
SCIENTIFIC WORKING GROUP FOR
MEDICOLEGAL DEATH INVESTIGATION

# Regional Medicolegal Autopsy and Death Investigation Centers
# -Construction, Staffing, and Costs-

## A Report and Recommendations
## Prepared by the System Infrastructure Committee of the
## Scientific Working Group on Medicolegal Death Investigation (SWGMDI)

### Executive Summary

Given the shortage of forensic pathologists and adequately equipped and staffed forensic autopsy facilities in the United States, a regional system of medicolegal autopsy and death investigation facilities might be an effective and efficient way of serving the needs for quality services in underserved areas of the United States. To this end, the National Research Council's (NRC) Report, *"Strengthening Forensic Science in the United States: A Path Forward"* recommended that funds be provided to build regional offices in areas of need. This report presents information that would be helpful in establishing and maintaining regional facilities: formulas for predicting facility size, construction costs, personnel needs, and ongoing costs based on a population-based model; minimum population catchment areas; and maximum feasible distances for transporting deceased bodies to regional facilities. The recommendations may be useful to jurisdictions that are considering the construction of regional medicolegal death investigation/autopsy centers in the United States. In short, this report focuses on details about construction, staffing, and ongoing operational costs, *not* on where such facilities should be located. The locations where regional centers are needed will be the subject of other Scientific Working Group on Medicolegal Death Investigation (SWGMDI) studies and reports.

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## INTRODUCTION

Recommendation 11a of the National Research Council (NRC) Report, *"Strengthening Forensic Science in the United States: A Path Forward"* is that funds be provided to build regional medical examiner offices (1). As a follow up to that recommendation, the Scientific Working Group on Medicolegal Death Investigation (SWGMDI) identified the perceived need for regional centers in the United States and indicated in that report that much more study is needed to determine where such centers should be located (2). Subsequently, the SWGMDI Board directed its System Infrastructure Committee to identify infrastructure needs for establishing regional facilities, including personnel and support service needs. The Committee was also charged with developing a per capita formula for personnel needs in any medicolegal death investigation system. Although the locations where regional centers are truly needed will be the subject of another SWGMDI report, this report presents formulas for predicting facility size, construction costs, and personnel needs and costs based on a population-based model. A recommended minimum population catchment is also provided, as is a minimum per capita annual cost to operate the constructed facility.

## METHODS

The SWGMDI System Infrastructure Committee reviewed available recommendations, inspection and accreditation reports and data, and surveys concerning staffing and infrastructure for medicolegal death investigation systems, including the following:

- Historical staffing pattern recommendations previously published by the National Association of Medical Examiners (NAME) (3).
- NAME Inspection and Accreditation system data from 2012 regarding office-specific population based catchment areas, facility square footage, autopsy room square footage, autopsy rate per 1,000 population, and annual budget per capita.
- Data previously collected by NAME in 2001 similar in scope to the NAME Inspection and Accreditation data of 2012.
- A survey specifically conducted for this report of medical examiner/coroner offices that have been constructed within the past 15 years, including square footage construction costs and the cost of equipment contained in the physical plant that was included in initial construction costs.
- Accreditation processes and standards of the International Association of Coroners and Medical Examiners and Inspection and Accreditation Checklist of the National Association of Medical Examiners (4, 5).

The Committee also considered input from SWGMDI Board Members who work in medical examiner/coroner offices to obtain their experience and perspective on staffing and infrastructure needs to effectively run a medicolegal autopsy facility.

Because a recent SWGMDI survey found that most responders did not perceive a need for other crime lab services to be included in regional autopsy centers (2), this report focuses on regional medicolegal autopsy centers that would support autopsy performance, investigative and support staff, and histology services.

