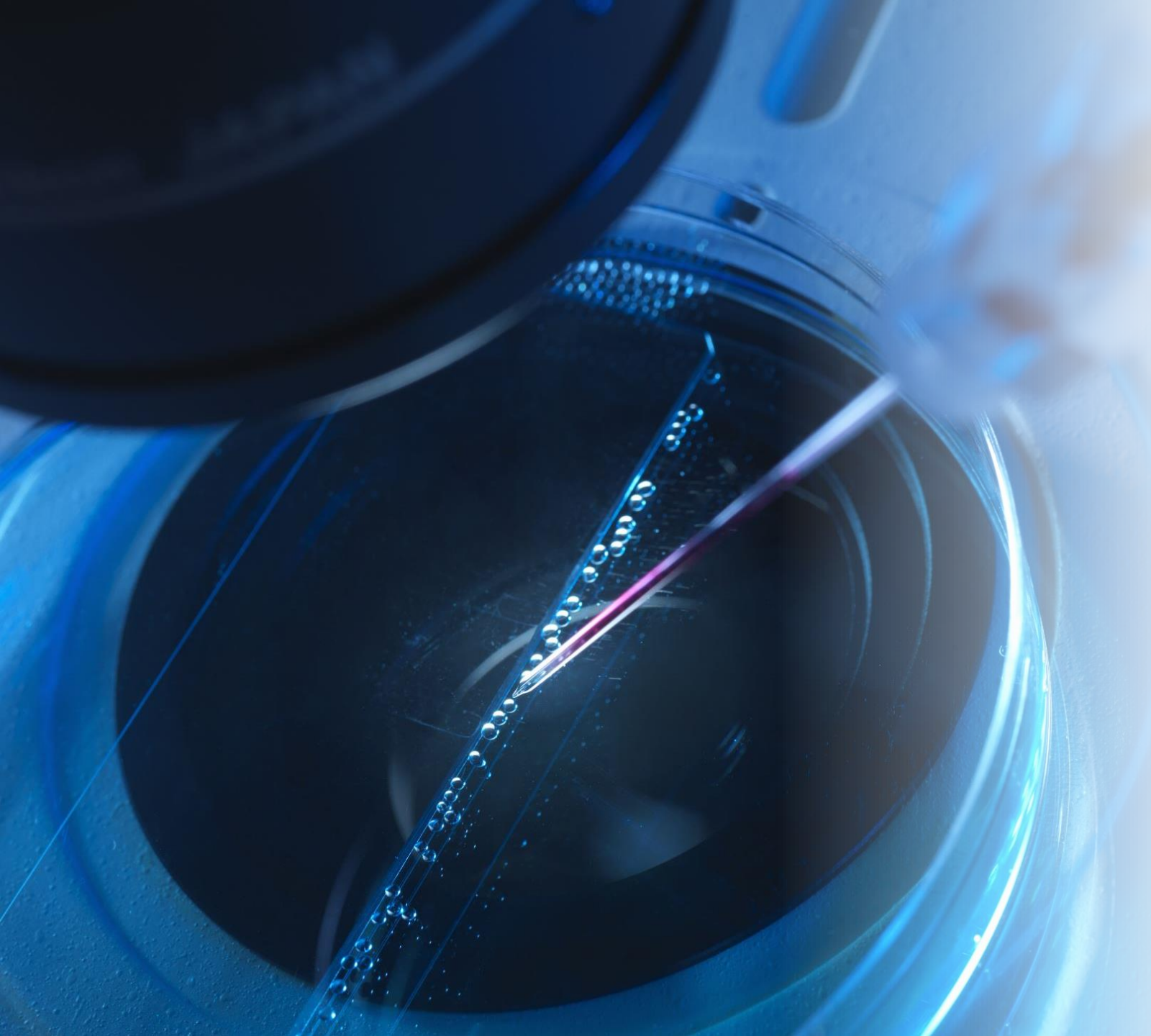
C27 Radiology's Role in Forensic Investigations

Objectives

Define forensic science in a diagnostic imaging environment

Discuss different modality roles in investigations

Understand the benefits of utilizing imaging over invasive biopsy



Thesis

The use of noninvasive imaging technologies in forensic investigations not only aids in establishing a clear cause of death but also ensures that vital forensic evidence remains intact for further analysis.

What is Forensic Science?

