A Landscape Study of Electronic Case Management Systems for Medical Examiners and Coroners

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Report Overview

Landscape Study Objectives

This landscape report provides medical examiners and coroners, supporting personnel, forensic laboratories, law enforcement agencies, prosecutors, courts, and other stakeholders and end users with the following:

- Background information on electronic case management systems (CMS) and their integration into the death investigation process, including both commercial off-the-shelf (COTS) products and internally developed CMS,

- Product details in the form of a landscape of representative COTS CMS products,

- Considerations for implementing a CMS[1], and

- Case studies illustrating best practices and lessons learned from incorporation of CMS into the death investigation workflow.

Landscape Methodology

To conduct this study, the FTCoE used a process that included

- Consulting secondary sources—including journals, federal reports (including the National Institute of Justice's Report to Congress: Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices,)[2] and industry literature—to obtain information on key CMS providers, successful use cases, and implementation considerations for these systems; and

- Interviewing various state and local medical examiner/coroner (ME/C) offices and organizations across the United States about their use and implementation of COTS and internally developed CMS, ultimately gaining insight from varied perspectives, including chief medical examiners, coroners, forensic investigators, forensic laboratory directors, toxicologists, information technology personnel, and public health personnel.

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[1] While the report will focus on selection and implementation of COTS CMS products, several key insights will apply to the implementation of internally developed systems.

[2] U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. (2017). *Report to Congress: Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices*. https://www.justice.gov/olp/page/file/1228306/download

Subject Matter Experts and Stakeholders

We would like to thank the forensic science community stakeholders and practitioners who offered insight, analysis, and review.

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Glossary of Commonly Used Words and Phrases

For the purposes of this document, the following terms are defined.

Application Programming Interface (API): Software code used to connect multiple hardware and software services together; typically, APIs are used in CMS to exchange data with external databases or information management systems.

Case Management System (CMS): Software used by coroners and medical examiners to input, manage, and store case-related material.

> **COTS CMS:** A "commercial-off-the-shelf" (COTS) CMS product purchased from a vendor.

> **Internally Developed CMS**: Custom-built software developed by a medical examiner or coroner (ME/C) office or jurisdiction personnel; often called "homegrown" systems.

Cloud-Hosted Solution: A CMS that is housed and stored off site and accessed through a cloud-based vendor.

CMS Configuration: The ability to adjust and create new fields or forms within a COTS CMS; typically, COTS CMS have some built-in configurations.

CMS Customization: The ability to change the source code of a COTS CMS to add new functionality to the software.

Electronic Records Management System: Software built specifically to manage a set of records from creation to disposition, and help users log, categorize, track, and search records. An electronic case management system is a specific type of electronic records management system.

Electronic Death Registration System (EDRS): A data management system operated by the state vital registration office with many functions, including electronically filing and certifying death certificates.

Information Management System (IMS): A system of software generally used to facilitate the storage, organization and retrieval of information.

Laboratory Information Management System (LIMS): Software used by laboratories that facilitate the storage, organization and retrieval of information.

On-Premise Solution: A CMS that is stored locally using ME/C office–maintained servers and hardware.

Executive Summary

Medical examiner and coroner (ME/C) offices sit at the nexus of forensic sciences and public health. These offices play a key role in the investigation of suspicious, unexplained, or unexpected deaths, dissemination of important data to public health entities, and communication with families of decedents. In the United States, many other criminal justice stakeholders—such as law enforcement, toxicology laboratories, courts, and Vital Statistics departments—contribute and request data important to medicolegal death investigation (MDI). Given the network of stakeholders playing a role in MDI, successful execution of ME/C tasks relies on proper case management, which enables secure and accurate aggregation, storage, and retrieval of information.

Electronic case management systems (CMS), or software-based systems that collect, structure, and store case-related data, provide significant benefits over traditional paper-based storage systems. These systems streamline the data sharing process by enabling users to input case data into standardized forms, request information, or rapidly share information with stakeholders. Standardized data entry allows for data aggregation and querying across multiple cases, allowing offices to quickly search across their entire database or identify important trends. Security and audit trail features help establish data continuity, even with personnel changes. Ultimately, CMS can enable ME/C offices—of all sizes—to improve performance on specific tasks within their death investigation workflow. The specific functionality of these software tools varies, but a CMS typically enables:

- Systematic management of case-related processes and procedures
- Robust query and data searching
- Standardized report creation
- Simplified dissemination of case materials
- Secure user permissions and audit trail

To extend value beyond the core functions of a CMS, vendors offer specialized features to streamline tasks or improve system interoperability with:

- Streamlined communication channels
- Data aggregation and analysis tools
- Configuration and customization
- Interfacing with third-party tools and databases
- Capabilities specific to mass fatality and disaster response

Agencies considering implementation of a CMS may elect to purchase a commercial-off-the-shelf solution (COTS) or develop their own homegrown solution. The National Institute of Justice's Forensic Technology Center of Excellence (FTCoE) received detailed product information inputs from the following vendors[3]:

- Cohero
- Forensic Advantage
- JusticeTrax
- MDILog
- PorterLee
- Quincy Tech
- VertiQ

Prior to implementing a CMS, ME/C personnel may need to consider associated changes in resources, workflow, and responsibilities. Beyond purchasing software licenses, offices should plan to invest time and money to configure the system to end user needs, train end users, interface the CMS with software and databases (like Electronic Death Records Systems [EDRS]), and maintain the system. Software costs may range from a few thousand to hundreds of thousands of dollars but are often scalable to agency size. Some ME/C offices may benefit from retrofitting a laboratory information management system (LIMS) to streamline data transfer from stakeholders. This report aims to help ME/C leadership make informed decisions on procuring or implementing an electronic CMS.

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[3] FTCoE did not receive product information inputs for vendors CoronerME, ForensicFiler, and ImageTrend, which are profiled using publicly available information.

The Role of Electronic CMS in Death Investigations

ME/C offices investigate roughly 600,000 deaths each year to determine the cause and manner of death in cases that are sudden, suspicious or violent, or lack an attending physician.[4] Through medicolegal death scene investigations, postmortem examinations, and other assessments, ME/C offices generate and gather important case-related data. Information in each case may provide valuable answers to families and public health systems that may prevent future deaths, inform the prosecution of criminal cases, and help complete death certificates. ME/C offices also submit case-related data to statewide or federal public health and safety databases, which can help analysts identify death trends that may warrant preventative actions. These databases may help drive policy and initiatives across other federal agencies.[5]

ME/C offices may incorporate data from a variety of stakeholders, such as law enforcement, hospital systems, or contracted autopsy facilities or laboratories. They may also disseminate these data to stakeholders, such as public health entities and court systems, as part of periodic reporting requirements or for criminal cases. These offices must create, organize, and access large amounts of data. Successful execution of these tasks relies on proper case management, which enables secure and accurate aggregation, storage, and dissemination of information.

Data from MDI systems inform policy decisions and initiatives for various federal agencies such as:[5]

► **Centers for Disease Control and Prevention:** Death certification and mortality data to identify public health problems, find solutions, and save lives.

► **Food and Drug Administration:** Pharmaceutical product post-market surveillance.

► **National Highway Traffic Safety Administration:** Identification of patterns in traffic-related fatalities.

► **Consumer Product Safety Commission:** Monitoring and investigation of potentially hazardous products.

► **Occupational Safety and Health Administration:** Surveillance of fatal occupational injuries to identify trends and appropriate courses of action.

Case management plays a crucial role in the organization, identification, and dissemination of case-related information.

Virtually all ME/C offices employ some form of case management method to manage their data, but tactics to manage these data vary significantly. The 2018 Bureau of Justice Statistics (BJS) Census of Medical Examiners and Coroner Offices indicated that "fewer than half (40%) of coroner offices and about half (54%) of city, country, district, or regional medical examiner officers had a computerized information management system." The percentage of total ME/C offices with computerized systems rose from 31% in 2004 to 43% in 2018. Census data showed that larger medical examiner and coroner offices serving larger populations were more likely to manage cases using a computerized system. [4,6] The 2018 BJS ME/C Census indicated that only 28% of ME/C offices serving populations of less than 25,000 had a computerized information management system.[4] ME/C agencies relying on paper-based approaches often run into limitations: aggregation for reporting is time intensive, data must be manually tracked down, data security is reduced with limited resiliency to loss or tampering, and there are potential constraints in data continuity in times of office leadership transition.

Furthermore, the ME/C community is experiencing increasing time and resource strain because of rising caseloads and shortages in ME/C personnel. For example, a 2017 National Institute of Justice (NIJ) Needs Assessment Report to

[4] U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics (2021). Medical Examiner and Coroner Offices, 2018. https://bjs.ojp.gov/content/pub/pdf/meco18.pdf
[5] Executive Office of the President. National Science and Technology Council. (2016). *Strengthening the Medicolegal Death-Investigation System: Improving data systems*. https://www.ojp.gov/pdffiles1/NIJ/251423.pdf
[6] BJS census was sent to 2,112 ME/C offices with a 80.9% response rate (1,648 offices).

Congress indicated that the number of opioid overdoses reported deaths were three times higher than those in 1999[7]. The same report found that practicing forensic pathologists covered less than half of the need in the ME/C community (400–500 in practice versus a projected 1,100–1,200 needed).[8,9] The COVID-19 pandemic has exacerbated the current deficit in ME/C personnel and resource strain of ME/C offices. Many COVID-19 deaths did not necessitate a ME/C investigation as the decedent had an attending physician, were hospitalized at the time of death, or had a known cause and manner of death. However, ME/C office still played a role in completing death certificates, reporting deaths to a state's vital records office, and providing fatality management (including body transport and storage), further increasing their workload.[10] The need for accurate and efficient technology-enabled case management practices is more critical than ever in death investigations.

