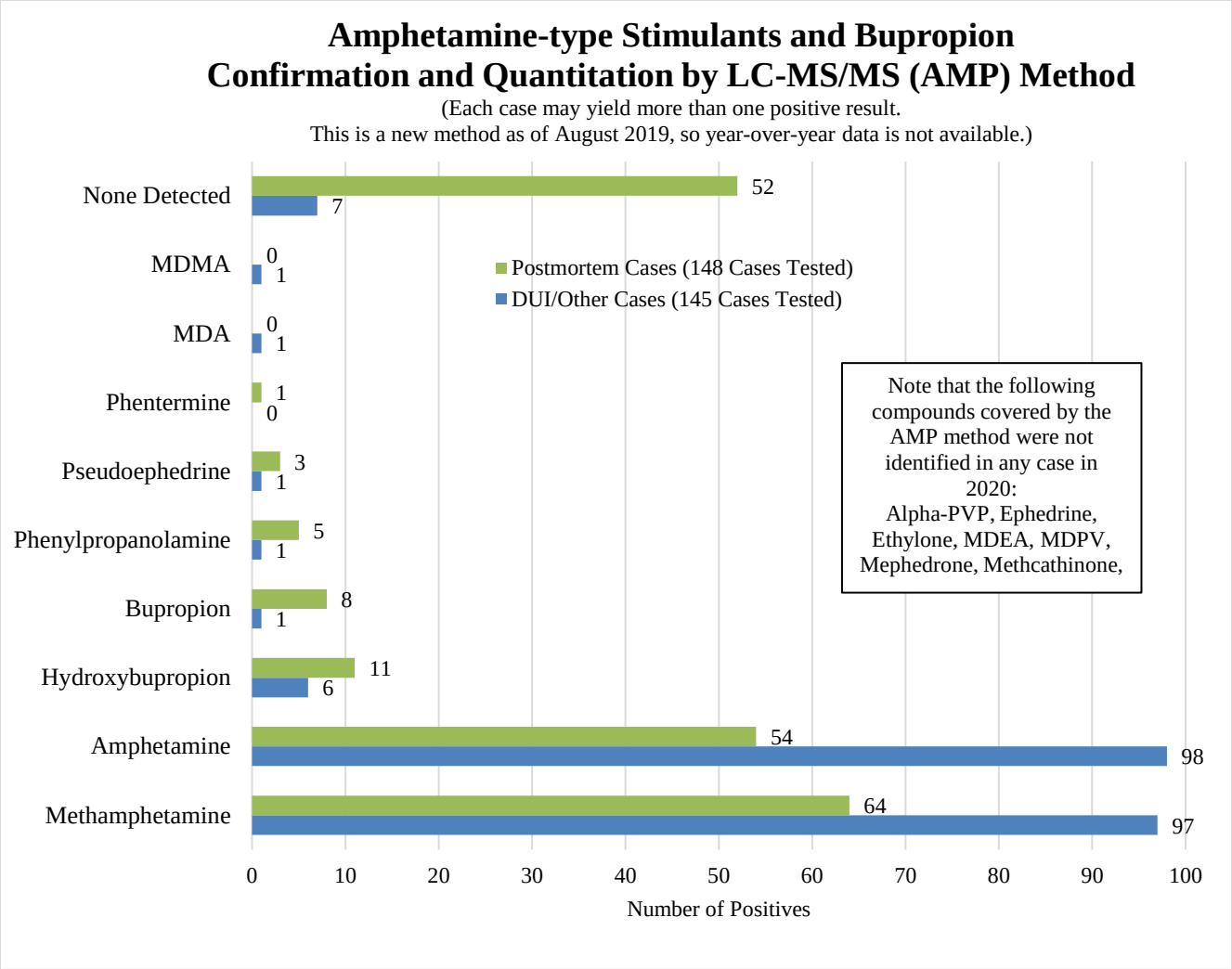
all members of the Tox team and the Quality Assurance Manager for their contributions to both completed projects.

Below are charts that show the analytes that were detected and reported with these new panels during 2020; data is also included for the *Amphetamine-type Stimulants and Bupropion Confirmation and Quantitation by LC-MS/MS*, which went into production for casework in August 2019 (thus 2020 is the first full year's worth of data). As the FENT chart shows, fentanyl was detected the most often for both case types, followed by norfentanyl and then 4-ANPP, which is a minor fentanyl metabolite and an intermediate in its synthesis (see comment on the chart regarding this analyte). As for fentanyl analogs, the only two detected thus far are acetyl fentanyl and para-fluorofentanyl.



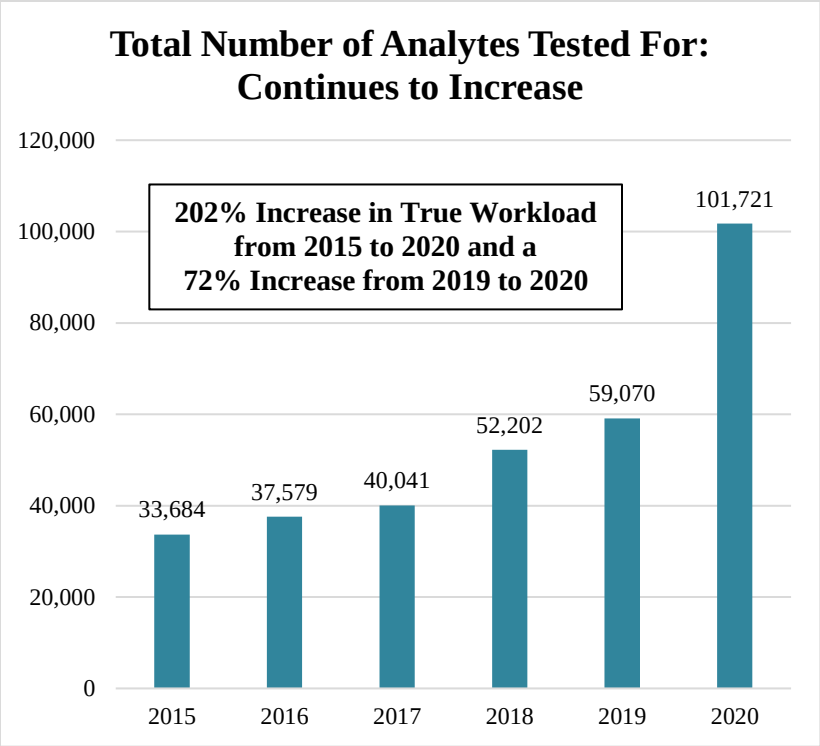
The BENZ chart shows that alprazolam is the analyte detected most often for DUI/Other cases and nordiazepam for postmortem cases, while the AMP chart shows that amphetamine and methamphetamine are by far the most common of the various analytes for both case types.





