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## Forensic Pathologists as Expert Witnesses in Estimating Time of Death

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## I. **OVERVIEW**

The practice of determining time of death, specifically those in wrongful death or murder cases, has been an accepted form of expert witness testimony. Many, if not all courts have allowed pathologists testify as expert witnesses in trials. Though all forensic pathologists require the same schooling and board testing, the decision of who qualifies as an expert in determining time of death often falls into specific guidelines. Furthermore, while these individuals sit for the same board exam, due to the number of ways to determine time of death, most, if not all, forensic pathologists will tell you that determining the time of death of a victim is never completely accurate.<sup>1</sup> Judges, when allowing forensic pathologists to testify as expert witnesses as to a victim's time of death, should exercise caution in how strongly the jury will rely on their testimony and should require a thorough explanation as to how the determination was reached. Because forensic pathologists are highly trained and experienced scientists in their field, they should be qualified to testify as expert witnesses, but should always advise that their determinations are not concrete.

## II. **BECOMING A PATHOLOGIST**

A forensic pathologist is a certified pathologist who performs autopsies.<sup>2</sup> Autopsies are medical examinations that are performed following an unusual, violent, or untimely death.<sup>3</sup> To determine a time of death, a forensic pathologist who goes to the scene of death will examine the human remains. They will look at the conditions surrounding the body as well as heavily document the condition (including, but not limited to clothing and position) of the body upon

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<sup>1</sup> "Time of Death," World of Forensic Science. . *Encyclopedia.com*. 10 Apr. 2019 <<https://www.encyclopedia.com>>

<sup>2</sup> Crime Museum, LLC, *Forensic Pathologist*, 2017. <https://www.crimemuseum.org/crime-library/forensic-investigation/forensic-pathologist/>

<sup>3</sup> 4. S. Cordner & H. McKelvie, *Autopsy: Medicolegal Considerations, Including Organ Retention Handling*, 285 (Elsevier Ltd. 2<sup>nd</sup> ed. 2015).

discovery.<sup>4</sup> Forensic pathologists may also obtain written observations that include photographs from the scene of death, and the medical history of the deceased if they were not able to be present at the crime scene.<sup>5</sup> While this may seem simple, becoming a forensic pathologists takes years of schooling and training.

Due to this required knowledge and varied testing involved in pathology, individuals who want to become a forensic pathologist are required to go through rigid schooling as well as examinations. They are first required to obtain a bachelor's degree which can be done under any major, followed by applying to and being accepted into medical school where they are required to obtain a MD. Both of these schools require four years, but following graduating from medical school, these now doctors must perform a 3-4-year residency which must focus on pathology and forensic pathology. Following the required residency, anyone who wishes to become a pathologist must sit for a board examination to become a licensed pathologist and those who would like to hone in on specific skills such as Forensic Pathology must sit for another board exam or receive a certification.<sup>6</sup>

**a. American Board of Pathology Examination**

Those who want to become a forensic pathologist are required to endure more training than pathologists, to meet specific qualifications. While pathologists are generally disconnected from humans and involved in examining tissue and blood, forensic pathologists are tasked with performing similar testing, but their scope of investigation may expand to other bodily fluid and

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<sup>4</sup> Dr. D Rao, *Crime Scene*, Forensic Pathology Online, 2013. <http://www.forensicpathologyonline.com/e-book/crime-scene>

<sup>5</sup> Department of Justice, *Forensic Pathology Research and Development*, National Institute of Justice, 2019. <https://nij.gov/topics/forensics/evidence/pathology/pages/welcome.aspx>

<sup>6</sup> The American Board of Pathology, *Requirements for Certification*, 2015. Certified <https://www.abpath.org/index.php/to-become-certified>



all of their testing comes from the deceased.<sup>7</sup> Furthermore, while pathologists look for diseases, forensic pathologists look for disease, a cause of death, and of course time of death. In addition to the schooling that pathologists are required to take, those pursuing a job in the forensic pathology field must perform 4-5-years of training in anatomic, clinical and forensic pathology as well as a one-year residency in forensic pathology. It is only once this training and residency is met that a forensic pathologist may sit for and pass three board exams to become a board-certified forensic pathologist.<sup>8</sup>

The board that pathologists and forensic pathologists must sit for is the American Board of Pathology (ABP). In order to become certified to sit for the ABP, individuals must have obtained a full and unrestricted medical degree and the “applicant must have completed a graduate medical education program in pathology” by either the Accreditation Council for Graduate Medical Education. To ensure only qualified individuals are applying, the applicant must have proof of completing a required pathology training program which is to be verified by a program director.<sup>9</sup> Candidates who wish to sit for the forensic pathology board exam must have already obtained a certification from the ABP Board, must complete a minimum of two years of training in Anatomic Pathology or Clinical Pathology, and must have “completed 12 months of training in an ACGME (Accredited Council for Graduate Medical Education) accredited forensic pathology program.”<sup>10</sup>

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<sup>7</sup> Rickey Persson, *Types of Pathologist*, GapMedics, Oct. 8, 2014.