Electronic CMS help the ME/C community input, manage, and communicate case-related data in a secure and effective way.

Electronic CMS are software-based tools that collect, structure, and store data related to a specific case. For MDI, these systems have been adapted to best fit ME/C needs. As illustrated in Figure 1, CMS can serve as a centralized hub that facilitates the various steps of a case while managing input and output of information.
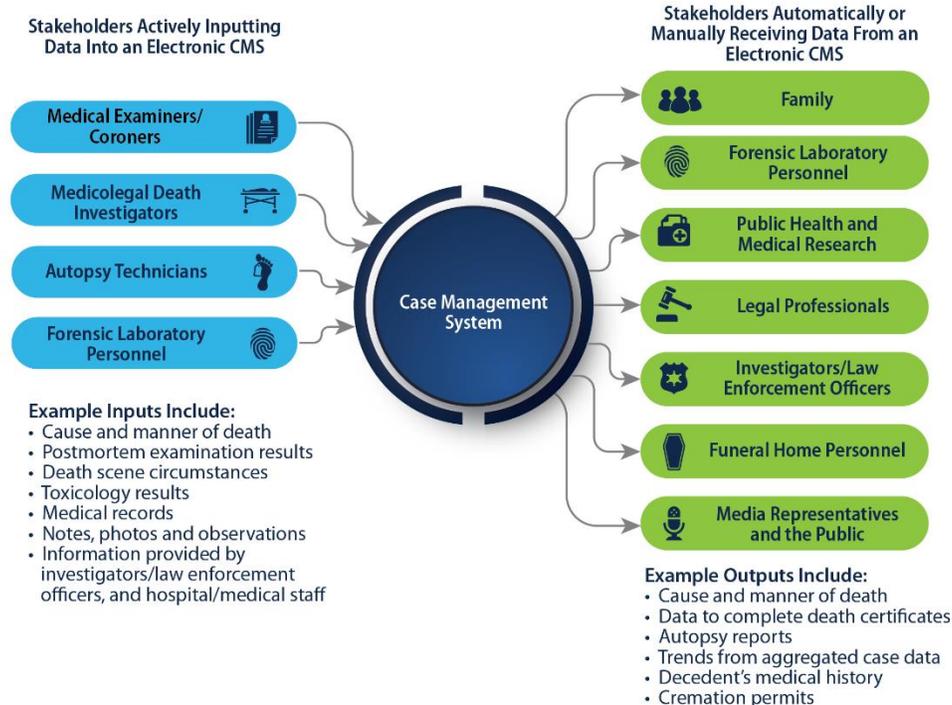
Figure 1. A CMS can help improve data management and information flow across stakeholders in death investigations.

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[7] U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. (2017). *Report to Congress: Needs Assessment of Forensic Laboratories and Medical Examiner/Coroner Offices.* https://www.justice.gov/olp/page/file/1228306/download

[8] U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics (2021). Medical Examiner and Coroner Offices, 2018. https://bjs.ojp.gov/content/pub/pdf/meco18.pdf

[9] The need for forensic pathologists may be higher, given that these estimates were developed prior to the rising workloads resulting from the current opioid crisis and the increasing rate of drug-related deaths.

[10] National Association of Medical Examiners. (2021). *Inquiries about COVID-19.* https://name.memberclicks.net/assets/docs/COVID/COVID-19%20PRESS%20RELEASE%204-24-21.pdf

The benefits of CMS often outweigh the investment in system deployment.

Comprehensive and standardized data collection benefits individual offices to inform national public health understanding and initiatives.

CMS go beyond solely recording the cause of death—they encourage comprehensive and consistent data collection across cases. Case data are centralized and easily accessible for stakeholders that need specific records. Data from MDI are influential in affecting the policy and initiatives of numerous federal agency programs. Widespread implementation of CMS across the ME/C community presents an opportunity for nationwide data reporting and analytics standardization to better shape future policy in critical public health areas.

> *"Having the investigator help me with updating the software was critical because we set it up in a way that was logical and made sense according to the way they conduct investigations."*
>
> *—Scott Hayes, IT Support, Orange County Sheriff's Office*

Security and continuity of data improves efficiency and justice outcomes.

Electronic systems guard against data loss when ME/C personnel change, and audit trails prevent tampering with data and help with investigating any incidents of data integrity breaches. Standardized data inputs in a CMS help to create reproducible and consistent reports for court testimony.

Time savings is critical with the current dearth of ME/C personnel.

ME/C offices can easily input, search for, locate, and disseminate information on a computer interface, rather than manually creating, updating, or searching for files. Multiple users can work in the same case documents simultaneously. While incredibly time intensive with paper-based systems, users can gather high-level trends from aggregate data in minutes.

Case management systems enhance information control and sharing across stakeholders.

Role-based access can help administrators control which stakeholders have access to data. Internal stakeholders may be granted access to amend or upload new documents directly, while external stakeholders can request files, such as statistics on the number of deaths from a specific cause. Many products allow users to access case information from the field, reducing the need for trips back to the office.

Products are scalable and configurable to ME/C office size, budget, and needs.

Though 2018 ME/C census data indicates lower electronic case management system utilization in ME/C offices serving smaller populations, these products can be a valuable tool for proper recordkeeping in smaller offices. Although specifics between large and small counties may differ—for example, smaller agencies may not need dashboards—all office sizes need secure, centralized data management for cases. Many software products are scalable to organization size, and storage costs for smaller amounts of records inherently have lower costs for a smaller ME/C office. Furthermore, COTS CMS vendors may offer configurability to better tailor certain components of the software to a ME/C office's needs, such as adding additional data fields and report layouts.

> *"One of the benefits of the system is that we are able to extract relevant information from previous cases. If we had a case of myocardial infarction in a five year old in the past, we would never have been able to recall that same data in the past with a paper-based system."*
>
> *—Reta Newman, Laboratory Director, Pinellas County Medical Examiner's Office*

Basic Functions of Electronic CMS for ME/Cs

Systematic management of case-related processes and procedures for MDI

A CMS can help ME/C stakeholders document all pertinent case information via form entry or attached documents. Role-based editing enables multiple stakeholders to access case information from their own device and update in real time, expediting case write-up processes. Many electronic CMS can assign tasks and oversee the entire case through the use of task managers, which keep all stakeholders aware of the status of multiple cases and outstanding needs.

Robust query and data searching capabilities

CMS are designed to be a centralized database for all case-related material and data, expediting the retrieval of data by the various stakeholders in death investigations. Users may recall information through query searches, rather than sifting through multiple paper reports. ME/Cs may use this information to explore specific metrics and trends, such as causes of death and the number of death investigations performed.

Standardized report generation

CMS are set up to gather standardized data for each case, streamlining the creation of reports that are frequently requested by stakeholders such as public health and safety department, vital records offices, organ and tissue procurement organizations, research institutes, and decedents' families. Reports may also help gather and communicate information that is required by accrediting bodies, such as the National Association of Medical Examiners (NAME) or the International Association of Coroners and Medical Examiners (IACME). After ME/C personnel input notes and information related to the death investigation into the CMS, case-related information can be seamlessly transferred into pre-defined documents and reports. This process ensures that the required information is included in the correct place for every report that the

CMS creates, leading to reproducible and consistent reporting. This standardization of information proves valuable through the criminal justice process (i.e., enabling reproducible and consistent reports for court testimony).

Dissemination of case-related material

A CMS can help ME/Cs automatically send completed reports out to internal stakeholders through email or push notifications. Case information may also be available to external stakeholders, who can request information directly from the ME/C or through a dedicated access portal with permissions as assigned by the ME/C office.

Secure case audit trail and user permissions

Security features in electronic CMS products help protect ME/C offices from tampering or data loss. Cloud-based solutions use different levels of encryption and government compliance to ensure safe storage of sensitive information. Vendors routinely perform storage backups to prevent data loss and corruption, and may offer multiple storage options to redundantly save data in case of a hardware failure. In an on-site hosted solution, data encryption and security are generally designed by the hosting organization and its information technology (IT) staff. Vendors also provide immediate access to emergency software updates to fix any bugs that might compromise data integrity.

Each software user accesses the system using a specific login and password. Two factor authentications may be required to limit the number of open computers accessing the network at any given time. Vendors have added "role-based editing" to their software to allow or restrict access of certain files and functionalities. Organization administrators are able to provide various levels of access, including Full Editing, View-Only, and Restricted Access. Audit trail capabilities ensure that all changes and information on data access are captured in the system, which may help prevent data tampering. These security functions help ensure the records kept by the software are accurate and comprehensive.

Advanced CMS Features

Streamlined communication channels with stakeholders

ME/Cs may be able to send out case-related information using email extensions built right into a CMS. These systems may also allow external stakeholders to request desired information through request portals. ME/Cs can directly grant or deny access permissions right in their software. These functions allow for quick and easy information flow to the relevant stakeholders without much of the busy work that traditionally has to go through administrative and support staff.

Data aggregation and analysis

A CMS is a data management system that contains information from past and present cases. Many CMS have built-in tools to visualize and organize aggregated data that may aid in trend analysis. For example, an office can query and visualize cases where a particular drug (like fentanyl) may have played a role to show instances of deaths associated with this drug over time or geographical "hot spots." In a paper-based system, it would be a very time-consuming and laborious task to go back through every case retrospectively and extract these relevant files. Further analysis may be performed either through customizable options provided by the CMS or exporting the data into another statistical software, like Microsoft Excel.

The use of dashboards is becoming increasingly common in CMS to help visualize and highlight information of interest into a single screen. Dashboards represent information from the entire CMS and are continuously updated to give a real-time reading of the status of the jurisdiction. A dashboard may display the current number of open and closed cases, year-to-date statistics, autopsy exam results, and other useful statistics that the jurisdiction finds useful.