Because these newly validated methods contain so many more analytes (and thus more data to process/review), the true workload increase for the unit has not been adequately shown in all former graphs herein. The graph below shows how much more data the Tox Team is now processing and reviewing with these much larger panels, comparing years 2015 through 2020. It charts the total number of analytes that the Tox Unit has tested for based on the number of tests performed for each assay and how many analytes are covered on each assay (note that ALKDS and ANDS are excluded from these totals due to the difficulty in capturing this information for them). As is clearly shown, not only is the Tox Unit handling more cases and more tests year after year, but the complexity of their testing is also rising steeply. The Tox Unit has handled what equates to a **202% increase in their true workload in the past 6 years** and a **72% increase from just 2019 to 2020**.

The Tox Unit received additional federal grant funds in 2020 through the Centers for Disease Control and Prevention's (CDC's) Overdose Data to Action (OD2A) cooperative agreement to support their efforts in



expanding testing in response to the opioid/fentanyl epidemic. With these funds, the unit purchased the following supplies and new equipment: extraction and instrumental columns, pipette tips, two new multi-vortexers, two new GC-MS sources, standards and reagents, disposable glassware, a new refrigerator to house postmortem specimens awaiting login, seven more benchtop hoods to increase safety in the unit, and other consumable supplies. In 2020, the Tox Unit also received grant funds through the Criminal Justice Council (CJC), which were used to purchase a new Tecan instrument (for ELISA drug screening, which will be installed and validated in 2021), along with necessary kits for the validation and three new textbooks. These supplies are necessary to continue meeting our mission and to expand our testing capabilities, especially those pertaining to the opioid/fentanyl epidemic.

Additionally, the Chief Forensic Toxicologist was involved with a collaborative project with the U.S. Army Combat Capabilities Development Command Chemical Biological Center in 2020, which involved the investigation into the use of lateral flow immunoassays for the detection of fentanyl in postmortem urine samples. This collaboration resulted in the following two publications:

- Daniel J. Angelini, Tracey D. Biggs, Amber M. Prugh, **Jessica A. Smith**, Jennifer A. Hanburger, Bob Llano, Raquel Avelar, Angela Ellis, Brady Lusk, Abdallah Naanaa, Michael G. Feasel, and Jennifer W. Sekowski. Detection of fentanyl and derivatives using a lateral flow immunoassay. *Forensic Chemistry*. Volume 23, 2021, 100309, ISSN 2468-1709, https://doi.org/10.1016/j.forc.2021.100309.
- Angelini DJ, Biggs TD, Prugh AM, **Smith JA**, Hanburger JA, Llano B, Avelar R, Ellis A, Lusk B, Malik Naanaa A, Sisco E, and Sekowski JW. The use of lateral flow immunoassays for the detection of fentanyl in seized drug samples and postmortem urine. *J Forensic Sci*. 2021 Mar;66(2):758-765. doi: 10.1111/1556-4029.14631. Epub 2020 Dec 4. PMID: 33275295.

DNA

Overview

The DNA laboratory consists of two sections, the Databasing or CODIS (COmbined DNA Index System) section and the Casework section. The Databasing section processes all the convicted offender samples submitted to the laboratory from the Delaware State Police/State Bureau of Identification (DSP/SBI), Probation and Parole, and the Department of Corrections (DOC), then uploads the generated DNA profiles into the CODIS 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 types of cases ranging from theft and property crimes to homicides and sexual assaults. The DNA profiles generated from processing casework may also be entered into CODIS at either the State or National index (level).

CODIS

At the beginning of 2020, 123 offender samples had not been uploaded to CODIS. All, except one, of these samples were received by the laboratory in December of 2019. All of these samples were uploaded into CODIS in January 2020. In 2020, the CODIS section received an additional 867 offender samples. This number includes samples that could not be tested due to incomplete submission information. The laboratory received approximately 38% fewer samples in 2020 than in 2019. Fewer samples were collected by Dept. of Corrections (DOC) due to COVID-19.

The average turnaround time (TAT) for uploading offender samples into the National database increased about 33% from an average of 15 total days (11 working days) in 2019 to an average of 20 total days (15 working days) in 2020. A new database analyst was hired at the end of 2019 and began processing offender samples after a 6-month training period. We continue to work with DOC when samples do not produce a usable profile.

In 2020, 779 offender samples and 138 casework samples were uploaded into the State and National indexes. Offender samples were processed monthly, and by the end of the year all samples received prior to December 2020 had been uploaded into CODIS. The 152 remaining samples from 2020 are on-schedule to be processed during the first quarter of 2021.

In 2020, the DNA laboratory had 53 CODIS hits or “matches” from either the State or National index. This includes 9 cases from New Jersey, Pennsylvania, Maryland, West Virginia, FBI, and Kentucky that hit to DE convicted offenders. The CODIS hits included theft, burglary, robbery, sexual assault, and homicide cases.

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; however, any kit that results in a DNA profile foreign to the victim is reviewed by DFS for upload into CODIS. We began receiving profiles from the private laboratory in May 2017. Almost all kits in Delaware have been tested and in 2020, we uploaded 12 unknown profiles into CODIS from SAKI cases. Those profiles have resulted in 5 hits at the state level and 3 hits at the national level.

The table below reflects the types of cases that have hit in CODIS for 2020.

CODIS Hits	Type of Case	CODIS Hits	Type of Case
17	Burglary	**3**	Robbery
2	Homicides	**21**	Sexual Assaults
1	Home Invasion	**1**	Indecent exposure
1	Possession w/ Intent to Distribute	**3**	Theft
2	Theft of motor vehicle	**1**	Reckless endangering
1	Possession of firearm during felony		

Casework and Grants

In the beginning of 2020, there were 50 cases that were either assigned but not completed, or unassigned from 2019. Four (4) of those cases were unassigned, this included cases with suspects and unknown suspect. In 2020, the DNA unit received 513 new case submissions and 48 subsequent submissions for a total of 561 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 an approximate 5% decrease in the total number of submissions from the previous year. By the end of 2020, there were 63 cases that were either assigned but not completed or unassigned. This is a 26% increase from the previous year. The number of unassigned cases at the end of 2020 was 37, compared to 4 in 2019. This increase is due to receiving 97 cases in the last two months of

Types of Cases Received in 2020	New Submissions	Supplemental Submissions
Homicide / Att. Homicide	**37**	**9**
Sexual Assault	**123**	**16**
Assault	**16**	**0**
Burglary	**64**	**9**
Robbery	**33**	**7**
Missing Person/Death Investigation	**3**	**3**
Miscellaneous	**64**	**0**
Possession of Firearms	**157**	**4**
Proficiency Tests	**16**	**0**

the year vs. only 65 during the same time period in 2019. The DNA Unit was also down two employees in end of the 2020.

The table provides a breakdown of the types of cases received during 2020. It should be noted that there was a decrease in the number of sexual assaults submitted to the DNA laboratory for testing. There was a slight increase in the number of homicide/att. homicide submitted for DNA testing.

Our average turnaround time (TAT) also decreased about 22% from 35 total days in 2019 to 27 total days in 2020.