<https://www.gapmedics.com/blog/2014/10/08/types-of-pathologist/>

<sup>8</sup> Liaison, *Forensic Pathologist*, ExploreHealthCareers, 2018. <https://explorehealthcareers.org/career/forensic-science/forensic-pathologist/#academic>

<sup>9</sup> American Board of Pathology, *Primary and Subspecialty Certification*, ABPath, 2015. <https://www.abpath.org/index.php/to-become-certified/requirements-for-certification>

<sup>10</sup> *Id.*

Once applicants have qualified for the exam, they must sit for both the Anatomic Pathology exam as well as the Clinical Pathology exam. The exams are generally 326 questions over the course of three-portions. The exam is comprised of a 1.75 hour long written portion, 2.25 hour practical portion that includes images, and a 3.75 hour microscopic and virtual portion. The Anatomic Pathology exam is made up of questions related to organ systems as well as multi-system diseases.<sup>11</sup> The tests also consists of general pathology questions including things such as: cellular, physical, and chemical injury, congenital and genetic diseases, infections, and more.<sup>12</sup> Test takers are presented with questions specific to diseases, male and female specific questions, and surgical pathology, autopsy, cytology, and forensic pathology. Other pathological questions fall into categories such as hematopathology and molecular pathology, and cytopathology.<sup>13</sup> Finally, test takers will be presented with microscopic images (those in which they generally view under a microscope) of gross specimens, karyotypes, histopathologic specimens, and more.<sup>14</sup>

Once candidates have passed the Anatomic Pathology portion, they will have to take the Clinical Pathology exam. The questions in this exam focus on “blood banking and transfusion medicine, immunopathology, chemical pathology, hematopathology, and medical microbiology.”<sup>15</sup> Each of these sections is broken down into specific questions that focus on methods, preparations, techniques, and overall knowledge of disorders as well as the scientific

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<sup>11</sup> American Board of Pathology, *Primary Examinations: Anatomic Pathology Examination*, ABPath, 2015 <https://www.abpath.org/index.php/taking-an-examination/primary-certificate-requirements>

<sup>12</sup> *Id.*

<sup>13</sup> *Id.*

<sup>14</sup> *Id.*

<sup>15</sup> American Board of Pathology, *Primary Examinations, Clinical Pathology Examination*, ABPath, 2015 <https://www.abpath.org/index.php/taking-an-examination/primary-certificate-requirements>



workings of the human body.<sup>16</sup> For both the AP and CP exams about 85% of testers pass the exam on the first attempt while 25-34% pass the exam on the second attempt.<sup>17</sup>

Once the AP and CP exams are passed, those who wish to sit for the Forensic Pathology exam are required to answer an additional 305 questions, over the course of 7 hours. These questions are “designed to measure the candidate’s body of knowledge and problem-solving ability.”<sup>18</sup> A variety, but not all of the subjects that are tested on this exam are:<sup>19</sup>

- “Pathology and interpretation of natural disease, therapy, and trauma
- Interpretation of injury patterns and stigmata
- Pathology and certification of natural and violent deaths
- Interpretation of clinical and postmortem chemistries and toxicologies
- Molecular biology, forensic odontology, physical anthropology
- Criminalistics, public health, jurisprudence, management, and safety”

Though a variety of these subjects require interpretation, that interpretation comes from scientific studies done on the human body to make conclusions or estimations into specific questions such as time of death. While there are far fewer applicants who take the exam, about 91% of exam takers pass the first time and 75% pass on the second attempt.<sup>20</sup> Although these numbers are relatively high, the results may speak to the extensive schooling and training required prior to being qualified to even sit for one of the three exams.

### III. **ORGANIZATIONS AND INSTITUTIONS**

#### a. **American Society for Clinical Pathology (ASCP)**

American Society for Clinical Pathology was founded in 1922 to provide education, certification, and advocacy for patients, pathologists, and lab professionals. The ASCP base their

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<sup>16</sup> *Id.*

<sup>17</sup> See *Supra* Anatomic and Clinical Pathology Examinations

<sup>18</sup> American Board of Pathology, *Taking an Examination: Subspecialty Examinations, Forensic Pathology*, ABPath, 2015. <https://www.abpath.org/index.php/taking-an-examination/primary-certificate-requirements>

<sup>19</sup> *Id.*

<sup>20</sup> *Id.*

objectives on four pillars; knowledge, advancement, collaboration, and global community.<sup>21</sup> The goals of the ASCP are to obtain and provide knowledge is to do so through a learning experience through and a collaborative network of members, experts, tools, and systems. There are often live events as well as educational resources provided to assist in a variety of learning styles and to ensure that members are always at the forefront of the profession. The Society uses funding as well as financial reimbursement to advance the pathology community, address workforce shortages, and interpret the most recent regulatory actions. ASCP is able to do this by collaborating with other medical non-governmental organizations, government agencies, and other medical societies. This allows for an expansion of resources that are often required for any professional field to advance. Finally, ASCP works with other pathologists to conduct training sessions and workshops to assist in educating and accrediting professionals around the world.<sup>22</sup>

**b. National Institute of Justice (NIJ)**

Originally named, the National Institute of Law Enforcement and Criminal Justice, the National Institute of Justice was established in 1968 as an agency of the U.S. Department of Justice that conducts research, development, and evaluations.<sup>23</sup> While NIJ is dedicated to improving the understanding and knowledge of the science involved in crime and justice, the research has been greatly expanded to forensic pathology. To assist forensic pathologists, NIJ believes more research in the use of virtual autopsies is needed.<sup>24</sup> NIJ expects that this research will become a more concrete way of determining time of death than that of the traditional

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<sup>21</sup> American Society For Clinical Pathology, *About ASCP, Supporting Our Members*, ASCP, 2018.