"When I started in the Medical Examiner community in '97, the world wasn't so data-driven. Now the expectation is "I want to know the answer to my question now." A CMS provides you with the ability to have a good set of data and you define what you want to track to be able to answer a specific question on the fly. Elected officials want to stay elected and being able to get data relatively quickly is imperative."
—Robert Zerby, Chief Medical Investigator, Monroe County Medical

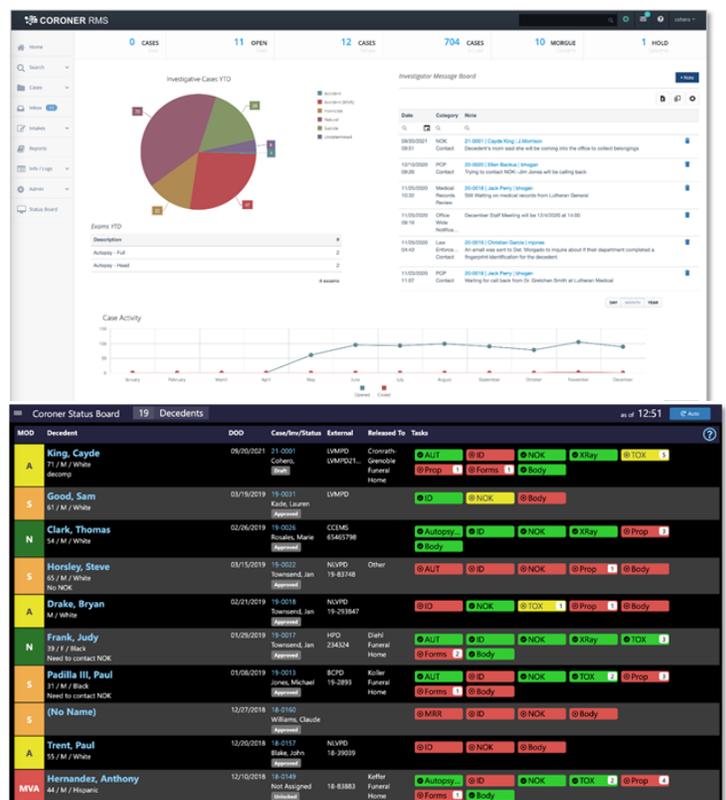**Figure 2.** Several vendors offer dashboards to help ME/C staff identify trends in case data at a glance (such as the top graphic, which shows a breakdown of investigative cases and trends/activity over time). Dashboards can also help staff coordinate and manage their caseloads (shown by the bottom graphic, which notes case status, tasks, and assigned staff for multiple decedents. Photos provided by Cohero.

Interfacing with third-party tools and databases

Having to input data into multiple data management systems manually takes time and increases the chance of incorrect data entry. Some CMS may communicate directly with other types of software systems, including LIMS, Property and Evidence Management Systems, and even other CMS. Vendors typically support out-of-the-box functionality between software of its own offering, or they have established relationships with other third-party software products. To extend functionality of a CMS even further, the vendor may work with a software company to enable the two products to communicate, using an Application Programming Interface (API). Using APIs requires coordination and agreements between vendors and offices. 78% of toxicology laboratories utilize either an electronic records management system or a LIMS in routine work.[11] Interfacing electronic records management systems (whether they are electronic CMS or LIMS) between ME/C offices and toxicology laboratories not only saves time by reducing manual data entry and transfer by personnel from both entities, but encourages consistent and reproducible data capture, storage, and sharing.

Some states Vital Records Offices allow CMS to communicate directly with the state Electronic Death Registration System (EDRS). CDC is working to modernization the National Vital Statistics system, with one aspect of this being move states toward fully electronic death registration that allows for data interoperability with other systems [12]. Standards based interoperability between the EDRS with medical examiner and coroner CMS is a high priority in this effort, as the ability for a CMS to communicate with a state EDRS gives the MDI the ability to upload death certificate information to the state automatically. This effort to transmit data into the EDRS saves ME/Cs time and reducing the risk of duplicate or erroneous entries.

Configuration and customization

The commercially available CMS software products in this landscape allow users to create, store, and retrieve case-related data; most of these features are "out-of-

the-box" functionalities. However, many offices value the ability to adjust how the software looks and operates. The need for change may happen after setup and installation; for example, a jurisdiction may want to implement a new type of report or expand the current fields to accommodate changing report needs. These types of changes can be made through customization and configurability options provided by the vendor.

CMS configurability is the ability to make changes to the software that do not require additional programming. These changes might be added to make the software look a specific way or record a specific data point. For example, a jurisdiction might want to record information that is not already found within the CMS. An IT technician might then go into the system and add a specific dropdown menu or add a list of corresponding answers to a question that pertains to that element. These changes can generally be made within a few days and require little technical expertise or vendor assistance to implement.

Customization requires the addition and creation of new code to the pre-existing software. These types of changes will likely take more time than configurable changes, but they can offer the most flexibility in what features the CMS may provide. Customization changes include interfacing with outside databases (such as an EDRS) or communication with other laboratory software and hardware through an API. Many CMS vendors have dedicated IT staff for programming these types of changes, which may require additional funds.

Mass fatality and disaster response tracking

Many CMS have been incorporating functionality into their platforms to help manage mass fatality and disaster response situations. Implementation of this feature varies depending on the vendor and software product. Some vendors offer a simple checkbox within a pre-defined case-related form to indicate if an event is related to a specific incident, whereas other vendors have built more complete modules for tracking items related to the incident.

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[11] National Forensic Laboratory Information System. (2017). *2017 Toxicology Laboratory Survey Report.*

https://www.nflis.deadiversion.usdoj.gov/nflisdata/docs/NFLIS-2017ToxLabSurveyReport.pdf

[12] NVSS - Modernizing the National Vital Statistics System (cdc.gov)

Product Landscape

All ME/C offices should utilize some type of case management or recordkeeping methodology. The 2018 BJS ME/C Census indicated that 40% of coroner offices and 54% of city, country, district, or regional medical examiner officers had a computerized information management system.[13] BJS data, shown in Figure 3, indicate that electronic CMS are more commonly used by medical examiner offices than coroner offices and that most ME/C offices in large jurisdictions rely on an electronic CMS. For electronic CMS, offices can either buy or build a system. When deciding the right type of CMS for their needs, ME/C should consider systems that are:

1) **Commercial Off The Shelf**—These CMS have widespread appeal and are geared toward making the implementation and usability of CMS as easy as possible. Choosing a COTS system removes much of the up-front investment in IT resources to program the system; however, these resources are necessary for planning and ongoing maintenance and configuration of the system (more information about IT investments is found in the section, "Implementing CMS in an ME/C Office"). Generally, COTS systems have a set of pre-defined features that the ME/C office can expect to be able to use upon implementation of the software. Sometimes a COTS system will offer add-on modules that extend the functionality of the software beyond what is readily available at the base-level price range. This landscape focuses on COTS systems. **Selection and implementation of COTS products are the focus of this report.**

2) **Internally Developed (Homegrown) Systems**—The 2017 NFLIS survey indicated that 15.6%, or 87 ME/C offices, use systems developed in house.[9,10] Building a custom CMS allows an ME/C office to make changes that directly solve a particular need. These systems vary widely in scale—from a simple Microsoft Access database to complex custom-built software.

ME/C Offices with Computerized Information Management Systems

Type of Office and Population Served	Offices with Computerized Information Management System (%)
Total	43.3
Coroner Office*	40.0
250,000 or more	81.4
25,000 to 249,999	49.1
Less than 25,000	27.6
Medical Examiner Office**	54.2
250,000 or more	92.2
25,000 to 249,999	46.4
Less than 25,000	28.3
State Medical Examiner Office	90.9

*including county, district, and regional coroner offices
**including city, county, district, and regional medical examiner offices

Figure 3. Approaches to case management varies by type of office (medical examiner vs. coroner office) and jurisdiction size.[12]

Home grown systems require dedicated IT staff or other staff members to build and maintain the software. Interoperability and upgrading are known to be common issues with systems that do not have the benefit of help desks and R&D departments tasked with improvements. More information about internally developed CMS can be found on Page 23.

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[13] U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics (2021). Medical Examiner and Coroner Offices, 2018. https://bjs.ojp.gov/content/pub/pdf/meco18.pdf

Commercially Available CMS Products

The FTCoE consulted ME/C personnel and CMS end users to learn about common vendors that ME/C offices around the country are using. Tables 1–4 provide an overview of basic and advanced features, technical specifications, and costs of a selection of electronic case management vendors for ME/C applications.

Vendors of note that responded to FTCoE's requests for information, which are profiled on the following pages:

1. Cohero
2. Forensic Advantage
3. JusticeTrax
4. MDILog
5. Porter Lee
6. QuincyTech
7. VertiQ

Vendors of note that did not respond to FTCoE's requests for information but are profiled to a lesser extent in the Product Landscape:[14]

1. ForensicFiler
2. ImageTrend
3. CoronerME

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[13] CMS vendors are described in half-page company profiles via publicly available information, which can be found on page 21. Databution preferred to be excluded from this landscape report.