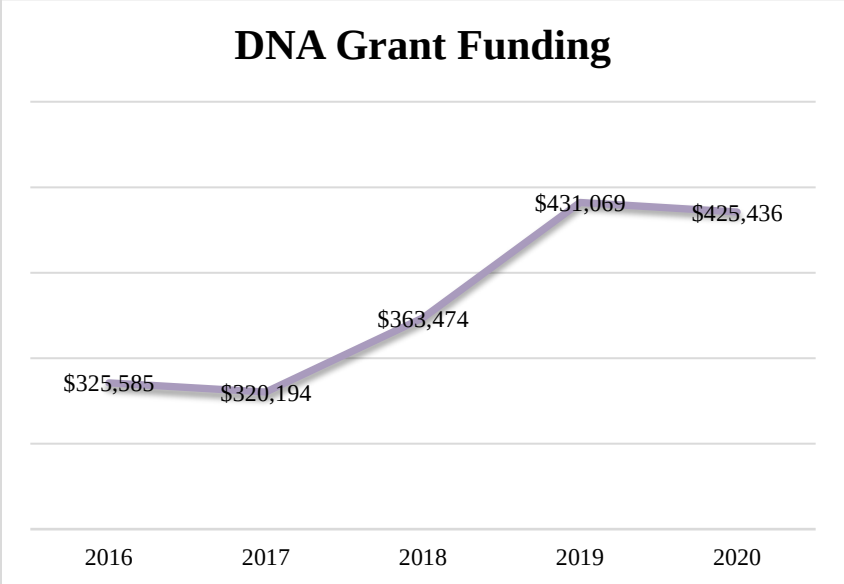
The Casework Manager continues to handle the DNA Backlog Reduction Grants. In December, the DNA Backlog Reduction Grant for FY2018 ended. The closeout documentation by the laboratory was due to the Bureau of Justice Assistance (BJA, the current funding source that replaced NIJ) by January 31, 2021. The laboratory is currently managing 2 DNA Backlog Reduction Grants, for FY2019, which closes in December 31, 2021, and FY2020. The FY20 grant was awarded in October for $425,436. This award will close on September 30, 2022.

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. This increase is due to the fact that the DNA Unit uses all the grant funds allotted. In 2019, DFS-DNA laboratory personnel were invited to be a part of the National Institute of Justice (NIJ) and the Scientific Working Group on DNA Analysis Methods (SWGDAM) to develop a “Best Practices for DNA Laboratory Efficiency Improvements” publication. After some delays due to COVID-19 and grants management moving from NIJ to BJA, this publication is projected to be released in 2021.

The amount of grant funds has fluctuated over the years. The FY2020 grant is less than the FY2019. It should be noted that over 90% of the DNA Unit’s operational budget comes from grant funds.

With the DNA FY2018 and 2019 grant funds, the laboratory continued to purchase reagents and other supplies for



processing casework and convicted offender samples, provided required continuing education training for each DNA Analyst, and purchased new laboratory equipment.

Examples of equipment and other purchases with FY18 grant funds:

- a new freezer for the storage of reagents and DNA samples
- updated our existing EZ1 instruments with flip cap racks and cards to enable analysts to perform the extraction process in a much quicker and less cumbersome manner
- upgrading both 3500XL genetic analyzer instruments to Windows 10 required the purchase of new data collection software and new computers
- purchasing of a new water purification system
- upgraded software for the BSD punch instrument that is used to process convicted offender samples
- purchased Bode Buccal cassettes for convicted offender samples storage
- new cameras used for taking pictures of items during evidence exams
- DNA proficiency tests required for analysts to stay current on their accreditation standards.
- the external audit for DNA QAS standards

Validation or performance checks are a critical part of forensic DNA work. Validations are done on new testing procedures while performance checks are done to verify upgrades or modifications to previously validated procedures. As noted in previous DFS annual reports, the DNA Laboratory does not have an individual primarily dedicated to performing validation/performance checks studies. Validation/performance checks are done by analysts and/or managers in the DNA Unit.

In 2020, performance checks were done on the following instruments due to software upgrade of Microsoft Windows 7 to Microsoft Windows 10: BSD punch (used for convicted offender samples) and 3500#1 Genetic Analyzer (used to detect DNA data). Additional performance checks were done on the following due to upgrades in specific software used: CODIS server and CODIS workstation (used to enter profiles into national or state level), GeneMapper ID-X v. 1.6 software patch (used for analysis of DNA data), and Standalone PopStats (used for statistical calculations).

A performance check was also done on the EasiCollect + buccal collection kit. This collection kit was being examined as a new substrate for collection of convicted offender samples by the Dept. of Corrections. All six (6) performance checks listed in this report were successful and are currently being used by the laboratory.

A validation that still needs to be completed is for Armed Xpert software. Several studies had already been completed. However, with the upgrade to Windows 10 and other analysis software, such as

GeneMapper ID-X, the Armed Xpert validation needed to be restarted to ensure that the data is still accurate. Because of the upgrade in the software, new licenses from the vendor were required for Armed Xpert.

As with all validations, studies must be completed, policies must be in place, and laboratory staff must be trained before using these procedures in casework or databasing. Validation studies and training are also required to maintain laboratory accreditation. During annual audits, validation study documentation is reviewed to determine if a sufficient number of studies have been performed to support the use of the new method/technology in casework/databasing. Training documentation is also reviewed during annual audits.

We continue to use a chemistry kit that examines 27 DNA markers, 7 more than the FBI requirement.

The DNA laboratory underwent on-site external audits for casework and databasing based on the newly revised FBI's Quality Assurance Standards in July 2020 as part of our reaccreditation assessment. The revised Quality Assurance Standards were effective as of July 1, 2020. We were one of the first labs in the country to be audited against the new standards. DFS received notification from the FBI that the laboratory is in compliance with FBI Director's Quality Assurance Standards.

All DNA quality control documents have been uploaded to Qualtrax, allowing auditors to easily access all documents.

The following chart provides a comparative analysis of casework for 2017, 2018, 2019, and 2020 (the percentages in parenthesis show year-over-year changes):

	2017	2018	2019	2020
Total Case completions	526 (+11%)	646 (+23%)	621(-4%)	548 (-12%)
Turnaround Time (Total days submission to completion)	66.4 (-20%)	56.9 (-14%)	34.7 (-39%)	27.1 (-22%)
Case submissions	549 (+23%)	622 (+13%)	592 (-5%)	561(-5%)
Staffing (full-time casework)	5 (-5%)	6 (+20%)	5.6 (-3%)	4.8 (-14%)