<https://www.ascp.org/content/about-ascp/supporting-our-members>

<sup>22</sup> American Society for Clinical Pathology; *Diverse Members, Diverse Resources*, ASCP, 2018.

<https://www.ascp.org/content/about-ascp/supporting-our-members>

<sup>23</sup> Department of Justice, *About the National Institute of Justice*, NIJ, 2019.

<https://nij.gov/about/Pages/welcome.aspx>

<sup>24</sup> Department of Justice, *Forensic Pathology Research and Development*, NIJ, 2019.

<https://nij.gov/about/Pages/welcome.aspx>



autopsies. This Institute has begun funding of development and research into virtual autopsy tools as well as avid research to develop better methods in making a more accurate determination in time of death cases.<sup>25</sup>

In addition to the research and development, NIJ also allows for members to access works that have recently been published or sponsored by the Institute. While these may be helpful to the advancement in the field of forensic pathology, NIJ also offers training specified to lines of work associated with the Department of Justice. Though these vary from online courses to classroom courses, the workshops, training, and symposiums allow for improvement in the field, a better understanding of the science, and more accurate determinations.

**c. Body Farms and the Forensic Anthropology Center**

Body farms are research facilities, or outdoor laboratories, where decomposition of human remains can be studied in a variety of different settings.<sup>26</sup> The Forensic Anthropology Center, established in 1981 is the first and one of the view places you will find a body farm. The FAC's goal is to achieve excellence in research, training, and service in forensic related fields.<sup>27</sup> The farm is approximately 2.5 acres and is scattered with bodies that are placed in a range of scenarios to assist in stimulating crime scenes.<sup>28</sup> At FAC, as well as the other body farms, forensic scientists can study decomposition of the human body and how different factors have an effect on the timing of the decomposition.<sup>29</sup> Because the rate of decomposition and insect mutilation, as well as weather conditions is often associated with time of death determinations,

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<sup>25</sup> See *Supra*

<sup>26</sup> *Body Farms*, Wikipedia, Apr. 11, 2019. [https://en.wikipedia.org/wiki/Body\\_farm](https://en.wikipedia.org/wiki/Body_farm)

<sup>27</sup> Emily YaMei, *The Body Farm*, Atlas Obscura, 2019. <https://www.atlasobscura.com/places/the-body-farm-knoxville-tennessee>

<sup>28</sup> *Id.*

<sup>29</sup> Brad Jones, *Human "Body Farms: Can Lead to Breakthroughs in Forensic Science*, Getty (2017).



scientists are able to study these effects and gain a better understanding to assist in making more accurate estimations of time of death.<sup>30</sup>

Body farms have received criticism for a number of reasons, ranging from lowering property values to lack of effectiveness and insufficient use of bodies. While the former may be true, body farms are not being promoted as a hard science nor are they advertised as finding the solution to making an exact time of death determination. In fact, very few individuals are allowed to use these body farms and some are even off limits to tours or online tours.<sup>31</sup> These body farms simply allow for research and study programs of current and future forensic scientists to one day advance the current methods forensic pathologists are using to determine cause of death, time of death, and what effect environmental factors may have on the deceased.<sup>32</sup>

#### IV. **TIME OF DEATH**

In a court setting, time of death can be used to exonerate a defendant or place him at the crime scene. Forensic pathologists' testimony regarding time of death can either refute or substantiate defendant statements and is often extremely important in murder and beneficiary cases.<sup>33</sup> Time of death is often broken down into three categories. There is the psychological time of death which is the time at which the victim's vital functions stopped working, the legal time of death which is the time recorded on the death certificate, and the estimated time of death which is the time of which the pathologists or medical examiner has estimated the time of death occurred.<sup>34</sup> For the purpose of the court room, often the legal time of death as well as the estimated time of death are those of which are in dispute. The estimated time of death is

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<sup>30</sup> *Id.*

<sup>31</sup> *See Supra* YaMei

<sup>32</sup> *Id.*

<sup>33</sup> D.P Lyle, *Howdunit Forensic*, at Writer's Digest, 2008.

<sup>34</sup> *Id.*

questioned due to the impossibility of determining the exact moment a person has died without being present at the death.<sup>35</sup>

While an exact time of death is almost impossible to determine, forensic pathologists who have been trained and experienced can make a reasonable estimation using a variety of scientific methods. These methods take numerous factors into consideration such as time and biological or pathological changes that occur in the body following death.<sup>36</sup> Additionally, given the deceased is available for an autopsy, the forensic pathologist will collect measurements of the body, weight, and possibly clothing. There will also be photographs taken, x-rays performed, sample of hair and nails taken, and finally all orifices will be inspected.<sup>37</sup> The condition of the deceased will allow for some of these actions to be performed while others may not.

Though much of the process of estimating time of death is scientific, pathologists must also rely on information provided to them by homicide and forensic consultants, officers, and others who investigated the crime scene. These individuals generally provide pictures, reports, and observations to better assist the pathologists in making an estimation. This requires the forensic pathologist to not only have a strong scientific background but strong technical skills.

Time of death, while not always accurate, takes a fair amount of investigative work. Forensic pathologists must be well versed in the variety of ways to determine time of death as well as providing valid and scientific explanations on their discovery. Though time of death is controversial, the general modes of determination remain the common practice.