Table 1. Features of Case Management System Software Products

Vendor	Caliber Public Safety	Cohero	JusticeTrax	MDILog	PorterLee	QuincyTech	VertiQ
Product	Forensic Advantage	Cohero Coroner RM5 v3.11	JusticeTrax LIMS-Plus	MDILog v4	Crime Fight B.E.A.S.T. Medical Examiner System	Case Management	CME v3 Moon
Input Data Type	Forensic Advantage Object Repository can accept any electronic artifact and associate it with a case(s) record.	Text, X-Rays, Word and Excel Documents, PDF, audio and video recordings. Basic file types (e.g., PDFs & photos) can be viewed in application, and others downloaded as individual or zip files.	Application accepts the basic field types. Attachments are stored in a file share that is accessible via the attachment module from the CMS.	Any electronic artifact	Attachments of any industry standard type (including PDF, jpeg, docx, and tiff). These can be included in "Notes Packets" documentation in analytical reports.	Various file types (e.g., PDF, docx, jpeg); text, numerical, date, phone, SSN, editable drop- down lists, etc.	Case-specific text and forms relating to the investigation. Supports the uploading and storing of any file type and extension.
Report Generation	Management, informational and statistical reports are included. Ad hoc reporting/searching may be exported to DevEx, DocGen, SQL Server Reporting Services (SSRS), or fed to Power BI/ Tableau.	Application uses SSRS for reporting, and customers may select from several report options or create and save an unlimited number of ad hoc queries and custom reports. Search and report results can be exported to Microsoft Excel.	Application has a Microsoft SQL database backend for data storage and reporting. It uses SAP Crystal Reports for creating analytical reports, worksheets and notes. Information may be exported to Microsoft SSRS and Power BI/ Tableau.	Application includes several standard reports (case/morgue/invoicing/ drug deaths/child deaths, etc.) for all users.	Several standard reports are available and can be customized. Analytical Reports and Analytical Worksheets will be tailored for the customer.	Reporting is generated through Active Reports 14 (GrapeCity). These reports can be exported to many formats including Word, Excel, PDF/A, CSV, etc.	Ad hoc reporting within any field of the system. Multitude of standard and statistical reports are included with this system.
Case Archival	Archive storage options depend on the installation. On-premise installations are achieved and stored on-premise by the agency's IT team. Software as a service (SaaS) data are archived by Forensic Advantage in the cloud environment specified by the client contract. Service fees for data storage/retrieval may apply depending on specific contract requirements.	All cases are stored in an SQL database online without the need to archive historical cases. No additional cost is associated for storing and retrieving archived cases. Attachments and documents are stored in their original file format in cost-effective online storage for long-term storage.	JusticeTrax LIMS-plus does not offer archiving functionality.	Archival is available through Amazon Web Services GovCloud. Data storage is included in system pricing for 5 years. Long-term storage moves to less expensive storage or maintained live at about $150 per year per 1,000 cases.	Cases for archive can be selected by several selections, including last activity date and case status for moving to an archive database. There is no additional cost.	Cases are archived on the same or separately linked server. Additional charges may apply for indefinite storage of full size images.	Case archival is not available. Cases are always available at no additional cost.

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Vendor	Caliber Public Safety	Cohero	JusticeTrax	MDILog	PorterLee	QuincyTech	VertiQ
Product	**Forensic Advantage**	**Cohero Coroner RM5 v3.11**	**JusticeTrax LIMS-Plus**	**MDILog v4**	**Crime Fight B.E.A.S.T. Medical Examiner System**	**Case Management**	**CME v3 Moon**
Customizable Features	Custom requests are considered on case by case basis. System interfaces require vendor implementation.	Customers may implement agency-specific enhancements or customizations, including security settings, data entry fields, cloud access options, and interfaces with vendor support.	Custom development for enhancements requested by customers that do not alter the workflow of the application or provide a negative impact may be scoped and implemented.	Several user interface options can be customized by the user.	Application allows the addition of new columns to existing tables, creation of entirely new supplemental tables and the defining of database triggers. Generally these changes are done by PorterLee Corporation, though customers may be trained to do so themselves.	All aspects of the workflow, data entry and reports are customizable. The application can evolve overtime as the needs of the clients change.	Field and form additions, as well as system interfacing, may be performed by VertiQ.
Configurable Offerings	System administrator can configure almost all aspects of the CMS including field name nomenclature, report templates, batch processing, reviews and statistical reporting.	Agency customizations include: workflows, role-based permissions, reference lists, custom reports/forms, agency specific logos and contact information printed on forms and reports.	Configurable functions/features can include the types of services offered, analytical modules (workflows) for results entry, analytical report templates, administrative report templates, additional data forms and fields, barcodes, and notifications.	Several user interface options can be configured by the user, including role-based access.	New forms, tables and database grids can be created. Microsoft Word templates and Crystal Reports are used throughout and can be modified as needed. Workflows may be configured for analytical report review cycles.	Configurable offerings include new user permissions, reports, Ad hoc queries and dropdown lists.	Options include role-based editing, management of dropdown lists and field labels, and report access configuration.
Interface Support	Various third-party software with vendor permission.	Possible interface systems include EDRS, external lab services, lab equipment, and other information systems. Extensive web API is available for import and export of case data and integration with third-party software.	Application API may be configured to exchange/share data with a number of third-party software—including records management systems, DNA sample management solutions, property and evidence systems, and more.	State organ procurement organizations, toxicology labs, EDRS systems, NVDRS, and NAME inspection and accreditation system.	The system can interface to third-party records management systems and other software. Additional Interfaces not already created can be designed.	Electronic Death Registration (EDRS), Laboratory Reporting (LIMS), Prescription Drug Monitoring, OPO (Organ Donor Alerts).	Bidirectional integration with NMS Labs and established integration with various state EDRS systems. Additional interface capabilities available upon request.
Mass Casualty Module	Offered	Mass casualty module is in development for 2022. Module will allow the collection of body and body parts in bulk and allows transferring them to cases as identity information becomes available.	JusticeTrax LIMS-plus provides multiple options. Ability to manage mass casualty depends on workflow for particular agencies.	Cases can be "linked" to one incident and tracked.	Ability to create quick case screens to aid in the entry, tracking and electronic manifests for outside DNA labs.	Ability to link multiple cases to the same incident.	Application allows for multiple individual cases to be created based on an incident/location. The application also contains a Case Association page, which allows a user to associate various cases together.

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External Communication with Stakeholders	A secure portal allows communication with constituents and can send out notifications when deliverables and other information is posted.	This functionality is being evaluated for future development.	The LIMS-Plus Portal enables pre-logging of case information. Stakeholders can view the status of any case/request for analysis they have submitted or download completed reports, with the ability to email reports from directly within the application.	Local system administrators can provide permissions to outside stakeholders and monitor access. Users can customize their account to send either text or email notification when specific tasks are completed.	A Prelog portal allows viewing of work to be done and its results. Discovery package gathers all electronic documents in the system and external sources and can notify the agency when the package is ready for download.	Built in Case Communication module tracks requests and interfaces with the client's email system to auto-log important communication initiated from within the application.	The COTS application allows for an internal user to enter in these requests through the document request page. The system supports the ability to provide the requested documents via email from within the application.
Dashboard	Offered	Several dashboards are available. The Status Board tracks decedents and the completion of tasks for each case. The Home Page displays graphs, charts, and tables with case statistics, along with the Investigator's Message Board, which displays shared case notes. The Morgue Log tracks morgue inventory with the ability to enter and modify location and status information. And finally, the Hold Log tracks information about delayed cases.	No application database is available, however functionality may be added through third-party Business Intelligence applications.	Dashboard is present with all NAME data requirement summary and 50+ standard queries included.	Dashboard is present with included charts and graphs, options to link to Tableau or Power BI (license not included), open assignments and tasks, and notifications and action items.	Application allows for an electronic white board to display critical case information. Dashboard can then be sorted and filtered like a spreadsheet by the user.	Application contains a task management module for ensuring case closure requirements are met. The system also provides the ability to see cases by investigator or pathologist.
Reference Databases and Medical Lists	Medical dictionaries and reference tools may be uploaded and configured.	Built-in support for U.S. Food and Drug Administration medication lists.	Although there is no built-in reference database functionality, users may utilize the inherent features of cases, custom fields and forms, and Crystal Reports within LIMS-plus to achieve database or reference collection goals.	Lists include CDC drug lists, VIEWS II validation, and Cause of Death listing. Each office has the ability to create their own custom references to auto-populate system data fields.	Application includes code tables (e.g., ICD10).	Standard toxicology compounds are incorporated in toxicology dropdown lists.	Application allows users to choose items from predetermined administrator managed dropdown lists.

Table 2. Technical Specifications for CMS Implementation

	FORENSIC ADVANTAGE	cohero	JusticeTrax	MDILog Medicolegal Death Investigation	PORTER LEE Corporation	QUINCYTECH ADVANCING FORENSIC INFORMATION MANAGEMENT	VertiQ software
Vendor	Caliber Public Safety	Cohero	JusticeTrax	MDILog	PorterLee	QuincyTech	VertiQ
Product	Forensic Advantage	Cohero Coroner RM5 v3.11	JusticeTrax LIMS-Plus	MDILog v4	Crime Fight B.E.A.S.T. Medical Examiner System	Case Management	CME v3 Moon
On-Premise Solution Offered	Yes	Yes	Yes	No	Yes	Yes	Yes
Cloud-Hosted Solution Offered	Yes	Yes (Cohero-hosted)	Yes (Locally hosted)	Yes (GovCloud)	Yes (Azure or Amazon Web Services)	Yes	Yes
Browser Support	Any modern web browser is supported (HTML5, ECMAScript 2017, CSS3, etc.)	Application supports the latest versions of the Chrome and Microsoft Edge browsers.	Application is compatible with Microsoft Edge, Microsoft Edge with Chromium, and Internet Explorer 11.0 or higher.	The latest versions Firefox, Chrome, Edge and Safari.	Google Chrome and Microsoft Edge. Older browsers are also available in pre-HTML5 branches but not recommended.	Application supports Google Chrome, Microsoft Edge and android OS devices. Also, can be configured to be accessed through Apple (IOS) devices.	Application supports the use of any web browser that is HTML compliant such as Google Chrome, Mozilla Firefox, Apple Safari and Microsoft Edge. Discontinued browsers such as Internet Explorer are not supported.
Mobile Capabilities	Application is compatible with any mobile device/ browser with current web standards (HTML5 and CSS3).	Web application is compatible with mobile devices supporting the latest versions of Google Chrome, Microsoft Edge, and Safari.	Software is accessible on any device with a supported web browser and an active network connection.	Compatible with mobile devices, including Apple and Android Apps.	Application can be accessed from mobile device with HTML5-compatible browsers (Chrome, Edge, Safari). Additional apps are available for body and personal asset inventory that interface to laser barcode scanners, signature capture windows, image capture and UHF RFID reading mobile devices.	Application is accessible on mobile devices (IOS or Android) through Chrome or Edge browsers.	Compatible with mobile devices.