## FINDINGS

### *Population catchment area*

Review of NAME Inspection and Accreditation data and previously collected facility data shows that Medical Examiner/Coroner (ME/C) offices operating at an acceptable level of autopsy performance annually perform approximately one autopsy per 1,000 persons. NAME inspection data show an average autopsy rate for all offices of all types of 0.5 per 1,000, and facility surveys found 0.7 per 1,000 persons. An autopsy rate of 1 per 1,000 population might be considered as a best case scenario formula for ensuring that medicolegal autopsies are performed in numbers that meet public health, public safety, justice system, medical quality assurance, and other needs. Thus, the SWGMDI regards an estimated autopsy rate of 1 per 1,000 population as one that can provide optimal benefit for all users and a target around which to plan. The NAME Accreditation criteria require that no forensic pathologist be required to perform more than 250 autopsies per year (5). Combining these data and criteria suggests that one forensic pathologist should be available for every 250,000 persons in a given jurisdiction. To provide adequate backup and coverage for off days for the office's jurisdiction and consultation, as needed, with a professional colleague, the Infrastructure Committee finds that each regional medicolegal autopsy facility should have a minimum of two forensic pathologists. Thus, to ensure efficient use of forensic pathologists, the Committee recommends a *minimum population catchment area of 500,000 population*, recognizing that smaller population catchment areas may be needed in some places when all factors such as death rate, travel distances, travel times, and other factors are considered.

### *Geographic catchment area*

Because body transport from the location of death to a jurisdiction's autopsy facility imposes costs on both the death investigation system and on families who may be charged for transport by funeral service providers, minimizing the distances that bodies must be transported helps to reduce costs. A recent survey of state medical examiner offices found that the maximum distance for transporting bodies ranged from 50 to 1,200 miles with an average (excluding the 1,200 outlier) of 211 miles (6). A very recent on-line survey of medical examiners and coroners conducted specifically for this report showed that body transport costs averaged $170 per case when a flat rate was paid, and $128 plus $1.47 per mile when a basic rate plus per mile fee was utilized (7). In many jurisdictions, one-way transport of a body may require up to 3 to 4 hours. Thus, costs for mileage and personnel time can be significant, and delays in the timeliness of autopsies resulting from lengthy transportation times can have an adverse impact on autopsy interpretations. Further, if medicolegal death investigators were to work in a regional center and need to travel to death scenes to conduct their investigations, travel distances would need to be

reasonable so that scene investigations were not discouraged. To address these considerations, the Infrastructure Committee recommends that transport distances exceed 100 miles in no more than 10% of cases. For example, in catchment areas containing a central, more densely populated area, it may be acceptable to have a larger catchment area maximum transport distance if the number of cases from outlying areas is relatively small and infrequent.

***Staffing***

The NAME's original Inspection and Accreditation Standards recommended that staffing be based on the number of autopsies performed annually, which in turn is based on population (3). For an office performing 1,000 autopsies per year, which would typically cover a population base of about 1 million persons, NAME recommended the following staffing:

| | |
|---|---|
| Chief Medical Examiner | 1 |
| Staff forensic pathologist | 5 |
| Autopsy assistant (Includes 2 photographers) | 7 |
| Histologist | 1 |
| Chief Investigator | 1 |
| Investigator | 8 |
| Reception/Administrative/Clerical | 9 |
| Security and Attendant | 6 |
| Custodial | 2 |
| Total | 40 |

One of the authors of this report (RH) works in the Fulton County (GA) Medical Examiner's (FCME) office that serves a population base of approximately 1 million, and the office's staffing pattern is almost identical to the recommendation above with slightly fewer employees (n=36). There are no significant shortages in personnel, caseloads meet NAME Inspection and Accreditation requirements, and the office complies with the NAME's Forensic Autopsy Performance Standards and the National Institute of Justice's Guidelines for the Death Scene Investigator (5, 8). The investigators work from the office, staff it 24/7/365, and respond to death scenes as needed. Autopsies are conducted 7 days a week, and there is always at least one security person or morgue attendant on the premises. One histologist can adequately manage the case load using a policy that tissues are processed to blocks in all autopsy cases and to glass slides when microscopy is needed. Staffing patterns in other accredited medical examiner and coroner offices are similar. Thus, the Infrastructure Committee recommends a *staffing pattern for regional offices similar to that in the older NAME accreditation standards, with approximately 35-40 employees per million persons.* Additional staff would be required if other lab services were provided by a regional office, such as toxicological analyses, fingerprinting, DNA profiling, trace evidence examination, drug identification, digital evidence analysis, arson evidence analysis, and firearms and ballistics investigations.

Some of the positions listed above would probably increase linearly as the population served increases (along with autopsies) such as forensic pathologist positions, while others might not

(such as Chief ME or Chief Investigator). Such facts should be kept in mind when staffing levels are planned.