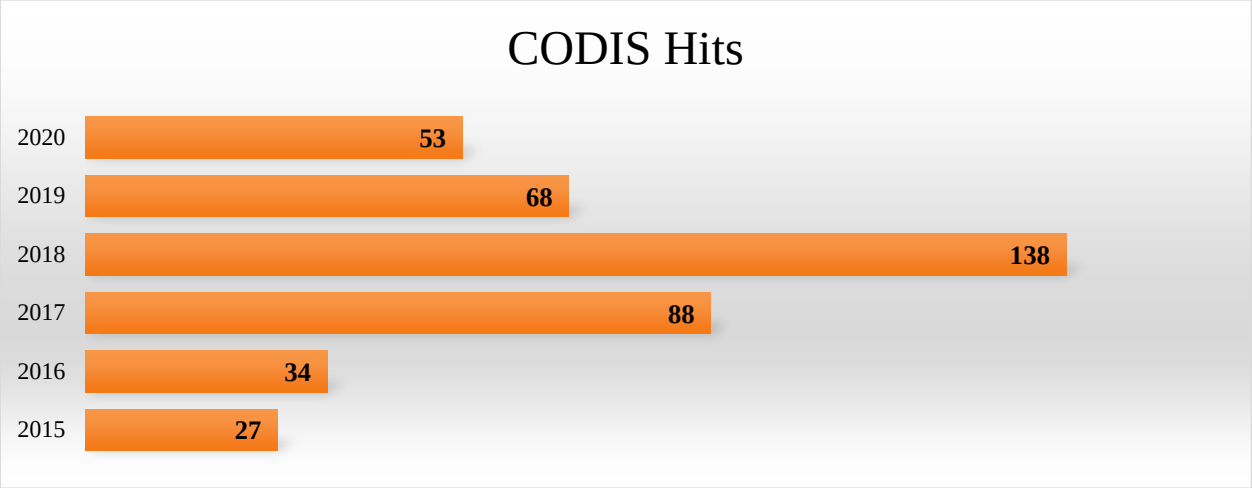
It should be noted that in 2020, due to the resignation of the laboratory technician, the database analyst was responsible for doing the laboratory technician duties and was not able to train for casework. The duties of the laboratory technician are critical to the DNA laboratory. Additionally, as noted above, at the end of the year, one analyst was on family leave. This reduction in casework staff in addition to an uptick

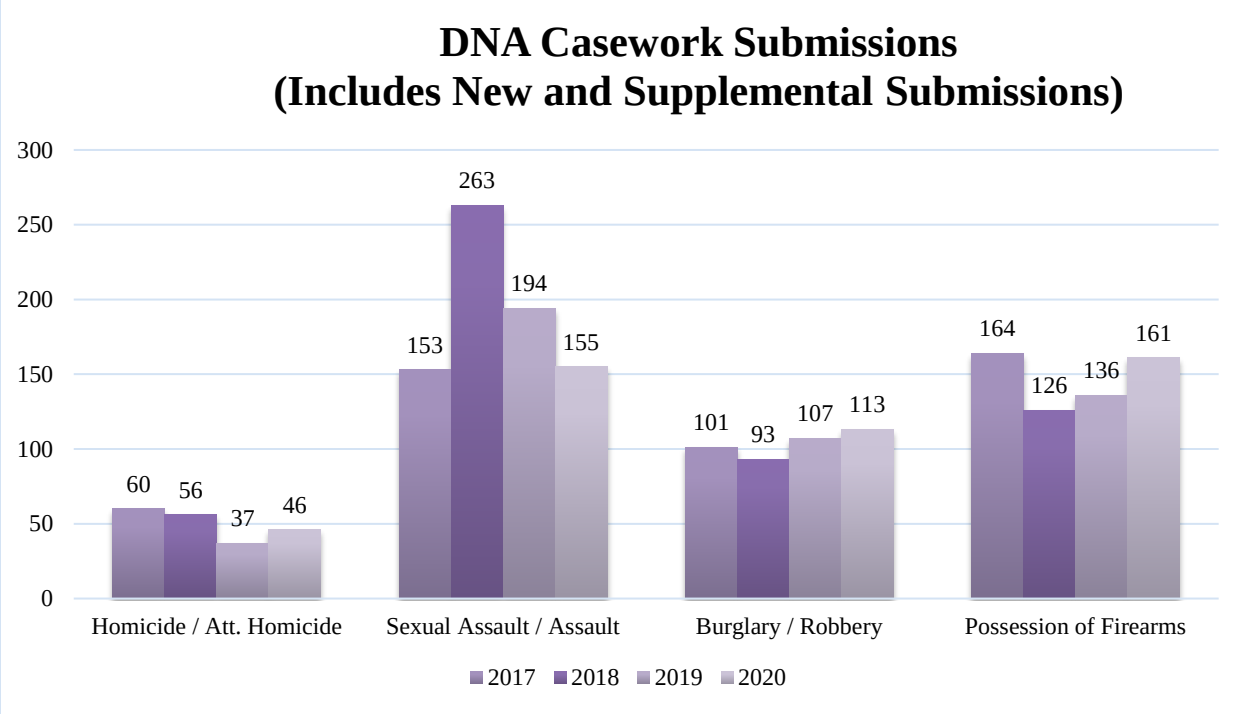
in the number of cases submitted in December are the primary reasons why the number of uncompleted cases in 2020 was higher than the number in 2019.

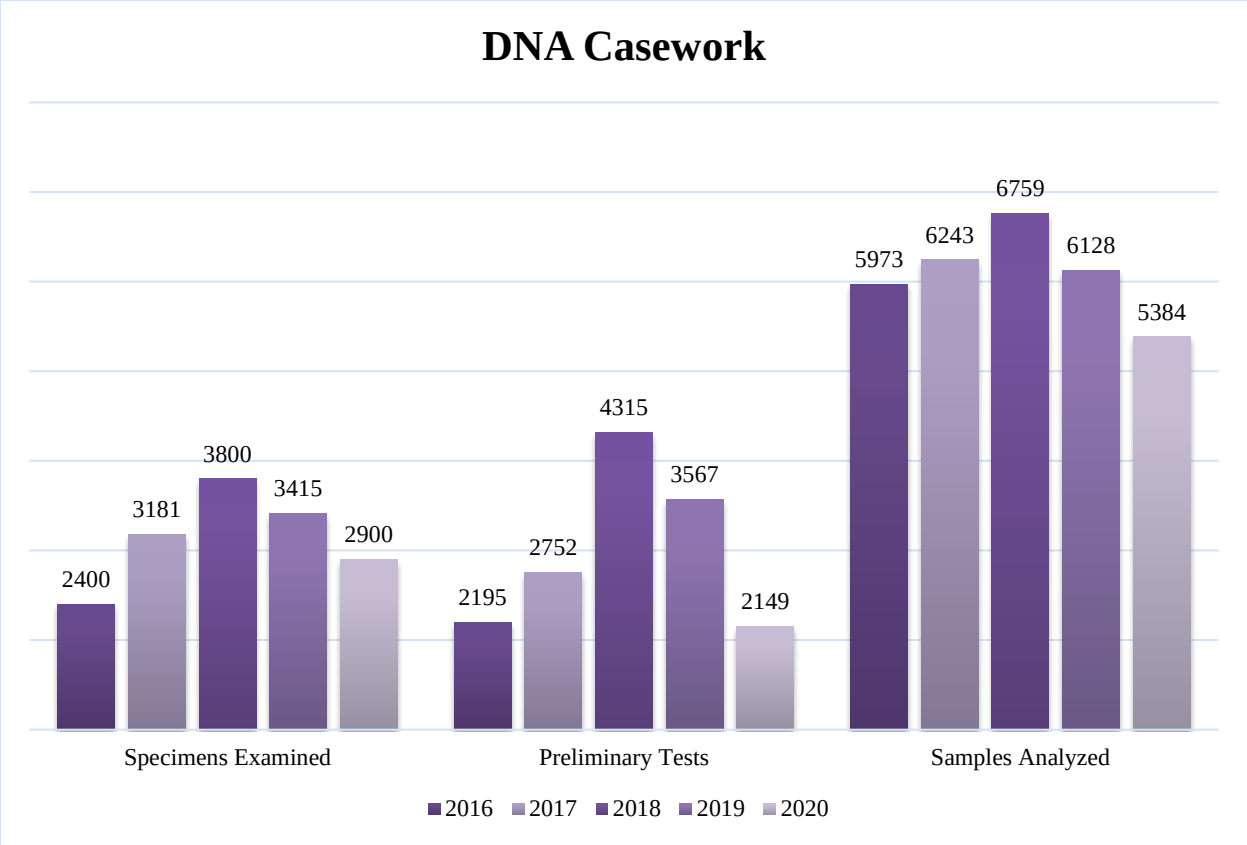
In summary, during 2020, the DNA laboratory received 5% fewer cases than were submitted in 2019, but in the past four years, there has been an increase in the number of cases the DNA laboratory has received.