- Any science used for a court of law
- Used to resolve civil disputes, enforce criminal laws and government regulations, and protect public health
- Scientific professionals use their knowledge to conduct tests to assist lawyers and judges
- Find the truth and seek justice in legal cases

https://www.mtmi.net/webinar/forensic-radiology-part-1

Guidelines for Forensic Imaging

- Constantly evolving every day, diagnostic imaging procedures
- Challenges arise for many different factors
    - Legal
    - Ethical
    - Cultural
- Many countries have their own standards
- Imaging professionals required to increase knowledge of differences in anatomy and pathological changes
    - Increase/ decrease technique
    - Manipulation for proper positioning

Becoming a Forensic Imaging Technologist

Skills required:

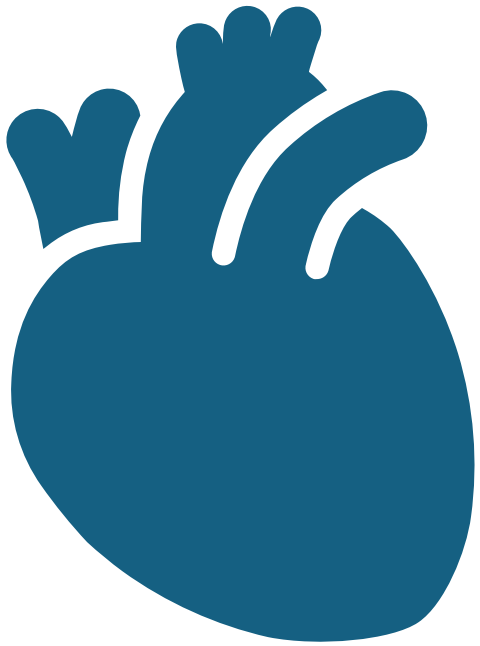
- An additional understanding of technical imaging skills
- Strong anatomy and physiology knowledge
- Carefully manipulate body without damaging evidence
- Excellent communication skills to professionally explain findings report to pathologists, law enforcement, and attorneys
- Emotional resilience in traumatic situations without allowing it to affect your work

Credentials required:

- ARRT in radiography
- ARRT in CT
- 2-3 trauma hospital experience
- Training through courses, workshops, and internships
- Apply for a job!

Post-Mortem X-ray

- First used in forensics and anthropology fields in 1896
- Used to locate fractures and foreign bodies including bullets
- The beginning of the cause
  - Finding the localized area
  - Better visualization of fragments
  - Other modalities show better detail, but streak artifacts are present



Limitations to X-rays

- Different projections are challenging due to rigor mortise
  - “Temporary stiffening of the cardiac and skeletal muscles that ensures shortly after death as the result of chemical changes within the muscular tissue” (Ladouceur 2024)
- No patient assistance
  - Positioning can be challenging to get proper positioning as the only form of patient movement comes from the technologists involved
- Manipulation of technique
  - Technique must be increased from 25-50%
  - X-ray tube must be manipulated and angled to achieve proper positioning

Post - Mortem CT (PMCT)

- Most common in post-mortem forensics
- Quick scans and optimal cross-sectional detail
- Used for patient identification and cause of death
  - Previous scans prior to death can be evaluated to compare bone structures
  - Old radiographs with fractures or abnormal findings
  - Not always accurate and can be very time consuming with the data in the system and possible matches
- Best used for lungs, heart, and abdomen
- Mobile CT scanners are brought directly to the site
- 3D reconstructions
  - Many causes of death are apparent, but 3D reconstructions can put the pieces back together for evidence purposes

https://www.clinicalradiologyonline.net/article/S0009-9260(08)00212-2/fulltext

PMCT cont.

- Cardiovascular issues are a common cause of sudden death
  - Traditional autopsy and post-mortem imaging delivers a static view of tissue, including coronary arteries, with PMCT angiography, but is limited to viewing a rupture or hemorrhage and cardiomyopathy (Morgan 2014)
- Chest CTs use ventilators to mimic inspiration
  - Best results are done within two hours of death
  - Visualization of lung pathology showing increased pulmonary ossification (livor mortis) can be mistaken for aspiration, pulmonary edema, or pneumonia (Morgan 2014)
- Better visualization of vessels and arteries, possible blockages, calcification or thrombus
- Inaccurate diagnosis due to poor circulation through the body
  - Questions arise if findings are due to cause of death or body decomposition

Post-Mortem MRI (PMRI)

- High visualization of soft tissue and organ pathology
- Uncommon due to high cost, time consumption, high contrast, and careful detail required
  - MRI contrast relies heavily on body temperature
- Mostly used on pediatric patients to avoid autopsies
  - 7 Tesla scanners will advance forensic imaging due to shorter time frame for images
  - Unfortunately, these are very high cost
  - Very beneficial for child abuse cases, showing subtle shearing injuries

PMRI cont.