***Funding***

NAME surveys conducted in 2001 found the following annual per capita funding levels for county and state medical examiner systems (9, 10):

| Type of System | Average annual funding per capita | Range of annual funding per capita |
|---|---|---|
| County medical examiner systems | $2.16 | $0.62 to $5.54 |
| State medical examiner systems | $1.41 | $0.34 to $3.20 |

The survey, however, included medical examiner offices that were well funded and others that had marginal or insufficient funding. Furthermore, some of the surveyed offices provided only basic death investigation services, while others had laboratories and provided a greater scope of services. In 2012, the average annual funding level was $3.79 per capita for 31 NAME-accredited offices that reported adequate or more than adequate facilities and staffing. Nineteen of these offices were county-based, and the remainder were regional or state offices.

Returning to the FCME office example, its 2012 budget was $3,784,793 or $3.78 per capita, which is well within the range shown above and almost identical to the average funding level reported in 2012. Fulton County's personnel costs including salaries, benefits, insurance, and pensions accounted for 80% of the office's total annual budget, a situation not unusual among government funded ME/C offices. Thus, a funding level of $3.78 per capita enables this office to provide basic death investigation and pathology services, histology services, body transport services, and other operational services that meet NAME Accreditation and other professional guidelines and standards.

Based on the above analysis, the Infrastructure Committee recommends minimum annual funding of $3.75 per capita for the operation of regional medicolegal autopsy and death investigation centers that would include investigative, autopsy, histological, body transport, and basic radiographic services. The per capita funding level would need to be adjusted upward if more comprehensive services were included.

***Facilities***

*Facility and Autopsy Room Square footage*

In 2001, data from 140 ME Offices, which covered 151,500,890 of the US population, showed that the average total facility and autopsy room square footage per thousand population were 12.7 (range: 0.2 to 140; median: 10) and 2.7 (range: 0.1 to 18.4; median: 2.1), respectively. These older data suggest that a regional facility serving a population of 500,000 should have a total area of about 6,350 square feet and about 1,350 square feet of autopsy room area.

In 2012, the average area for the total facility and autopsy areas were 19.5 square feet and 2.7 square feet per 1,000 population, respectively, for 31 NAME-accredited offices that reported adequate or more than adequate facility space. Thus, current data on average show greater total facility sizes but identical amounts of autopsy room space. These newer averages suggest that a

regional facility serving a population of 500,000 should have a total area of about 9,750 square feet and about 1,350 square feet of autopsy room area. It would be wise to build in additional space that might eventually accommodate installation of newer imaging equipment such as CT and MRI scanners. Plans should include enough space to accommodate future need, realizing that many public office spaces are built to last for a 25 to 30 year period.

Facilities should also be of adequate size to ensure that space exists to perform needed functions and that accreditation capability is not put at risk because of inadequate facility size.

*Autopsy Tables and Body Storage*
Review of 2001 data from 154 ME offices, which covered 161,408,392 of the US Population, showed that the average number of autopsy stations and bodies that could be stored was 5 (range: 0.5 to 60; median: 4) and 42 (range: 1 to 250; median: 28) per million population, respectively. These averages suggest that a regional facility serving a population of 500,000 should have 2-3 autopsy stations and storage space for approximately 20 bodies.

***Construction Costs***
An online survey of NAME members provided the following construction costs per square foot for 10 medical examiner facilities built since 1997: median: $371; mean: $345; range: $110 - $474.[1] The three facilities with the highest costs per square foot include more equipment and services, such as additional forensic laboratories and CT-scanners with specialized rooms for the scanners, than the basic medicolegal death investigation facility. The average construction cost for the seven more basic facilities was $340 per square foot. Construction costs will vary regionally depending on the local economy and other factors such as building codes that have to do with appearances of buildings and special considerations related to the environment, such as earthquake and high wind risks. Further, the cost of land may need to be considered as a separate budget item over and above basic construction costs for the physical facility and its contents.

## RECOMMENDATIONS

Based upon the above considerations and other information, a summary of recommendations has been developed for regional medicolegal autopsy centers that could be designed to house basic medicolegal death investigation and autopsy services including histology.