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<sup>35</sup> *Id.*

<sup>36</sup> Vernon J. Geberth, *Estimating the Time of Death in Practical Homicide Investigations*, 55 Law and Order Magazine 1, (2007).

<sup>37</sup> Samuel D Hodge, Nicole M. Saitta, *Behind the Closed Doors of the Coroner's Office-The Medical/Legal Secrets Involving an Autopsy*, 32 Temp. J. Sci. Tech. & Envtl. L. 1 (2013). [ARTICLE: Behind the Closed Doors of the Coroner's Office - The Medical/Legal Secrets Involving an Autopsy, 32 Temp. J. Sci. Tech. & Envtl. L. 1](#) Orifice or body orifices are the openings of the body. These are typically the eyes, the mouth, the ears, and the nostrils.



V. **MODES OF DETERMINING TIME OF DEATH**

The most common ways of determining time of death involve looking to the changes in the body. This ranges from the coloring of the skin to insects that may be present in or on the body at the time of discovery. Each mode of determination, though different, uses different scientific methods and steps that forensic pathologists must be well versed in. These common practices assist in alleviating some of the variation seen in different estimations and assist court rooms in understanding findings.

a. **Decomposition**

Decomposition of the human body begins immediately following the occurrence of death. This process however is often broken down into five stages, all divided into categories based on the potential number of days the victim has been deceased.<sup>38</sup> The first stage, known as the flesh stage, begins at the time the victim has died and lasts until about the second day. During this time the cells are being deprived of oxygen, the normal pH balance of the human body begins to change, and flies begin to be attracted to the deceased.<sup>39</sup> This is when the process of autolysis begins. During autolysis, cells begin to break down which releases enzymes into the body further breaking down cells as well as tissue.<sup>40</sup> The first two days of decomposition is also when a variety of other conditions begin to occur which pathologists can use to determine time of death. These involve things such as rigor mortis, algor mortis, and forensic entomology which will all be discussed below.

The next stage, often referred to as the bloated stage, begins the second day of death and lasts for about four days. If the victim is discovered during this time, a forensic pathologist will find

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<sup>38</sup> The Forensics Library: *Decomposition*, AboutForensics, 2018. <https://aboutforensics.co.uk/decomposition/>

<sup>39</sup> Lee Goff M. *Early Post-Mortem Changes and Stages of Decomposition in Exposed Cadavers*, 21-36 (Exp. Appl. Acarol. 49, 2009).

<sup>40</sup> *Id.* at 21-36.

the first outward signs of decomposition. The body will begin to build up gases that are produced from bacteria in the body, which results in an inflated abdomen. The tongue and eyes will also begin to protrude from a similar build-up of gases. Finally, the skin color will begin to change, and blood bubbles may form at openings such as eyes, nostrils, mouth, and ears.<sup>41</sup> These significant changes lead to the next stage in decomposition.

The decay stage, or the third stage, begins on day 5 and lasts until about day 11. The inflation in the abdomen begins to deflate and the internal gases begin to release. Tissues continue to break down, leading to the corpse appearing wet and odors becoming more noticeable.<sup>42</sup> A variety of new insects may start to become attracted to the victim and the bodily fluids will begin to drain from the deceased in the same areas the blood bubbles occurred. Finally, during the third stage internal organs will begin to decompose beginning with the intestines and ending with either the prostate or the uterus.<sup>43</sup>

The last two stages are referred to as the post-decay stage and the dry stage. The post-decay stage goes from day 11 until 24 and the dry stage begins on day 24 and lasts until the body is either discovered or skeleton remains. During post-decay, decomposition begins to slow down, most of the flesh from the deceased has been removed from the skeleton, and odors begin to subside. During the last stage, forensic pathologists are generally left with the bones of the deceased, dried skin, and dried cartilage.<sup>44</sup> Bodies discovered at this point often make it much more difficult, if not impossible to make an accurate estimation of time of death.

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<sup>41</sup> *Id.* at 24.

<sup>42</sup> *Id.* at 37

<sup>43</sup> *Id.* at 30. *See also* 3 Takatori, T. *The mechanism of Human Adipocere Formation*, 193-204 (Legal Medicine 2001)

<sup>44</sup> *Id.* at 31.



The stages of decomposition are not the only indications forensic pathologists use to determine time of death. If the deceased is found to be mutilated or only the skeleton remains, the forensic pathologist will attempt to put the body back together and describe the coloring of the bones and skin. Once this is done, the forensic pathologist can then look to the texture of the skin (e.g., waxy or oily) to assist in defining the stage of decomposition the body is in.<sup>45</sup> Furthermore, in practice, the forensic pathologists will determine the outside conditions, such as the environment, to assist in determining the stage of decomposition. For example, if the body is found in a wooded and moist area, the color of the skin as well as the rate of decomposition may have occurred faster than someone who was found in moderate temperatures and not exposed to rain or a variety of animals. Because the stages of decomposition vary so greatly in terms of days, forensic pathologists will use their observations to give an estimation as to a number of days instead of a number of hours. Though difficult, this is especially helpful in missing person cases where the last known location of a victim may have been, but no DNA evidence is available. Those who are testifying as to the time of death will often preset this information to the courtroom to support how and why they've made such determinations. While decomposition is a long process, every mode of science used to determine time of death takes place during decomposition.