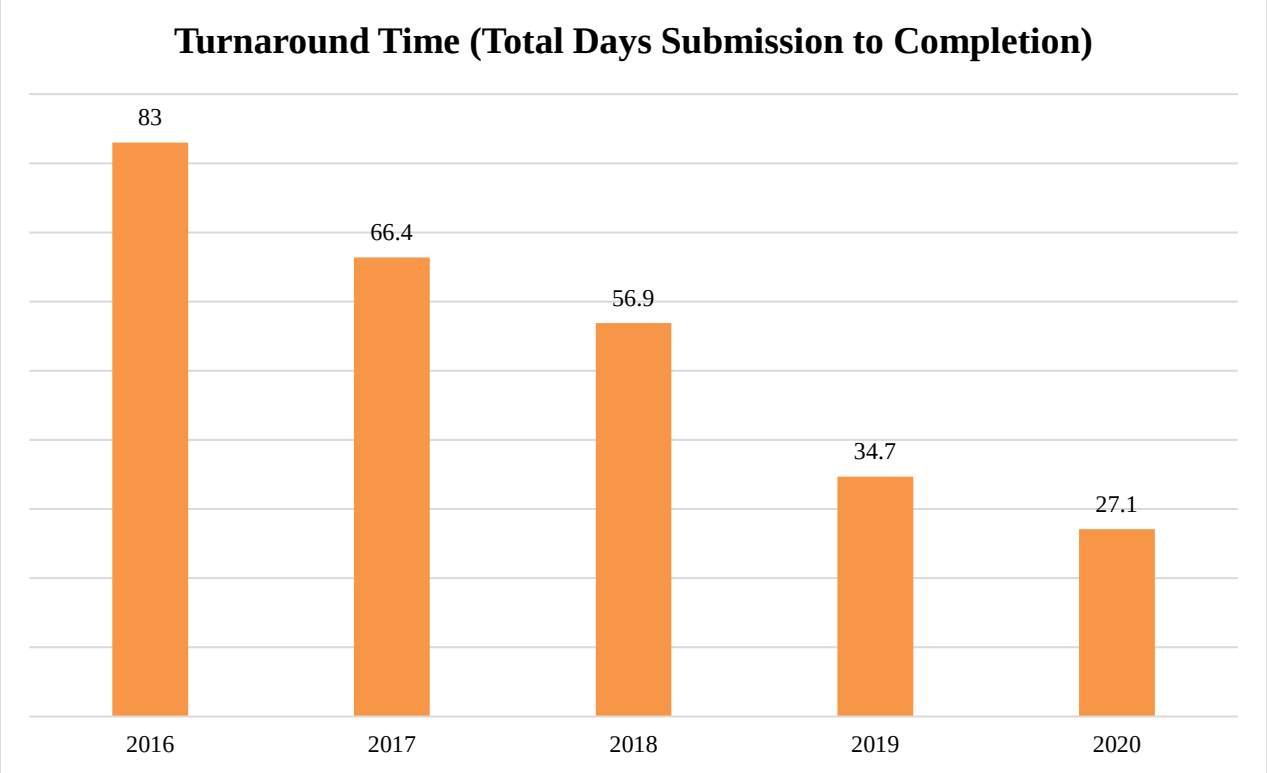
The number of cases completed by the DNA laboratory has kept pace with the number of case submission. The DNA laboratory has reduced overall TATs for casework. We hope to keep our backlog to a manageable number in the next year.

Data






DNA Casework
2400
3181
3800
3415
2900
2195
2752
4315
3567
2149
5973
6243
6759
6128
5384
Specimens Examined
Preliminary Tests
Samples Analyzed
2016
2017
2018
2019
2020


Turnaround Time (Total Days Submission to Completion)
83
66.4
56.9
34.7
27.1
2016
2017
2018
2019
2020

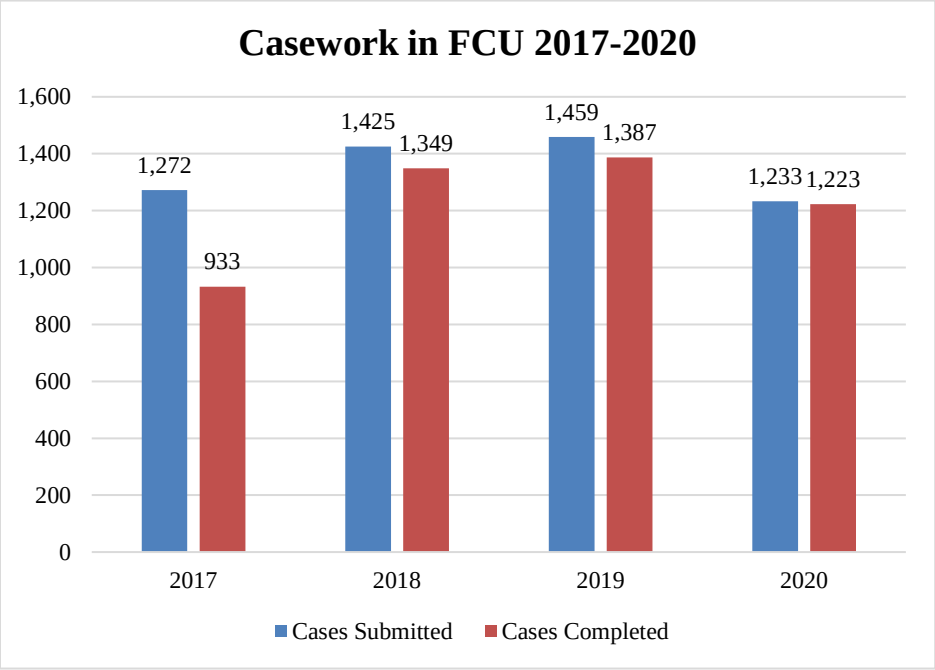
Forensic Chemistry

Overview

The Forensic Chemistry Unit (FCU) analyzes evidence submitted by Delaware law enforcement agencies for the presence of controlled substances. These controlled substances may be present in substances such as powders, liquids, food products, oil, waxes, plant material, paper, mushrooms, commercially produced pharmaceuticals and clandestine tablets or capsules. The FCU follows the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) recommendations for an analytical scheme for identification of drugs. This also includes an internationally accepted statistical sampling plan that allows the chemist to make an inference about a population by testing a set portion of exhibits with a 95% level of confidence. This sampling plan reduces the amount of time processing cases while providing scientifically valid results.