1) The minimum population catchment areas should be targeted at 500,000 unless the geography or square mileage of the area makes a 500,000 population catchment area impractical, in which case smaller population catchment areas should be considered.
2) Centers should be located in areas, when feasible, so that body transport distances do not exceed 100 miles in more than 10% of cases.
3) For a center serving 500,000 population: Minimum square footage of the facility should be 9,750 square feet with a minimum autopsy room area of 1,350 square feet and having at least 3 autopsy tables and body storage capacity of at least 20.

[1] The centers that provided information on construction costs and the year in which they were constructed are Fulton County, GA (1999); Cuyahoga County, OH (1999); Collier County, FL (1998); Macomb County, MI (2008); Anoka County, MN (2008); Orlando, FL (2009); Albuquerque, NM (2010); Baltimore, MD (2010); University of North Dakota, Grand Forks, ND (2011); and West Tennessee, Memphis, TN (2012).

4) Ideally, all newly constructed facilities should have at least two buildings, when feasible, with separate HVAC and air handling equipment, one building for office space and the other for performance of autopsies, body storage, and histology services. One building can suffice if air handling and other design features ensure mitigation of possible biosafety hazards.
5) If there are two buildings, the main building should have office space for forensic pathologists, investigators, administrative, reception, and clerical staff; conference space for quality assurance activities and meetings with clients/users; a suitable private room for meeting with families; and a records storage area.
6) If there are two buildings, the autopsy building should have space for the autopsy room, body storage, x-ray performance and development, photographers, forensic autopsy assistants, the histology lab, tissue procurement area, and evidence processing and storage. Space should be built suitable for installing a CT and/or MRI scanner as these become more available and affordable. Tissue procurement organizations should be consulted when planning any tissue procurement area.
7) Autopsy areas should have ceiling to floor air flow, negative pressure, a minimum air exchange rate of 12 per hour, and at least one ventilated hood.
8) Specimen storage cabinets should be ventilated to the outside.
9) Design plans should be calculated on an estimated construction cost of about $350 per square foot, including the equipment installed. For a minimum size regional center serving 500,000 population, estimated construction costs should be about $3,412,000.
10) Generic formulas should be used to assist in planning. The formulas to assess ***minimum*** requirements are shown in the table on the next page.

| **Parameter** | **Formula** |
|---|---|
| Facility space | 19.5 sq. ft. per 1,000 population |
| Autopsy room space | 2.7 sq. ft. per 1,000 population |
| Body storage capacity | 0.042 bodies per 1,000 population |
| Number of autopsy stations | 0.005 per 1,000 population |
| Number of expected autopsies | 1 per 1,000 population |
| Number of forensic pathologists | 6 per 1,000 expected autopsies (includes one Chief) |
| Number of investigators | 9 per 1,000 autopsies (includes one Chief) |
| Number of autopsy assistants | 7 per 1,000 autopsies (includes photographers) |
| Number of histologists | 1 per 1,000 autopsies |
| Number of security and attendant personnel | 6 per 1,000 autopsies |
| Number of reception/administrative/clerical/custodial personnel | 11 per 1,000 autopsies |
| Total number of employees | 38 per 1,000 autopsies |
| Annual budget | $3.75 per capita |
| Personnel costs | 80% of annual budget |
| Operation costs | 20% of annual budget |
| Minimum construction cost | $350 per sq. ft. |

Regardless of size, construction and planning must be of a nature that the following are also given due consideration:

- Requirements for biosafety must be met
- Facility security
- Case information and management data system with security and back-up
- Emergency power availability
- Showers and locker room with changing areas
- Biohazard and medical waste disposal policies and procedures
- Laundry facilities or services
- Storage areas and inventory system for consumable supplies
- Disaster plan with a business continuity plan to ensure continuation of services if the facility must be closed or is non-operational

## COMMENTS

Although a separate SWGMDI report addresses possible locations of regional centers, two comments from that report are worth repeating here. First, where appropriate, consideration should be given to a regional center serving contiguous populations in adjacent states. Second, there are some existing medicolegal autopsy centers that currently do not function as regional centers but could formally function in such a way without building a new facility. The SWGMDI has assembled a comprehensive list of medicolegal autopsy centers in the United States, and further work is needed to identify potential opportunities for evolution of some of them into regional centers (2, 11).