**b. Algor Mortis**

Algor mortis is the loss or increase of body heat until the body temperature reaches that of the surrounding environmental temperature. On average, the body loses 1.4° F every hour

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<sup>45</sup> See *Supra* Rao

following death; however, depending on the environmental conditions this can vary greatly.<sup>46</sup>

For instance, if someone has died in Florida in June, it is likely the body temperature will decrease (if at all) less rapidly than someone who has died in a snow bank in Alaska.

Additionally, if the temperatures in the environment vary greatly the estimation of time of death may be much more difficult to assess.<sup>47</sup> There are a variety of other things that will determine how fast or slow the body loses heat or heats up. These are things such as the thickness of clothing, drugs that the deceased may have taken, weather conditions such as rain and snow, and a variety of other intrinsic factors.

When determining time of death, the forensic pathologists will use a variety of equations. They will first begin with the standard body temperature which is 98.6°F and take the current body temperature. This will give the forensic pathologist the amount of body temperature that was lost at the time of discovery. They will then use the amount of body temperature lost to determine the number of hours that the victim has been deceased. However, depending on the amount lost, additional equations are required to be performed to get an estimation as to the number of hours a victim has been dead.<sup>48</sup> Once again, the forensic pathologist performing the tests will consider the environment the individual was found in and calculate the outside temperature appropriately. With this information, the forensic pathologist is able to explain the method used and show the equations performed to lead them to their estimation. While there is a scientific role in determining the body temperature at the time of the autopsy, this cannot be the only assessment used to determine time of death.<sup>49</sup>

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<sup>46</sup> Steven A. Koehler, *Estimating Time of Death from Postmortem Changes: Forensic Sciences* § 25B.07 (2019)

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

<sup>49</sup> Mahak Jalan, *What are the 4 Postmortem Stages of Death*, ScienceABC (2018).

<https://www.scienceabc.com/humans/post-mortemstages-of-death-different-stages-the-body-goes-through-after-death.html>



**c. Rigor Mortis**

Following death, the muscles of a corpse become weak and the body begins to stiffen. Because energy is required to keep the muscles functioning appropriately – muscles form bonds to contract and break bonds to relax – when a person dies, their respiration ceases, and muscles can no longer contract and relax. The weakened muscles contract to this stiffened position and will stay there for some time. This process is known as rigor mortis.<sup>50</sup> Rigor mortis normally begins with smaller muscles, such as the face and works its way through the larger muscles.<sup>51</sup> Forensic pathologists who are examining the deceased individual who is in rigor mortis, they will note what stage of rigor the body is in. These stages vary depending on the stiffness of the muscle.<sup>52</sup> One of the most common indicators that a body is in rigor mortis is the stiffness of the body, especially those holding unusual positions.<sup>53</sup> For instance, if a person dies gripping their fists, it would be common for the body to remain, and stiffen in this position for some time after death. This entire process starts within two hours of death and can be completed within 8 hours; however, the science varies, there have been studies that estimate rigor mortis lasting between 18- and 48-hours following death. Once the muscles decompose, which can be dependent on the environmental factors, rigor mortis ends.<sup>54</sup>

To determine time of death through rigor mortis, forensic pathologists may perform flexibility tests.<sup>55</sup> Once these are done, the forensic pathologist will often present evidence of the degree of muscle a person may possess. Those who are stronger may take longer to enter rigor

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<sup>50</sup> *Id.* Mahak

<sup>51</sup> *Id.* Mahak

<sup>52</sup> Admin, *Rigor Mortis*, Facts.net, Oct. 17, 2019. <https://facts.net/rigor-mortis/>

<sup>53</sup> *Id.*

<sup>54</sup> *See Supra* Mahak

<sup>55</sup> Burbrink, Donald et. al, *Conducting Scene Investigations*, 157 CDC  
[https://www.cdc.gov/sids/pdf/suidmanual/Chapter6\\_tag\\_508.pdf](https://www.cdc.gov/sids/pdf/suidmanual/Chapter6_tag_508.pdf)

mortis due to the size of their muscles, while those who have weak or smaller muscles may enter rigor mortis more quickly.<sup>56</sup> Based on this information as well as the known average hours rigor mortis takes to set in as well as how long it lasts, forensic pathologists can provide a potential timeline as to when the victim passed. Though rigor mortis can assist in determining time of death due to environmental factors, movement of the body, and the composition of the specific human body, rigor mortis is difficult to use to determine an accurate time of death.<sup>57</sup>

#### **d. Livor Mortis/Lividity**

Livor mortis is also referred to as lividity, hypostasis, or the final stage of death.<sup>58</sup> When a person's heart stops beating, blood will flow following gravity and will collect at the lowest or dependent part of the body. While this occurs normally within 1 or 2 hours, it may vary based on the clothing the person was wearing, how the person died, the position they were in at the time of death, or if they were moved following their death.<sup>59</sup> At the beginning stage of livor mortis the discoloration that occurs is temporary and will change if the body moves. About 9 hours after livor mortis has set in, the discoloration becomes permanent, thus making it much more difficult to make an accurate estimation of the time of death following this time.<sup>60</sup>

When determining time of death and presenting this information to a jury, forensic pathologists will make note of the position of the body and where the coloration has fallen. For example, if the coloration has become permanent but has settled in the body in the opposite direction of gravity, a forensic pathologist will be able to determine at least how long the person

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<sup>56</sup> 9, Kori Shivpoojan *Time Since Death from Rigor Mortis; Forensic Prospective*, 002, J. Forensic Sci. & Crim. Inves. (JP, 2018).