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Security	Annual third-party audits help to ensure adoption of industry best practices. FIPS 140-2 NIST certification is used throughout the CMS and two-factor authentication may be enabled.	Multilayered security is encrypted using TLS 1.2 or greater authentication. Passwords are encrypted both in transit and at rest. Sensitive settings are encrypted using AES-256. Multifactor authentication is available.	Data encryption for data both in transit and at rest. Application requires both username and password entry to gain access to the application.	Meets the U.S. government compliance requirements and U.S. Department of Defense Security Requirements Guide at Impact Levels 2, 4 and 5.	Support Staff complete CJIS compliance certification. Support staff who work directly with customer data submit to background checks as required by the customer.	Encrypted at rest, multifactor authentication is available if required.	Hosted Solution: All data are encrypted in transit, at rest, and in the backups. Includes the following security compliance certifications: HIPPA, CJIS, FIPS 140, FedRAMP High, NIST 800-171, ISO 27001, SOC 1, SOC 2, SOC3 and CSA Star certified. In an On-Premise solution: Security is the responsibility of the Client's IT.
Server Requirements (for On-Prem)	Server specifications are kept up to date latest Microsoft's server platforms (e.g. Windows 11, SQL 2019 etc.).	The application requires a Microsoft Windows Server running Docker and Microsoft SQL Server. Internet and remote access are required for support by authorized Cohero staff.	Microsoft Server Standard Edition 2016 or higher Database: Microsoft SQL Server 2016 or higher	None locally	Oracle or SQL Server; Webserver: IIS on Windows server	SQL Server 2012 & IIS 2014. Size depending on # cases processed annually and the amount of historical records imported.	MS IIS 10.0 or newer. Web Deployment Tool MS .Net Framework 4.7.1 MS SQL Server 2016 or newer, CLR enabled MS Analysis Server (optional), MS Reporting Server (optional). Requires SMTP server access to send out emails
Hardware Requirements	Cloud-based hardware: Requires device with a compatible browser. On-premise hardware: Requires a computer capable of running Forensic Advantage platform. Storage demands are variable, however 77Mb per case is recommended for agencies wishing to store supporting objects (images and attachments)."	Cloud-hosted implementations include all server hardware, with the customer supplying all client hardware. On-premise deployments require one or more servers running Microsoft Windows Server and Microsoft SQL Server. Hardware requirements will vary depending on the agency's size and requested configuration.	A detailed system requirements document is available upon request to agencies interested. Software requirements follow industry standards and do not include proprietary standards. JusticeTrax does not provide hardware solutions.	None, but performance can be limited by (1) internet speed and (2) hardware memory.	Hardware requirements are met with any recent workstation and supported browser.	Standard PC Workstations	Memory 16GB; Recommended 20GB. Disk space should be adapted in accordance with the volume of documents and images to be stored. Newfoundland will have to assess their document and database needs to determine the 5-year growth. Minimum 4 CPUs, AMD Opteron, AMD Athlon 64, Intel Xeon with Intel EM64T support, Intel Pentium IV with EM64T support. Speed, 2.0 GHz or faster.

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Local Operating Systems	Forensic Advantage has been developed on the Microsoft Platform (SQL Server, .Net Framework, etc.).	No specific client operating system is required.	Microsoft Windows 8.1 or higher	All that support internet access and use one of the top browsers.	If not using cloud, Database servers run MSSQL (Windows) or Oracle(Windows or Linux). Web servers run Windows with IIS. Image vault servers run on Windows. All 3 servers may be run on the same hardware. Virtual machines may be used. Workstations are primary Windows 10 & Windows 11. The system can be accessed from any OS supporting an HTML5 browser.	Minimum: Microsoft Windows 7; prefer Windows 10	Windows Server 2016 through 2019
Update Frequency	Software is updated at least twice annually. Customers with current maintenance and support contracts or SaaS agreements are eligible for product releases and assistance in upgrade process.	Typically 2 system upgrades per year. Patches, bug fixes, correction of substantial defects, and fixes due to any conflicts with mandatory operating system security patches are included with SaaS licensing, or via a first-year warranty and ongoing maintenance services for perpetual licensing. Source code is available as an option with perpetual licenses. This offers our clients increased long-term security, along with the flexibility to self-customize if desired.	Generally at least one major release of software annually, which is provided under the Maintenance Agreement.	No regular update schedule, and no additional fees to upgrade to current V4 system.	Software updates (1) are available at a minimum of once per year and (2) are included in the support and maintenance costs. Porter Lee handles the entire update process of bringing the system and all customizations into the main branch.	Average of 2 system upgrades per year. Windows and SQL security updates as released, approximately 1x per month.	No regular update schedule. Bug-related issues are scheduled as soon as deployable.

Table 3. CMS Procurement Costs

	Caliber Public Safety FORENSIC ADVANTAGE	Cohero	JusticeTrax	MDILog Medicolegal Death Investigation	PORTER LEE Corporation	QUINCYTECH ADVANCING FORENSIC INFORMATION MANAGEMENT	VertiQ software
Vendor	Caliber Public Safety	Cohero	JusticeTrax	MDILog	PorterLee	QuincyTech	VertiQ
Product	Forensic Advantage	Cohero Coroner RM5 v3.11	JusticeTrax LIMS-Plus	MDILog v4	Crime Fight B.E.A.S.T. Medical Examiner System	Case Management	CME v3 Moon
Pricing	Specific customer price will vary based on agency requirements and modules selected.	Offers (1) one-time perpetual license or (2) ongoing SaaS licensing. Three levels of site features are available, and pricing is based on criteria—including agency size, records/attachments stored, feature set, and deployment type.	Perpetual license priced by active named user; per license costs are scaled by agency size.	Pricing based on jurisdictional population, quotes can be found on the MDI Log website.	Perpetual license pricing models, including (1) site license, (2) per concurrent user, (3) per workstation.	Pricing depends on number of concurrent users, number of modules and interfaces, amount of customization and storage needs.	On-Prem: one-time upfront license fee (determined by number of concurrent users) + annual maintenance and support fee. Hosted: Annual fee (determined by number of concurrent users).
Maintenance Support Cost	Maintenance, technical support cost, and SaaS hosting fees will vary based on requirements.	For perpetual licenses, annual support and maintenance is based on a percentage of price for the total cost of the original system configuration, effective after an initial 1-year warranty. Our support agreements include no-cost version upgrades.	Support and maintenance costs are calculated at 18% of total software licensing cost. Maintenance includes software updates and customer support.	Pricing can be found on the MDI Log website.	Support and maintenance costs are typically 15% of the software license cost.	Annual licensing & support costs estimated between 15-25% of installation costs.	Annual maintenance and support costs are determined by the number of concurrent users the client/agency has.
Additional Costs	Module implementation fees will vary by engagement based on specific agency requirements.	Costs for integration add-ons are determined by the type and scope of integrations.	No response provided	No response provided	Add-on modules not directly associated with the lab management are designed and quoted separately depending on the scope and requirements.	Quote required for specific interfaces for Accounting (Export) EDRS, LIMS, OPO's, etc.	Costs for integration add-ons are determined by the type and scope of integrations.
Add-on Packages	Add-ons include PreLog, OnSCENE Mobile Case Management, WEB, Batch Processing, SAK Tracker and BrAD modules.	The Trusted Reporter Portal module enables outside agencies to enter death intake information. The Status Board module provides a large-format view of case status, like a typical case tracking white board in a coroner's office.	Consumables Inventory and Management System records and tracks all consumables used by an agency. JusticeTrax Indexer allows users to print important files, emails, documents, and more directly in the application.	Custom interfaces with third-party systems may be scoped.	Add-ons include instrument and third-party systems/database interfaces. Examples include complete bidirectional DNA robotics instrument interfaces and toxicology screening instruments.	Application supports EDRS interfaces, LIMS, Autopsy Suites, and other third-party interfaces.	Application modules are included with every client install. Interfacing capabilities available upon request.