- Most common MRI is the brain
  - “MRIs of fixed brain tissue can then be performed in order to complement the autopsy examination, and to provide a 3D image of the specimen to pathologists” (Kanawaku et al. 2014)
- Contrast levels are highly important to visibility of details
  - A study using mice brains showed a contrast mixture of formaldehyde and gadoteridol, which is used in MRI, resulted in a greater resolution of contrast of the brain
    - Mixture was able to penetrate deep into the brain tissue showing optimal detail
- Setback of cost and time steers medical professionals away, even with the results of the imaging diagnosis

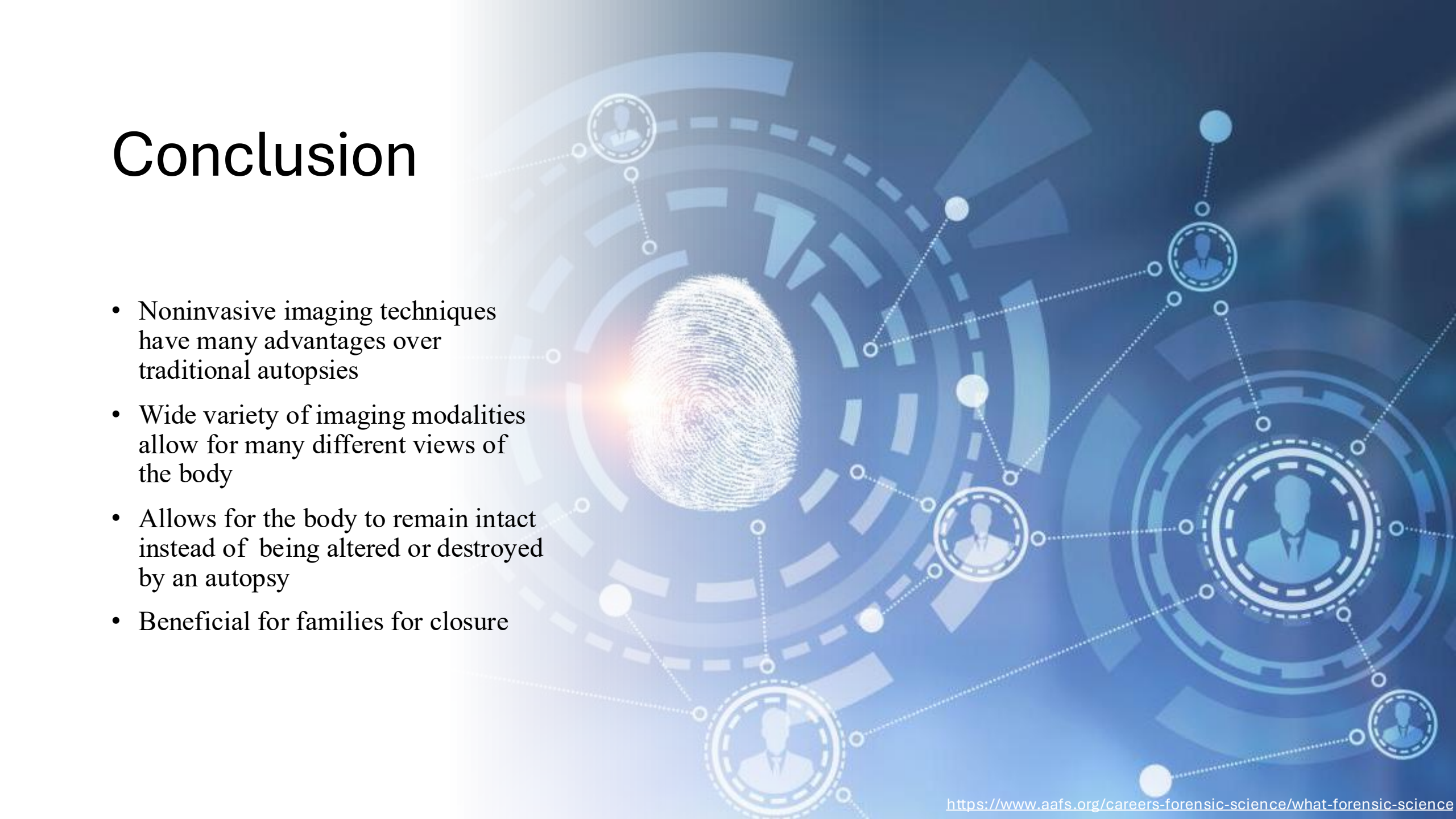
Benefits of Imaging Over Autopsies

- The best way to visual internal body without making unnecessary incisions
- Imaging results in seconds rather than hours or days
    - 2.9 million people in America die each year and about 500,000 of them receive post-mortem evaluation
- Better for meeting the needs of families
    - Some cultures are against autopsies
    - Families can learn more about their medical history and what to be cautious of in their own health

https://www.istockphoto.com/photos/forensic-scie

Conclusion

- Noninvasive imaging techniques have many advantages over traditional autopsies
- Wide variety of imaging modalities allow for many different views of the body
- Allows for the body to remain intact instead of being altered or destroyed by an autopsy
- Beneficial for families for closure



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