<sup>57</sup> See *Supra* Mahak

<sup>58</sup> Mahak Jalan, *What are the 4 Postmortem Stages of Death*, ScienceABC (2018).

<https://www.scienceabc.com/humans/post-mortemstages-of-death-different-stages-the-body-goes-through-after-death.html>

<sup>59</sup> *Id.* Mahak

<sup>60</sup> See *Supra*. Koehler



has been dead and if they've been moved. Due to the how quickly livor mortis sets in, in combination with other modes of determining time of death will give the forensic pathologist a more accurate estimation.

**e. Stomach Contents**

Stomach contents provide a great insight into the time at which someone died. Once a person has died, digestion stops because the peristaltic movement (the contracting and releasing of the stomach) needed to work with enzymes and acids is no longer present.<sup>61</sup> Depending on the size and the nature of the last food consumed, ingested foods will remain in the stomach for different periods of time. Under common circumstances (those who are alive) the stomach will empty its contents 4 to 6 hours after a meal giving the forensic pathologist the ability to make an estimation of time of death. However, the type of food, amount of food consumed, and the metabolism of the deceased will all likely have an effect on digestion and therefore can complicate such estimations.<sup>62</sup> For instance, because the stomach begins to empty within ten minutes after your first bite of food, the majority of the meal will likely take 2 hours to leave the stomach. On the other hand, a smaller meal can take between ½ hour to 2 hours, an average sized meal can take between 3 and 4 hours, and a heavy meal can take as long as 6 hours to leave the stomach.

The size of the meal is not the only contributing factor, in fact things such as carbohydrates, proteins, and fats will also assist in the rate at which food is digested. Carbohydrates are normally the first to be digested followed by proteins and then fats. Liquids, depending on the type of liquid, generally leave the body at about a 2-hour rate. Thus, depending on the size of the

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<sup>61</sup> Manpreet Kaul, et al., *Digestive Status of Stomach Contents – An Indicator of Time Since Death*, 16 IOSR-JDMS at 26, 34 (2017).

<sup>62</sup> *Id.* at 27

meal and the type of food found in the stomach of the deceased, a forensic pathologist can make an estimation into the time of death.

If the stomach is empty, death likely took place at least 4-8 hours after the last meal was consumed, a semi-digested meal found in the stomach means the deceased likely ate their last meal anywhere between 2-6 hours before they died, and if the stomach content is undigested, death likely occurred within 1-2 hours of the last meal.<sup>63</sup> While this seems like a sound science, things such as meats, green vegetables and root vegetables are unrecognizable in the stomach after 4 hours making it more difficult to determine the type of food in the stomach and thus more difficult to get an a clear estimation. Though stomach contents cannot give an absolute certain time of death conclusion, they do require a great deal of science and assist in getting that much closer to knowing when the victim died.

**f. Putrefaction**

Putrefaction is part of decomposition and has three characteristics; “discoloration – changes in the color of the tissues, disfiguration – the evolution of gases in the tissues, and dissolution – the liquefaction of tissues.”<sup>64</sup> Just like decomposition, putrefaction of the organs happens in a specific order. The larynx and trachea will first show signs followed by the stomach, intestines and spleen, then the liver and lungs, next the brain, the heart, the kidney, bladder, and uterus, the skin, muscle, and tendon are affected next, and finally the bones.<sup>65</sup> The organs, including the skin will go from a red color eventually becoming black while the intestines become soft and greasy.<sup>66</sup> While this begins immediately following death and occurs between 1-24 days, things

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<sup>63</sup> *Id.* at 34

<sup>64</sup> D. Rao, *Post Mortem Changes: Putrefaction*, Forensic Pathology Online (2013).  
<http://www.forensicpathologyonline.com/e-book/crime-scene>

<sup>65</sup> *Id.*

<sup>66</sup> *Id.*

such as external temperature, water, air, moisture, clothing, manner of burial, the condition of the body and the cause of death all have an effect on the rate at which it occurs.<sup>67</sup> Though most forensic pathologists can make an estimate as to when the victim died, these factors make it increasingly difficult to find an exact time of death.

**g. Forensic Entomology**

Forensic entomology is the study of insects present in the corpse to assist in determining time of death.<sup>68</sup> Flies, which are normally the first insects to discover a dead body, have predictable development times when under particular environmental conditions. Forensic pathologists can calculate time of death by counting back the days from the state of development that the insects are in. Insects also follow the rate at which the body decomposes, allowing forensic pathologists to use the decomposing stage time-lines to assist them.<sup>69</sup>

According to some scientists, there are four categories of insects that can be found on a decomposing body. These are necrophagous insects (flies) which are feeding on the body, predators and parasites (beetles) which are feeding on the necrophagous insects (predators and parasites also contain schizophagous insects which first feed on the decomposing body and then feed on the other insects), omnivorous and arthropods (ants, wasps, beetles), and spiders or springtails which use the body as part of their environment.<sup>70</sup>

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<sup>67</sup> *Id.*

<sup>68</sup> Lee Dye, *48 Years Later, Bugs Clear Convicted Murderer*, ABC News ((2014). Forensic Pathologists used the bugs found on the deceased to prove that a convicted murderer could not have committed the murder. Though the court could not declare him innocent, the conviction was thrown out.