If the federal government were to provide construction grants to states needing new regional facilities at an estimated cost of $3,412,500 per center, and if the previous SWGMDI study identifying a perceived need of 46 regional centers in the United States is anywhere near the real need, an estimated minimum total of $156,975,000 would be required to construct the needed facilities throughout the United States. That estimate is based on the assumption that all regional centers would be of minimum size and would each serve a population of approximately 500,000. The total cost estimate is also based on construction of 46 centers that are perceived as being needed, but some of which may not be needed or practical. Further study is needed to identify where regional centers are truly needed and what their size would need to be in each location in order to better estimate construction costs for individual facilities.

To date, the SWGMDI has reported on the *perceived* need for regional centers and has made no recommendations about where such centers should actually be located. The principles outlined in this document are generic planning guides and are independent of where regional centers would be located. The SWGMDI fully understands that the generic guides may need to be modified to fit a specific locale, such as establishing a smaller or larger population catchment area or a smaller or larger geographic area to be served. It is for such reasons that further state-specific study will be needed. The SWGMDI has an ongoing project to better identify areas that may be underserved in terms of quality medicolegal autopsy and death investigation centers.

Within the death investigation community itself, there may be some resistance to the development of regional centers for reasons including, but not limited to, a fear of reduced income, increased workload, or loss of local influence and control. Another problem is that some systems that are marginally operating may incorrectly view themselves as being in no need of improvement. For example, a system may be "getting by" by performing many external exams, or not doing examinations at all in some cases when, in fact, they should probably be doing complete autopsies in more cases or examining more bodies. These are issues that will need study at the state and local levels to assess compliance with professional standards, the actual quality and scope of work in the contexts of real need and best case scenarios, and other issues such as those mentioned above.

The concept of regional centers is applicable whether the existing system is medical examiner or coroner. In either case, quality uniform investigations need to occur locally by trained and qualified people, and quality medicolegal autopsy services need to be available.

When the time comes to specifically identify places that may benefit from regional centers, numerous factors need to be considered. These factors include the possibility of decentralizing, consolidating, cooperating across state lines, turning existing non-regional facilities into regional ones, and other factors as outlined in this report.

## *APPENDIX 1: A Sample Facility*

The Fulton County Medical Examiner (FCME) serves a population of slightly more than 1 million, and each year processes about 2,400 death reports, performs about 1,000 autopsies, and conducts about 900 on-scene investigations.

The FCME facility was built in 1999 at a cost of $200 per square foot, including equipment. The facility consists of three separate buildings:

- One building houses office space for all administrative, clerical, investigative and medical staff, and several conference rooms.
- A second building includes the primary autopsy room (8 stations), a histology lab, an x-ray room, evidence storage and processing areas, a photography office, offices for forensic autopsy assistants, a laundry room, two large body cooler areas, the body receiving and release area, and a tissue procurement area.
- A third building has 2 autopsy stations, a body cooler area, a small anthropology workspace, and storage space for skeletonized remains. This building is used for decomposed, skeletonized, or other cases in which isolation is preferred.

Each building has its own HVAC system, and the buildings are connected by covered outside walkways. Autopsy areas have OSHA compliant ceiling to floor air flow, a minimum of 12 air exchanges per hour, and negative pressure relative to adjacent areas.

Construction was primarily with concrete block, decorative brick external façade, sheetrock walls, grid ceilings with drop-in tiles, epoxy resin floors in autopsy and related areas, and impermeable synthetic coverings on the walls of autopsy areas. Ample free parking is available for employees and visitors. The grounds are secured by fencing, controlled access gates, and video surveillance. The only laboratory is for histology services. All specimens for forensic analyses are sent to the state crime lab or to hospital or private laboratories.

Assuming a 4% annual inflation rate since construction, the estimated cost of building a similar facility today would be $11.8 million or $357 per square foot.

In 2012, the FCME office was fully accredited, operated in compliance with NAME and other professional guidelines and standards, and operated at $3.78 per capita annual budget.

For a hypothetical catchment area of 500,000 population, an analogous annual budget would amount to $1.9 million.

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**This document was approved for final publication by the SWGMDI Board on September 17, 2013. At that time, the SWGMDI Board Members were:**

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