Casework and Accomplishments

The number of cases submitted to the FCU in 2020 decreased by approximately 15% compared to the previous year. However, this can be attributed to a 54% decrease in case submission for the months of April through June as compared to 2019 submissions. Chemists in the FCU completed 1223 cases in 2020, which was approximately 154 cases per chemist. In the cases submitted in 2020, there were 120,884 exhibits submitted, and of those, 18,949 were tested.



The turn-around-time for the cases was 29 days from submission to completion, however a bench turn-around-time starting from analysis to completion was 10 days across the unit.

In addition to timely and efficient case processing, the FCU remained committed to community outreach, and participated in career fair presentations for Delaware State University and a chemist alumni college.

The Fire Debris Section worked with the Bureau of Alcohol, Tobacco, Firearms and Explosives, and the Fire Marshal's Office to increase chemist interpretation knowledge and was added back to the scope after the external accreditation audit in July.

Staffing

The full complement of the Forensic Chemistry Unit starting in 2020 included a Laboratory Manager II, Laboratory Manager I, 11 full-time analytical chemists, 1 part time analytical chemist, 1 laboratory technician, and two forensic evidence specialists. However, due to greater staffing needs in the DFS, one full time analytical chemist position was transitioned to a Forensic Investigator. One chemist and both current laboratory managers are cross trained in both controlled substance and fire debris analysis.

The FCU underwent significant staffing changes in 2020. Two chemists and a Forensic Evidence Specialist resigned, and the Laboratory Manager II transitioned into a new role at DFS. The FCU was able to hire one full time, and one part time chemist (who was hired and later transitioned from the laboratory technician position), and complete training for 3 chemists throughout the year. The laboratory management positions were filled by the end of October.

Also, staring in March, chemists' schedules were altered to allow for social distancing in the laboratory and at the shared office space. The chemists were separated into two groups and those groups alternated days working from home and working in the laboratory. This reduced the amount of laboratory time for the chemists by 50% for the remainder of the year.

Despite the changes in staffing, the members of the FCU were able to continue to process cases from all law enforcement agencies in a timely fashion. Fire Debris casework continued to be outsourced to a private lab, however the anticipated date to process cases is spring 2021.

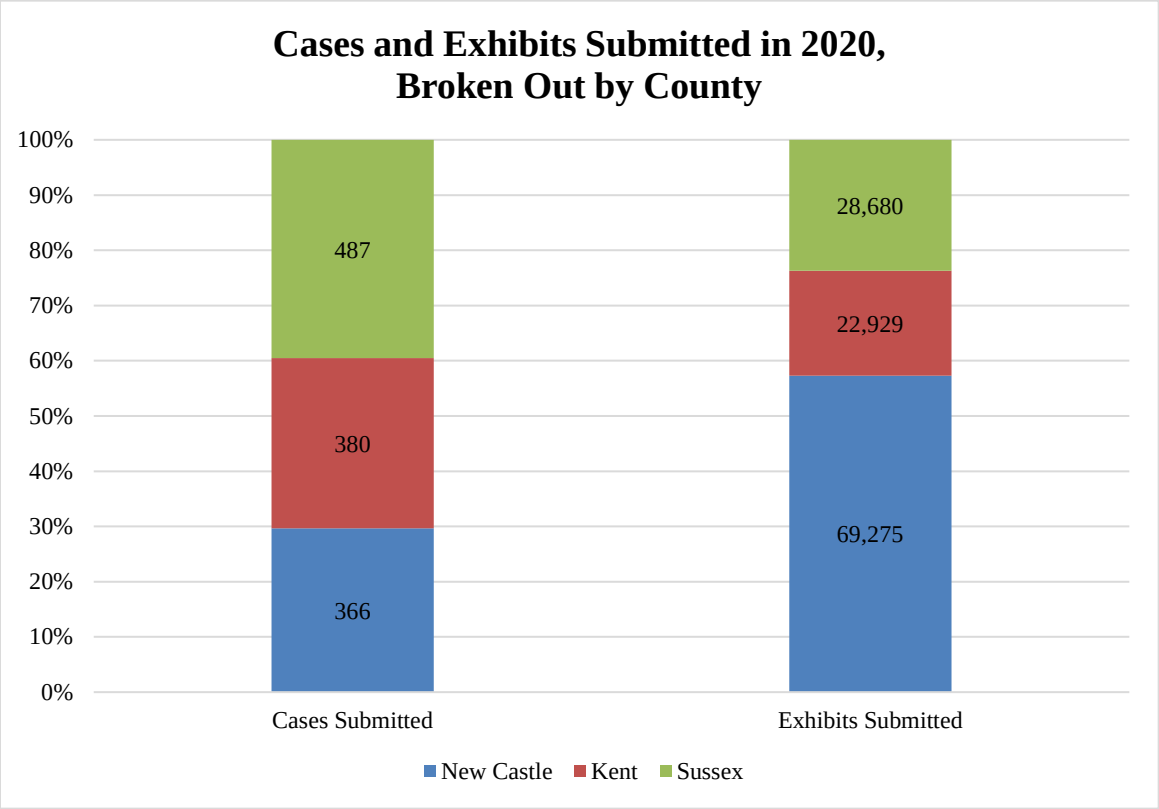
Projects and Grants

The FCU received grant funding for three major projects in 2020. In August, 12 snorkel hoods were installed across the three processing laboratories. This enabled each chemist to have a venting hood above their bench space while opening and processing evidence. Installation of the snorkel hoods was imperative to ensure the safety of the chemists while processing dangerous controlled substances. Funding was also used to purchase up to date standards and a qualification from an outside company toward the validation of an existing FTIR. The FTIR is a robust, simple, and streamlined analytical technique to identify compounds with a high degree of specificity. Once validated, this instrument could be used to analyze unknown powders with a reduced cost and analysis time compared to current methods. Finally, grant funding was used to purchase instrumentation, equipment, and standards toward the quantification of potency in plant material by microextraction and High-Performance Liquid