<sup>69</sup> Amendt J. et al., *Forensic Entomology*, Naturwissenschaften, at 51–65 (2004). Insects are typically looked at to determine time of death. These forensic scientists specialize in the classification of insects present in or on the deceased at the time of discovery and autopsy. These scientists can look at the life cycle stage of specific insects, including flies and maggots, to assist in determining time of death. Though often challenged based on classification of insect, this specialized science required an advanced knowledge. *See also*: Steven A. Koehler, *Forensic Mediocriminal Entomology – Applications in Medicolegal Investigations: Forensic Sciences* § 25C.03 (2019)

<sup>70</sup> *Id.* at 51-65. These are not a conclusive list of insects that are attracted to a deceased body but rather a simplification of the type of insect that will be attracted. For instance, bugs similar to flies may settle on the body immediately following death, and bugs similar to ants and spiders may use the body as part of their environment.



There are two methods that forensic scientists use to determine time of death through insects. The first is by using the “successional waves of insects” and the second is “maggot age and development.”<sup>71</sup> Successional waves of insects is the result of insects becoming attracted to the deceased as the body decomposes. The different stages of decomposition invite different species of insects to the body.<sup>72</sup> This normally begins within about ten minutes after death has occurred. Within a day, the flies are accompanied by the predator insects. As the body progresses through decomposition bugs such as Piophilidae (another species of flies) arrive to feed on the body.<sup>73</sup> After about 4 days, larval stages of the flies become present. Within 10-23 days, which is referred to as the post-decay stage, larvae leave the carcass and arthropod insects are the major insects found on the deceased.<sup>74</sup> Researchers have found that insect larvae that are present in the body can provide evidence of time of death up to one month; however, it has been noted that the environment will assist in determining the type of insects attracted to the body and it is of utmost importance that the proper insect is determined to make a more accurate estimation.<sup>75</sup> Because many species of bugs may overlap through the stages of decomposition, the forensic scientist investigating the body must know the regional insects, the times of colonization for each insect, and the season/environment during which the death occurred.<sup>76</sup>

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<sup>71</sup> Investigating Forensics, *Forensic Entomology or the use of Insects in Death Investigations*, SFU Museum of Archaeology and Ethnology (2010), [http://www.sfu.museum/forensics/eng/pg\\_media-media\\_pg/entomologie-entomology/](http://www.sfu.museum/forensics/eng/pg_media-media_pg/entomologie-entomology/)

<sup>72</sup> *Id.*

<sup>73</sup> *Id.*

<sup>74</sup> LeBlanc HN, Logan JG, *Exploiting Insect Olfaction in Forensic Entomology*, Netherlands Springer at 205-221 (2010). While the article uses specific insects as examples, these are not to be taken or interpreted as the only insects which would feed on or use the deceased following the time of death. Within each four classifications of insects there are a number of specific insects. To make explanatory reasons simpler, these scientists have resorted to using most commonly known insects such as flies and spiders.

<sup>75</sup> *Id.* *Exploiting Insect Olfaction in Forensic Entomology*

<sup>76</sup> See *Supra* Investigating Forensics

The second way to determine time of death through forensic entomology is the maggot age and development. However, this method requires the body be found within a few weeks of the death because the determination is normally only accurate within a few days (as opposed to hours).<sup>77</sup> As described above, this is the process of flies and maggots laying eggs. The eggs are usually laid in open wounds or “natural openings” such as eyes, mouth, and nose.<sup>78</sup> Forensic entomologists are able to determine the life cycle stage by looking at the size and number of spiracles (or breathing holes) present.<sup>79</sup> While this can be affected by temperature and environment, forensic entomologists can make an estimate the day in which the deceased died by looking at the oldest stage of the insects.<sup>80</sup> It is important to note that once the first adults emerge, entomologists can no longer determine the time of death. Forensic entomology, though a new process, is a major step to making more accurate determinations in time of death cases.

## VI. LEGAL ANALYSIS

### a. **Forensic Pathologists Expert Witnesses Guidelines**

The Federal Rules of Evidence, as well as individual State Rules dictate who qualifies as an expert witness in court proceedings, forensic pathologists have guidelines within their occupation that must be followed. Those who are testifying must be “qualified to provide the testimony that they give” and “must testify as fairly and objectively as possible.”<sup>81</sup> In order to meet this qualification, a pathologist must:

- “Be licensed to practice medicine or osteopathy in a legal jurisdiction within the United States;
- Be certified by a recognized certifying body in pathology; and

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<sup>77</sup> *Id.*

<sup>78</sup> *Id.*

<sup>79</sup> *Id.*

<sup>80</sup> *Id.*

<sup>81</sup> Ed Finkel, *Expert Witness Guidelines for the Specialty of Pathology*, CAP Today (2006), [http://www.captodayonline.com/Archives/feature\\_stories/0706ExpertSide.html](http://www.captodayonline.com/Archives/feature_stories/0706ExpertSide.html)

- Be in active practice of pathology for three years immediately before the date of the incident or conduct that is subject of the testimony.”<sup>82</sup>

Forensic pathologists are not required to but are asked to meet additional criteria when testifying.