Table 4. Technical Support and Training

Vendor	Caliber Public Safety	Cohero	JusticeTrax	MDILog	PorterLee	QuincyTech	VertiQ
Product	Forensic Advantage	Cohero Coroner RM5 v3.11	JusticeTrax LIMS-Plus	MDILog v4	Crime Fight B.E.A.S.T. Medical Examiner System	Case Management	CME v3 Moon
Technical Support	24x7x365 in-house Technical Support call center, FA Customer Hub is a direct link to our support ticketing system where clients can create, modify, and manage their agency's support issues and clients are assigned a customer success manager as a single point of contact for general and technical support. On-site support is available based on specific client needs.	Cohero generally provides remote support, with the ability to provide on-site technical support for on-premise deployments in the usual event where an issue cannot be corrected remotely. Our service level agreements outline issue priority levels and typical response times, which may vary based on individual customer requirements. Support can be requested by email, telephone, or in-app feedback tool. Remote support is typically provided via Zoom or similar service.	Standard customer support hours are Monday through Friday 8:00 a.m. to 5:00 p.m. MST. Customers have access to our Customer Care team via our online customer portal, Zendesk, our implementation tracking solution, basecamp, via email and via telephone. Detailed customer support escalation policy and prioritization is available upon request.	Monday through Friday 8:00 a.m. to 5:00 p.m. EST: human support; Afterhours: email and system user support	Phone, email, and website tech support are offered. Remote support is also provided via Teams, GotoMyPC, WebEx, Zoom or compatible platform.	Complete helpdesk support ticketing system for application. Local IT (Workstation / Printer / Internet) is usually the responsibility of the client.	For clients on hosted solutions, technical support is available 24x7x365 days a year. For clients with on - prem solutions, technical support is available Monday–Friday from 6:00 a.m. to 5:00 p.m. PST.
Training	Training provided as part of project implementation; ongoing and specific module training is available.	Training is included for system administrators, end users, and train-the-trainers. User manuals and training documents are included and training may take place over online video or in person for a fee.	Administrator/ Configuration training and End User training. Additional training for SAP Crystal Reporting is offered.	Webinar no charge; $1,000 a day for in-person training	Implementation includes on-site training for IT Staff, LIMS Administrators, Section supervisors, and LIMS users.	Train the Trainer (USERS), Global Admin (Super USERS), IT Support, are included in the installation. Additional training can be supported.	System Administrator and Train the Trainer are included in the project plan. Costs are determined by the number of concurrent users and/or roles that require or desire training. End user training can also be performed if desired.

The following three software-based CMS vendors were identified in FTCoE's market search, but these companies did not respond to the request for information. Profile content is based on secondary research sources.

ForensicFiler
www.forensicfiler.com/

ImageTrend
www.imagetrend.com/

CoronerME
www.coronerme.com/

Company Overview

ForensicFiler is a CMS offered by Summit IT Solutions in Akron, Ohio. This is a cloud-based CMS that is currently implemented in 14 states and 80 counties for MDI.

Basic Features

ForensicFiler allows comprehensive data entry of numerous data fields, including decedent demographics, dates/times recorded, medical history, and more. These data fields are collected in a number of available forms, and these forms may be turned into one of several predetermined report types. The software is also able to support expense and mileage tracking.

Advanced Features

ForensicFiler can support statewide reporting with a signed data sharing agreement with state offices.

Security

ForensicFilerOnline database information is stored in an SSL-encrypted data center. They backup data information nightly and maintain strict user security. All software users must login with a secure username and password. The system automatically logs out users for inactivity or simultaneous logins on multiple devices.

Support

ForensicFiler offers live phone support and email communication. No information was found on IT implementation support.

Company Overview

Envoy is a CMS offered by ImageTrend, a developer of web-based software applications based in Lakeville, Minnesota. Envoy is described as a complete CMS for managing coroner and violent death cases.

Basic Features

Envoy allows quick and easy reporting of all data collection from a crime scene. It supports the attachment of external files to a case, and this information can be used to create annual and custom reports, coroner verdicts, and internal reviews. This information can be accessed at any time with an internet connection.

Advanced Features

Envoy offers a pre-defined medical history database for repeatable and accurate reporting practices. The software has the capabilities to be used as a statewide reporting tool and integrated with state specific EDRS and state toxicology integration. These systems need to be granted permission by state officials. ImageTrend has various standalone software and modules designed for law enforcement and coroner use. Of note is the reporting solutions tool for simplified reporting and analysis. Check with ImageTrend for the specifics on the compatibility of these product offerings.

Security

No publicly available information related to security was found.

Support

ImageTrend offers technical support through a self-service portal and a support line that is available Monday through Friday.

Company Overview

CoronerME is a web-based CMS based in Crothersville, Indiana. The software was developed by former coroners who wanted to offer an affordable solution to counties with budget constraints. CoronerME is a complete solution with no additional add-on modules for purchase.

Basic Features

CoronerME is a complete records database that can be used to store input text, photos, and scanned images and to perform queries across records. Administrators have the ability to set various access levels and re-assign cases to new investigators. The software also supports expense tracking and contains a case checklist.

Advanced Features

CoronerME has a built-in set of queries that can be used to prepare annual reports. The software has the ability to be implemented at a statewide level and can automatically email reports to family member and generate reports to be sent to news media. A medication list is available as a medication dictionary for accurate spelling.

Security

No publicly available information related to security was found.

Support

CoronerME offers a feature called "Continuing Education" that records and keeps track of user training. Technical support is available through phone.

Internally Developed CMS

There are numerous examples of homegrown CMS that have been successfully used in ME/C offices around the United States. Although the focus of this landscape is COTS CMS, there are many lessons that can be learned regarding implementation of homegrown CMS. The major benefits of a homegrown CMS are its flexibility and lower cost. When developing a custom CMS, it is often built from a pre-existing architecture that serves as the backbone for the platform that will be implemented down the line. This allows software engineers and IT personnel to build specific features that the ME/C office needs. For some offices, internally developed systems may be as simple as a computerized spreadsheet or access database with well-crafted permissions and version control.

Many jurisdictions that chose to build their own system do so because they can integrate various departments within the jurisdiction from the ground up. Natrona County, for example, built a CMS that automatically integrates with the Wyoming Department of Health Vital Statistics to upload electronic death certificates. In doing so, they do not have to rely on the capabilities of a vendor to tie these departments together under the same system correctly. The Natrona example is illustrated as a case study on the next page.

Another example of an internally developed system is the notably robust Medical Examiner Tracking System [15] in Palm Beach County, Florida. According to the

county, the program was first funded to replace an old CMS that no longer fit the current needs of the county. The county developed a system that contains multiple modules or components that various departments can access. In addition to the ME Case Management module, the program has added modules for cremation management and approvals, interfaces with law enforcement agencies for electronically submitting death investigation forms to the medical examiner's office, toxicology and laboratory tests tracking, an evidence management module for maintaining property and items collected during autopsy, and a records management system designed to convert all paper files to electronic formats. The county has estimated an 80% reduction in manual data entry because of automatic case processing to external databases, like the EDRS in the Bureau of Vital Statistics.

One potential downside to an internally developed CMS is that creation and maintenance can be difficult. Homegrown solutions require dedicated IT staff capable of developing the software and the necessary hardware to store the database on a server on site. These solutions can be financially costly and require a lot of implementation time. In the case of the METS example, it took over 17,000 hours over a 3-year period to get the system built and operational. Not every county manages the same number of cases that METS was designed to do, in which case a cheaper COTS CMS may fit their needs just as well.

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[15] Palm Beach County. (2019). *Medical Examiner Tracking System (METS)*. https://discover.pbcgov.org/iss/Documents/DigitalCommunities/2019/Medical-Examiner-Tracking-System.pdf ↗

Creating a custom CMS has increased information flow between the Coroner's Office and other departments in Natrona County.

James Whipps shared his experience as the coroner of Natrona County Coroner's Office in Evansville, Wyoming, which uses an internally developed CMS.

Natrona County is one of the busiest offices in Wyoming and uses a coroner system that manages more than 300 cases a year. When James Whipps took office, he led an initiative to centralize all of the county's case-related information into a single software. The county partnered with Gartner Software to create a custom, fully equipped CMS, which directly interfaces with the state vital records office. The process of creating this software has led to several improvements in how the county shares case information with authorized individuals.

- **Consolidation of information**—Prior to using the custom software, Natrona County was managing cases using four different systems, which was inefficient and redundant. This led to long turnarounds in data transfer and disorganization of information. After implementing the current system, the county was able to centralize its case-related information and move data around between its coroner's office and vital records office more quickly. Photos and documents are stored in the system and recalled and searched at any time. It has also acted as a more reliable form of storage for sensitive case information.

- **Communication between stakeholders**—This system allows county administrators to give permissions to various parties involved in the case management process. The county moves information back and forth between its vital records office and has the capabilities to extend permissions to family members and outside agencies, although the county does not choose to do so at this time. Natrona county looks to expand its information exchange to include the state's Board of Pharmacy Department.

Building a custom CMS has allowed the county to implement a system that directly fits the needs of the office. While this solution requires a substantial upfront investment, the centralization of information and increased communication has relieved a huge burden off the coroner's office. Now that the system is up and running, it is very user friendly, and new personnel can learn the system in just a few days.

Key Lessons Learned

1. Centralization of functions in one software product can reduce down time and improve workflow efficiencies.
2. Communication between stakeholders is faster and more efficient with the Internally developed CMS.
3. Custom CMS may allow more specific functionality to meet the needs of the county, compared with some rigid COTS products.