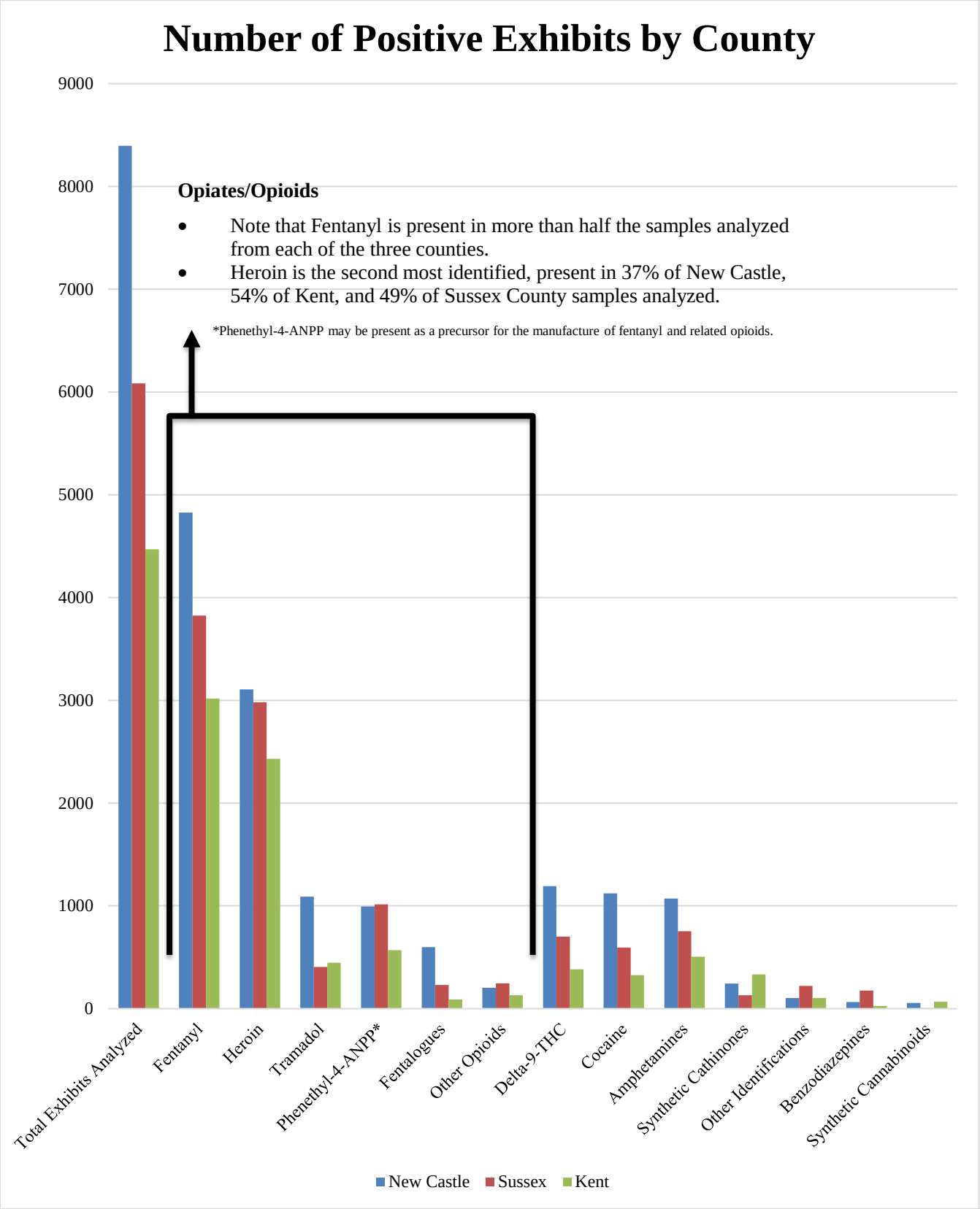
Chromatography- Photo Diode Array (HPLC-PDA). This extraction and instrument will allow chemists to determine the amount of Delta-9-THC present in potential marijuana samples. This testing is in anticipation of Delaware's Title 16 update to reflect the federal government's Hemp Farming Act of 2018, which removes low-THC cannabis from regulation under the Controlled Substances Act.