Implementing CMS in a ME/C Office

Adoption of a CMS in a ME/C office can enable streamlined and more efficient workflows, but this requires sufficient planning prior to and during implementation of the systems. Prior to implementing a CMS, ME/C personnel may consider the resource changes, workflow, and responsibilities that may be needed. Interviews with experts revealed several key lessons learned that ME/C offices should consider when implementing CMS, regardless of vendor or internally developed approach:

Commercially available case management products, while offering some out-of-the-box functionality, may require significant resource investments to implement. Front-end planning, communicating, testing, and training offer significant value returns for long-term, steady-state use of the system. When thinking about implementing a CMS, decisionmakers should consider the following questions:

1. *What upfront and ongoing resources will be needed to purchase and maintain the CMS?*
2. *How will this CMS integrate with my current MDI workflow, and how should I adjust my workflow to improve efficiencies?*
3. *How might the responsibilities of my staff shift with adoption of a CMS?*
4. *What level of training do I need to get my personnel competent and comfortable with operating the system?*
5. *How much internal or external IT support is required for configuring and maintaining the CMS?*
6. *Can my CMS easily comply with my jurisdiction's security protocols?*
7. *What is a realistic expectation of transition time?*

Plan for Resource Allocation and Implementation

Implementing a CMS in a ME/C office requires upfront and ongoing resource allocation to purchase hardware and software, train personnel, and maintain the system. CMS base prices can range from a few thousand dollars to upwards of a quarter of a million dollars because of a multitude of factors, including base features, a jurisdiction's caseload and population size, the number of licenses needed for ME/C personnel, and the location of the system (in-house or cloud-based). There may be costs associated with add-on modules, yearly maintenance fees, IT support, customization of the software, supplemental training, and additional licenses. Therefore, ME/C offices should not only plan for a one-time investment with the implementation of the CMS but should ensure the appropriate amount of resources is allocated in annual budgeting to provide system upkeep and changes to better serve the ME/C MDI workflow. When implementing CMS, offices will need to

- Assess the current workflow
- Identify changing responsibilities
- Train end users
- Assess IT capabilities for setup and maintenance
- Engage stakeholders that need to interact with the system to get buy-in
- Evaluate opportunities to eliminate reporting redundancies
- Assess state-level mass fatality and disaster resources
- Consider funding opportunities for implementing a CMS
- Understand opportunities and limitations of retrofitting a LIMS

Assess the current workflow

When assessing COTS CMS options, ME/C offices first may want to document their death investigation workflow and determine the points of integration for a CMS. It may be helpful to document what data need to be captured across all cases, a general protocol for conducting death investigations, a map of the stakeholders involved in death investigations and the flow of information, and what case-related questions are commonly posed by external stakeholders. Doing this prior to procurement can help decisionmakers understand what features are crucial to office workflows.

Offices should also consider that a well-designed CMS does not automatically improve efficiency of their workflows. The procurement process is a helpful opportunity for structured time to review workflow, assess its value for the office and other stakeholders, and adjust to more efficient processes for death investigations.

Identify changing responsibilities

In addition to potentially causing shifts in workflow, adopting a CMS may change the responsibilities of stakeholders and ME/C personnel. CMS adoption could eliminate redundant and manual tasks for ME/C personnel, such as searching for data in paper files, thus freeing up their time to perform more valuable activities. In the beginning of implementation, ME/C personnel and stakeholders may have a role in helping with the configuration of the system and ensuring the system matches their workflow. Time investments for incorporating stakeholder feedback and training on system use will be offset by time savings from paper reduction, easy searching, and system interfacing—as indicated by the Onondaga County Medical Examiner's Office case study below.

Train end users

To help with the CMS adoption process, it may be helpful to provide training for users that will interact with the system daily. Some CMS vendors offer training programs and courses for staff that occur during the installation and implementation process. ME/C offices may want to develop their own training program and manuals for the CMS, especially if the CMS has been significantly configured from its COTS version.

> "On the front-end decide what you really need in a CMS before exploring options and choosing a system. What are questions that commonly come to you that you'd like to answer easily? Look at your current processes and ask yourself will this CMS integrate? When adopting a CMS, it also may be a good time to adjust your process and model if it makes sense."
>
> —Robert Zerby, Chief Medical Officer, Monroe County Medical Examiner's Office

Assess IT capabilities for setup and maintenance

Continued maintenance is crucial for sustained adoption and optimized operations. ME/C offices should assess their IT capabilities and determine what activities can be supported in-house versus what must be outsourced. Many CMS vendors offer maintenance and software update support for a yearly fee. Vendors may also offer customization services at an additional cost. However, for configuration of data entry forms and smaller changes to the CMS, it may be more efficient for ME/C offices to have internal IT support. ME/C offices may want to choose a technical expert or CMS administrator to oversee the system maintenance plan and continuous improvement cycles with a CMS.

Investment in an integrated CMS led to cost savings that could be reinvested within the Medical Examiner's Office.

Brian Ehret is the Chief Forensic Investigator of Onondaga County Medical Examiner's Office in the state of New York.

In 2007, Onondaga County received funding to update its CMS. After trialing various software products on the market, Onondaga County chose Porter Lee's B.E.A.S.T. software for all case-related tracking. As part of this upgrade, the county moved the medical examiner's office, the crime laboratory, law enforcement agencies, and the district attorney's office to B.E.A.S.T. and linked data on one server. Although B.E.A.S.T. is typically used to track evidence, the county was able to create screens that worked for the needs of the ME/C office. The system is entirely paperless; records are accessible to multiple stakeholders through a web browser, and report requests and delivery are automatically coordinated through email. While B.E.A.S.T. software was not fully featured at the beginning, it has been modified and configured into a robust system that fits Onondaga County's needs. The county noted the following benefits for using this system:

- **Time and money savings**—The CMS has reduced duplicate data entries and entry errors. This long-term time savings vastly offsets the upfront time commitment that the county had to go through when implementing the system. Purchasing a unified system has helped the department cut back on individual software fees and additional hardware requirements. The software is customized by the vendor, allowing in-county IT staff to work on other tasks.

- **Centralized report access**—By setting up B.E.A.S.T. as a centralized data repository with permission controls, the county could easily access records necessary for investigative functions (e.g., autopsy and toxicology reports).

- **Comprehensive, case-relevant information**—Onondaga County set up comprehensive data entry fields for each case. For each case type selected (e.g., suicide by firearm), the software is programmed to ask for specific data relevant to the case type (e.g., serial number of the firearm). Investigators must complete all questions presented in the form. This robust documentation helps assemble inclusive reports that are disseminated to different stakeholders, and helps provide details necessary for court testimony.

According to Mr. Ehret, the B.E.A.S.T. system implemented in Onondaga County has become very sophisticated and fits the needs of the various departments and their stakeholders. Although it would be ideal for every county to implement something similar, Mr. Ehret acknowledges that each county must balance their own staffing and budget and implement a system that fits within their constraints.

Key Lessons Learned:

1. The initial investment in time and money to implement a CMS will pay for itself over time.
2. Standardized data inputs in a CMS helps to create reproducible and consistent reports for court testimony.
3. Although every jurisdiction may not need the advanced features of an electronic CMS, every jurisdiction should consider implementing some sort of CMS.

Engage stakeholders that need to interact with the system to get buy-in

MDIs commonly involve stakeholders beyond ME/C personnel, including law enforcement, hospital systems, crime laboratories, public health organizations and more. When choosing a CMS, consider who may need to interact with the system and how. While evaluating COTS CMS, it may be helpful to engage these stakeholders to understand what features and functionalities would help them in their daily activities. After CMS selection, the stakeholders should be involved in the implementation process to not only train them on the system but also to provide opportunity for their input on configuration to ensure the CMS aligns with their workflow. Getting buy-in from the stakeholders and communicating the value of the CMS early in adoption will ease the transition and ensure the system is being used to serve the entire death investigation process.

Evaluate opportunities to eliminate reporting redundancies

ME/C offices are often key data contributors to state and federal authorities for tracking and reporting deaths. When implementing a CMS, ME/C personnel should not only consider how the system will streamline data aggregation and analytics for reporting, but also opportunities for reducing redundancies during state-level reporting. The Monroe County Medical Examiner's Office, for example, saw time-saving impacts with a CMS that interfaces with many external databases.

ME/C offices may use external statewide reporting systems, which collect and aggregate data from multiple offices. The majority of the states in the United States, except West Virginia and Rhode Island, utilize EDRS to register death certificates, reducing the need for paper-based transfers.[16] The Centers for Disease Control and Prevention (CDC)-funded National Violent Death Reporting System (NVDRS) is a state-based database implemented across the United States that aggregates medicolegal case–related data from a variety of formats, including ME/C reports, law enforcement reports, and toxicology reports in one place for trend and pattern identification in violent deaths to inform policy and program initiatives.[17] A state's Vital Statistics Department may require additional data reporting requirements outside of medicolegal death investigations (e.g., cremation requests) to upload data to their databases.

An office's CMS may be able to interface with statewide reporting systems and automatically upload case-related data to eliminate redundancies in data entry. However, some states and programs may not allow this type of interface and communication between systems because of concerns over data security. When implementing a CMS, ME/C personnel should speak with stakeholders at their state's Vital Statistics Department to understand what redundancy-eliminating measures are possible. ME/C personnel should identify what data formats are compatible with statewide reporting systems and ensure the CMS chosen can record data in those formats. Prior to adopting a CMS, ME/C personnel should ensure the system can meet their state reporting requirements and during implementation plan time if necessary for configuration of the system data fields to streamline the process.

[16] National Association for Public Health Statistics and Information Systems. (n.d.). *Jurisdictions. Electronic death registration systems.* https://www.naphsis.org/systems

[17] Centers for Disease Control and Prevention. (n.d.). *National Violent Death Reporting System (NVDRS).* https://cdc.gov/violenceprevention/datasources/nvdrs/index.html

Implementing VertiQ in the Monroe County Medical Examiner's Office gives users instant access to case data and speeds up information distribution to stakeholders.

Robert Zerby is the Chief Medical Examiner of the Monroe County Medical Examiner's Office in New York.

The Monroe County Medical Examiner's Office serves approximately 750,000 residents. The county was an early adopter of electronic case management back in 1996, with their first implementation using a mainframe computer with some light word processing. The office adopted VertiQ in the early 2000s to keep up with management demands. The team witnessed the product in action at the Los Angeles County Department of Medical Examiner-Coroner's Office and appreciated the ME/C specific content that the service had to offer. The county has since upgraded to v2.5 and has been able to customize the software to work seamlessly with their daily needs. Currently, the system can interface with outside databases like EDRS, and they have plans to interface the system with new laboratory hardware. Monroe County has valued the following aspects of the CMS:

- **Query search**—A CMS has been essential for centralizing information. Mr. Zerby can create simple queries that span multiple cases to extract important information at any given time. The expectation is becoming clear that coroners and medical examiners should be able to readily provide information to various stakeholders at any time. Adopting a CMS has enabled expedient responses to data requests.

- **Configurability**—The first iteration of VertiQ was installed locally on the office's computers and required a significant amount of setup. Any changes and updates to the software had to be done by vendor technicians and would take time to take effect. The county is currently running v2.5 and has found the cloud-based system to be much smoother, easier to implement, and harder to "break."

- **Cost savings**—Implementing a COTS case management system has been financially feasible given their relative population size. A cloud-based system removes much of the technical burden on the counties IT department, and Mr. Zerby described the annual maintenance fees associated with the software as minimal and substantially less than other software they use.

Monroe County will likely be transitioning to a newer version in the future because current browsers will not support older versions of VertiQ. Mr. Zerby noted that it is important for ME/C offices to understand what you want to get out of a CMS in terms of data collection and process efficiencies prior to adoption and implementation and to be open-minded about implementing features of a system that an office currently may not use. Adopting these features may help improve daily workflows in unexpected ways.

Key Lessons Learned:

1. Utilizing a cloud-based CMS may offset some financial investment by reducing internal IT staff requirements.
2. Very few COTS systems are truly plug-and-play; most systems require some configurability to the needs of the ME/C, resulting in a "unique" version from county to county.

Assess state-level mass fatality and disaster resources

Some agencies may use built-in mass fatality and disaster modules offered by a COTS CMS. Others use separate mass fatality programs developed by their state for use in specific scenarios. For example, after the September 11 terrorist attacks in 2001, New York City's Medical Examiner's Office collaborated with Sapphire International Inc. to develop the Unified Victim Identification System (UVIS),[18] a robust mass fatality program that is still in use[19] by New York City and surrounding jurisdictions. ME/C offices may also leverage nationwide programs in the incidence of mass fatalities.

When considering what features are needed in their CMS, ME/C offices should assess whether adjacent jurisdictions or their state have a mass fatality program that could be utilized by their office or whether their COTS CMS needs this capability. In addition, ME/C personnel should consider and plan for how the statewide mass fatality program may impact their death investigation workflow and interface with their COTS CMS. During implementation, it may be helpful for ME/C personnel to work with their COTS CMS vendor and stakeholders from the statewide mass fatality program to proactively set up interfacing capabilities between the two systems to streamline data transfer and eliminate data entry redundancies.

Unified Victim Identification System (UVIS)

UVIS contains three modules: **ante-mortem**, where family members and friends can report missing persons; **pan flu** with a records management functionality to track infectious disease prevalence; and a **postmortem module** with a built-in CMS and human remains management and disaster victim identification capabilities.[15] The most recent activation of UVIS was April 2020 during the height of the COVID-19 pandemic.[16]

Consider funding opportunities for implementing a CMS

Implementing a CMS is a multi-step effort. It requires planning and configuration, engaging with multiple criminal justice stakeholders, training, and ongoing maintenance. Costs beyond the site licenses include maintenance contracts, add-on modules, training costs, change orders, and the labor costs to train users. ME/C offices may look to funding opportunities, like state or federal grants, to support their case management

product implementation. For example, the Bureau of Justice Assistance administers the Paul Coverdell Forensic Science Improvement Grants Program, which provides funding to improve the quality of forensic science and medical examiner[20,21]

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[18] The City of New York Office of Chief Medical Examiner. (2009). *UVIS information guide.* https://www.nyc.gov/html/ocme/downloads/pdf/Special%20Operations/ UVIS%20Information%20Guide_20090917.pdf

[19] The Official Website of the City of New York. (2020). *Mayor de Blasio announces activation of the Unified Victim Identification System.* https://www1.nyc.gov/office-of-the-mayor/news/266-20/mayor-de-blasio-activation-the-unified-victim-identification-system

[21] Executive Office of the President. National Science and Technology Council. (2016). *Strengthening the Medicolegal Death-Investigation System: Improving data systems.* https://www.ojp.gov/pdffiles1/NIJ/251423.pdf

Understand opportunities and limitations of retrofitting a LIMS

LIMS are similar database management systems designed specifically for the needs of crime and toxicology laboratories. As flexible and robust systems, they can be adjusted to fit the needs of ME/C offices. Offices choosing to implement a LIMS as their CMS should not only consider the opportunities of consolidating processes throughout the course of a death investigation in one system but also the limitations of retrofitting this program for their needs.

Most ME/C offices do not have in-house toxicology services and thus, leverage external labs for comprehensive toxicology workups. Of the ME/C offices surveyed in the 2017 NFLIS Medical Examiner/Coroner Office Survey Report, 96% outsource their toxicology testing, which often includes state or local forensic crime laboratories.[2] Implementing software that communicates between the ME/C office and forensic crime labs can help streamline operations. This may provide value by

- Aggregating the workflow and data for a case in one place.
- Potentially eliminating needs for setting up interfacing capabilities between two systems.
- Enabling cost sharing for implementing, training on, and maintaining software.

For more information on selecting and implementing LIMS, which share many information management qualities as a CMS, consider the following FTCoE resources:

Landscape Study of Laboratory Information Management Systems for Forensic Crime Laboratories

Leveraging Laboratory Information Management Systems (LIMS) to Maintain Continuity of Operations: Lessons from the COVID-19 Pandemic

The Pinellas County Forensic Laboratory at the District Six Medical Examiner's Office decided to use a LIMS for both day-to-day forensic laboratory and ME/C case management operations because of the value of streamlining these data (mentioned in the case study below).

Despite these potential benefits, ME/C offices must consider some limitations of retrofitting LIMS software:

- Standalone COTS CMS will still need to be configured specifically to an office's needs but will likely require less effort to do so than that required for a LIMS.
- There may be some confusion or pushback from ME/C personnel with a LIMS, as the look and feel of the software will not be tailored to the workflow of MDIs and may require some additional training to implement.
- Some functionality in a LIMS, such as batch processing, is not applicable to death investigations and thus, do not add value.

When considering what type of CMS to implement for your agency, ensure you are looking holistically at your workflow and mapping the points of integration of activities and data outputs with the CMS. Consider the level of flexibility in the program to allow configuration and customization for an office's case management needs. Resources like time, manpower, and money should be allocated for this configuration process, and offices should recognize this process will not be a one-time activity but rather continuous as the needs of the ME/C personnel change.

> "We started with a forensic LIMS in 2018 and had to integrate ME/C case management into this. We wanted one system, not two systems having to talk to each other."
>
> —*Reta Newman, Laboratory Director, Pinellas County*

Managing cases through a LIMS enabled Pinellas County Forensic Laboratory to streamlining communications with their medical examiner office partners.

Reta Newman is the director of Pinellas County Forensic Laboratory at the District Six Medical Examiner's Office in Largo, Florida.

The Pinellas County Forensic Laboratory serves the District Six Medical Examiner's Office. In 2006, Pinellas County decided to replace their previously aging homegrown LIMS with a COTS. Given Pinellas County's need for the LIMS to also serve the role of ME/C case management, they chose JusticeTrax as their COTS system in 2018 largely because of the opportunity for configurability. Pinellas County began with implementing the LIMS functionality of the software and moved to ME/C CMS implementation in January 2021.

- **Connection between LIMS and CMS**—One of the most valuable features of this CMS is the ability to move information around automatically and allow multiple stakeholders to access different parts of the case all at the same time. When an investigator opens a case, they immediately get a case number and attach it to that case. From there, every piece of evidence (body, evidence at the scene, etc.) gets a barcode and can become associated with that case number. This information can then be retrieved by the Department of Vital Statistics, autopsy technicians, doctors, morticians, toxicologists, and others who have to interact with the system. Because the LIMS and CMS are connected, toxicology and identification reports can be transitioned seamlessly between the two systems, and stakeholders can search and query for data across both systems at the same time.

- **Configurabilit**y—One of the struggles that the department has had in retrofitting this LIMS as a CMS is that names and files are not standardized to match the terms and file names that ME/Cs would prefer to use. This has been fixed through the configurability features that JusticeTrax offers within its platform. The county has been able to consolidate several bits of information into a single tab and "rewrite" forms to best match the terminology used by medical examiners.

Ms. Newman advised that ME/C offices need to consider having an internal technical support champion for the CMS. For Pinellas County, IT services are provided by JusticeTrax for the maintenance and customization of the software, but Ms. Newman emphasized the importance of having an internal stakeholder to know the ins and outs of the software for daily trouble shooting, configuration, and training of other staff members.

Key Lessons Learned:

1. Retrofitting a LIMS for ME/C CMS needs may be helpful for offices with in-house laboratory services.
2. If choosing to retrofit a LIMS for CMS, ensure the software has enough configurability opportunity to meet the needs of an MDI workflow.
3. Internal technical support is crucial for maintenance of a CMS.

The NIJ Forensic Technology Center of Excellence

RTI International (RTI) and its academic and community based-consortium of partnerships, including its Forensic Science Education Programs Accreditation Commission partners, work to meet all tasks and objectives put forward under the National Institute of Justice (NIJ) Forensic Technology Center of Excellence (FTCoE) Cooperative Agreement (award number 2016-MU-BX-K110). These efforts include determining technology needs; developing technology program plans to address those needs; developing solutions; demonstrating, testing, evaluating, and adopting potential solutions into practice; developing and updating technology guidelines; and building capacity and conducting outreach. The FTCoE is led by RTI, a global research institute dedicated to improving the human condition by turning knowledge into practice. The FTCoE builds on RTI's expertise in forensic science, innovation, technology application, economics, data analytics, statistics, program evaluation, public health and information science.

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