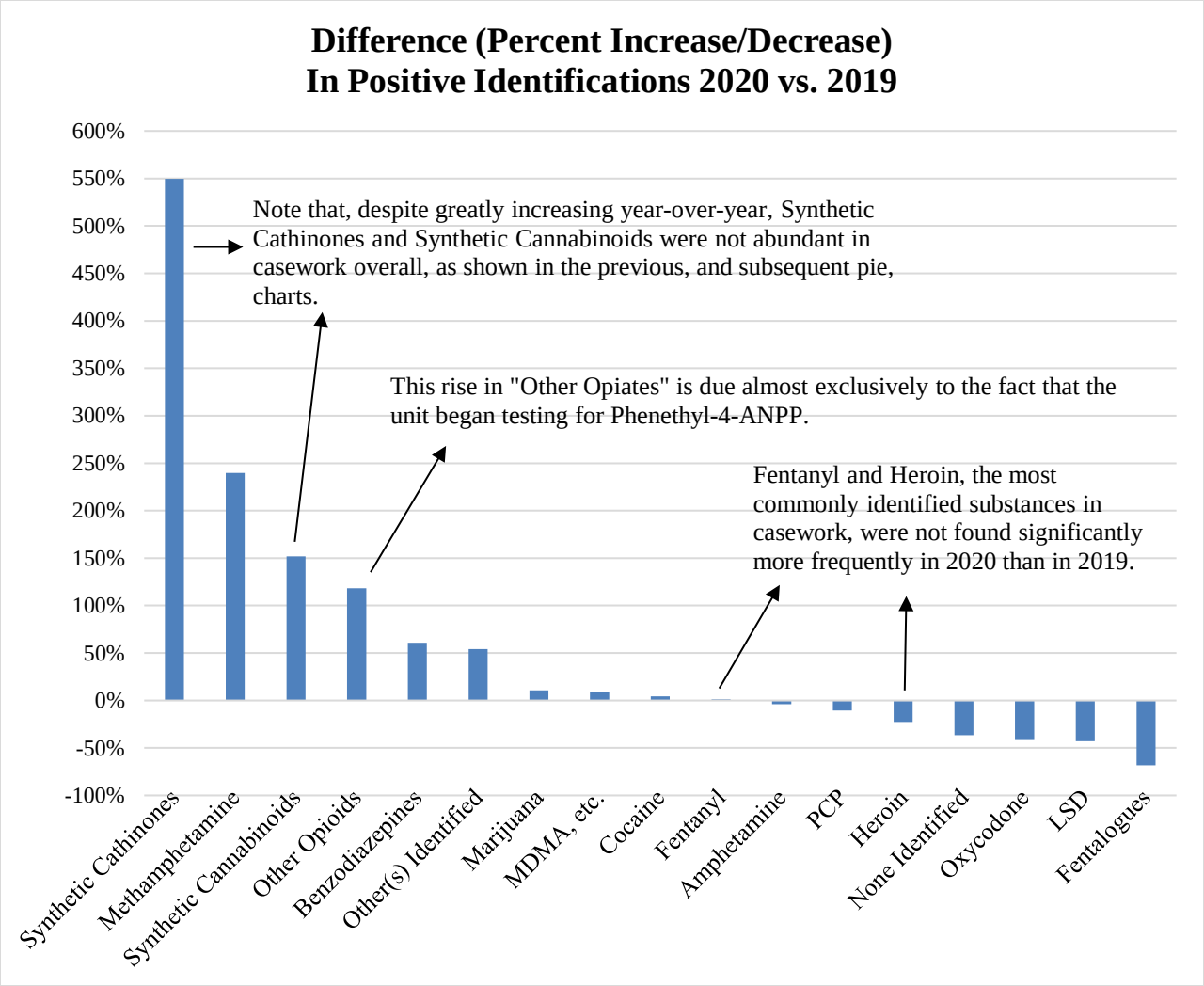
Data

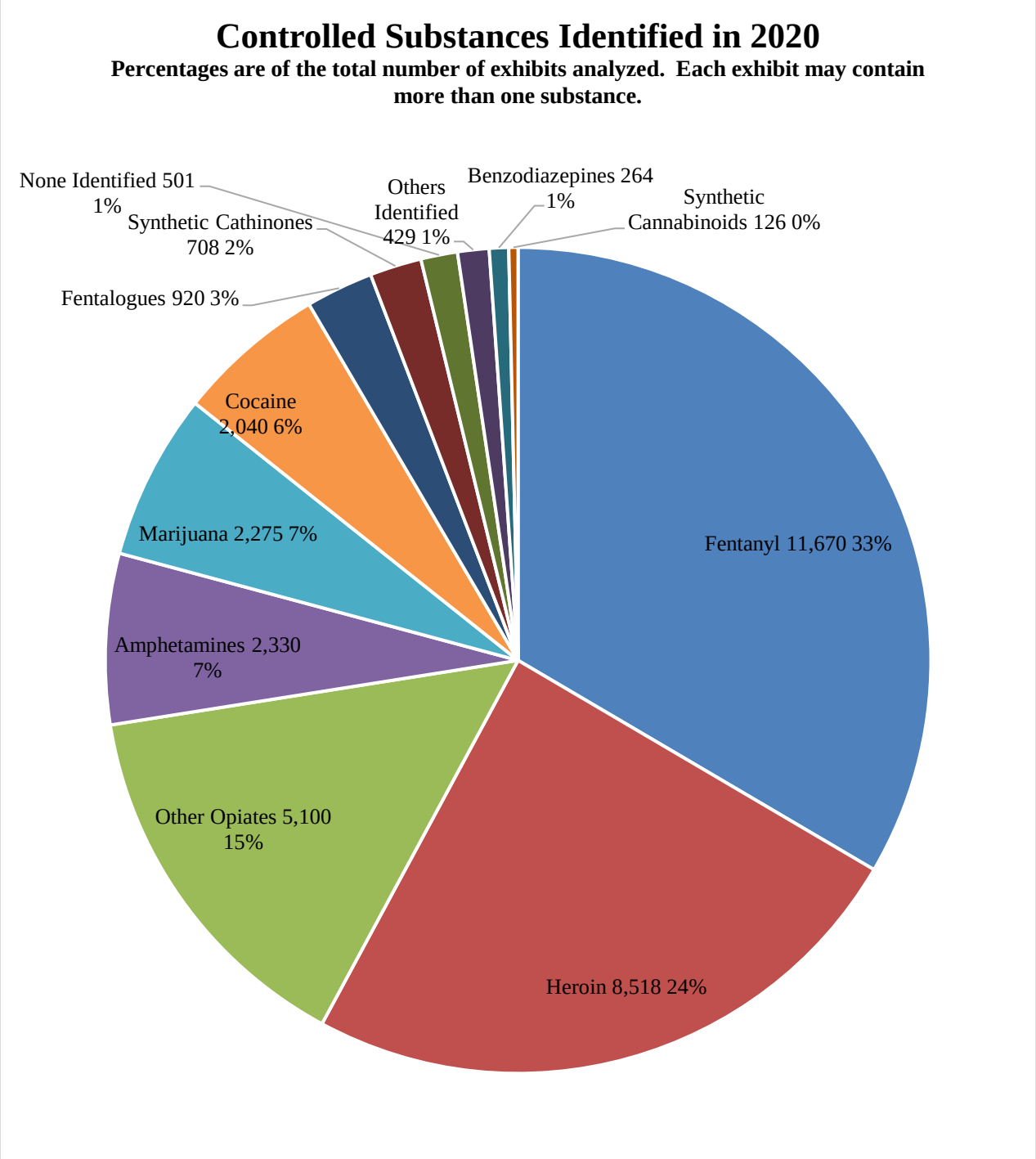
The chart below illustrates the breakdown, by county, of the cases submitted to the DFS Controlled Substances Unit. Although the number of cases submitted by each county is similar, New Castle County submits by far the largest number of exhibits.



The following data displays testing completed by the Forensic Chemistry Unit in 2020. The FCU processes cases of varying complexity; a case may have one exhibit or thousands of exhibits. It is important to note that one exhibit may contain multiple controlled substances or may not contain any identifiable controlled substances. The data presented includes results from exhibits that have been tested and included in reports.


Number of Positive Exhibits by County
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Opiates/Opioids
Note that Fentanyl is present in more than half the samples analyzed from each of the three counties.
Heroin is the second most identified, present in 37% of New Castle, 54% of Kent, and 49% of Sussex County samples analyzed.
*Phenethyl-4-ANPP may be present as a precursor for the manufacture of fentanyl and related opioids.
Total Exhibits Analyzed
Fentanyl
Heroin
Tramadol
Phenethyl-4-ANPP*
Fentalogues
Other Opioids
Delta-9-THC
Cocaine
Amphetamines
Synthetic Cathinones
Other Identifications
Benzodiazepines
Synthetic Cannabinoids
New Castle
Sussex
Kent


Difference (Percent Increase/Decrease)
In Positive Identifications 2020 vs. 2019
600%
550%
500%
450%
400%
350%
300%
250%
200%
150%
100%
50%
0%
-50%
-100%
Note that, despite greatly increasing year-over-year, Synthetic Cathinones and Synthetic Cannabinoids were not abundant in casework overall, as shown in the previous, and subsequent pie, charts.
This rise in "Other Opiates" is due almost exclusively to the fact that the unit began testing for Phenethyl-4-ANPP.
Fentanyl and Heroin, the most commonly identified substances in casework, were not found significantly more frequently in 2020 than in 2019.
Synthetic Cathinones
Methamphetamine
Synthetic Cannabinoids
Other Opioids
Benzodiazepines
Other(s) Identified
Marijuana
MDMA, etc.
Cocaine
Fentanyl
Amphetamine
PCP
Heroin
None Identified
Oxycodone
LSD
Fentalogues



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."