These requirements attempt to ensure that the pathologists are not misleading judges or juries and adhering to the proper standards. The additional criteria ask that:

- “The expert witness should possess current experience and ongoing knowledge in the area in which he or she is asked to testify.
- The expert witness should be willing to submit the transcripts of depositions and testimony to peer review.
- The expert witness should not accept compensation that is contingent on the outcome of the litigation.
- The expert witness should not provide expert medical testimony that is false, misleading, or without medical foundation (look at current literature and records)
- The expert witness should review the medical facts in a thorough, fair, and objective manner and should not exclude any relevant information to create a view favoring the plaintiff or defendant.”<sup>83</sup>

**b. Rules of Evidence**

The Federal Rules of Evidence Rule 702 dictates who qualifies as an expert witness and what the goals of the expert are. Under Rule 702 an expert witness is one who can testify in the form of an opinion based on knowledge, skill, experience, training, or education.<sup>84</sup> Furthermore, an attorney can ask an expert to testify using the expert’s scientific, technical, or special knowledge to help the trier of fact understand the evidence or determine a fact at issue in the case.<sup>85</sup> Additionally, under Rule 702 the testimony from the expert witness must be based on sufficient facts or data, must be the product of reliable principles and method, and the expert must have reliably applied the principles and methods to the fact of the case at issue.<sup>86</sup>

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<sup>82</sup> *Id.* See Qualifications

<sup>83</sup> *Id.* Fairness and Objectivity

<sup>84</sup> Fed. R. Evid. 702.

<sup>85</sup> *Id.*

<sup>86</sup> *Id.*



Under Rule 702, forensic pathologists would likely be qualified to testify based on their knowledge, skill, training, experience, and education. These experts, as previously discussed are required to endure 8 years of school, 4 of which are specific to their occupation. Additionally, they must perform 4-5 years of residency which allows them to train, gain experience, and gain further knowledge into their occupation. Finally, the testing they must pass to become certified requires that they not only pass the three required tests, but also admit proof that they performed hundreds of autopsies as well as specific training hours and cases.<sup>87</sup>

Though these individuals are highly trained, upon a hearing one of the main criticisms forensic pathologists may face is that they are unable to make a conclusive time of death determination. While this may be true, no forensic pathologists argue that their time of death estimations are or ever will be conclusive. However, they stand by the fact that they are able to make such estimations based on the above qualifications.<sup>88</sup>

Rule 702 also requires that to qualify as an expert the witness must have scientific, technical, or special knowledge. Forensic pathologists, under this criterion would qualify as experts. As previously stated, these experts must go through extensive schooling and testing to become certified as a forensic pathologist.<sup>89</sup> Forensic pathologists go through a variety of tests to assist them in determining time of death.<sup>90</sup> This varies from scientific methods, such as the aforementioned (including autopsies), technical methods, and special skills. These individuals not only take outside factors into consideration but do a number of tests and take observations on the deceased to make an informed estimation.<sup>91</sup> This includes scientific methods such as looking

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<sup>87</sup> See *Supra* ABPath

<sup>88</sup> *Rogers v. Pearson*, 6 E.D. Va. (2012). See also *Sutton v. Bell*, 62 E.D. Tenn. 63 (2011).

<sup>89</sup> See *Supra* AbPath

<sup>90</sup> See *Supra*. See *Estimating the Time of Death in Practical Homicide Investigations* (2007).

<sup>91</sup> *Id.* at 6, 9. See also J.A. 1842-46, 3079, 3082, 3150-53

at biological factors, including the coloration, temperature, and size of internal organs, bone measurements, and insect life stages or infliction on the body.<sup>92</sup> The latter forms of determining time of death (special skills) consist of looking at reports from the scene of death, looking at photographs, and charts.<sup>93</sup> Though the technical knowledge may overlap the scientific knowledge, the ability to look at environmental factors on the body as well as other outside factors; including clothing, movement, etc.; as well as the reliance on reports requires a skill from the pathologists that a lay person would not possess without proper schooling. Thus, these individuals possess the knowledge required by Rule 702 that would help explain an issue of the case to the trier of fact.

### c. New Jersey Rules of Evidence

Each state has their own guidelines for requirements on expert witnesses. New Jersey requires that the testimony the witness is giving concerns a subject matter that is beyond the knowledge of the average juror.<sup>94</sup> Furthermore, the field that is being testified to must be a state of the art such that an expert's testimony could be sufficiently reliable.<sup>95</sup> Finally, the witness must have sufficient expertise to offer the intended testimony.<sup>96</sup> While this is similar to the Federal Rules of Evidence, the statutory wording is important and must be taken into consideration. Under New Jersey, expert witnesses would likely have to qualify at a higher

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<sup>92</sup> See *Supra* at 62.

<sup>93</sup> J Thomas Sullivan, *When Death is the Issue: Uses of Pathological Testimony and Autopsy Reports at Trial*, University of Arkansas at Little Rock William H. Bowen School of Law: Law Repository (1983). "The medical expert may testify concerning the time of death, a common finding included in the autopsy report, even though this opinion is not strictly based upon scientific tests--any objection goes to the weight and not admissibility of the testimony." *Commonwealth v. Campbell*, 378 Mass. 680, 393 N.E.2d 820, (1979); see also *State v. Smoot*, 381 So. 2d 668, 670-671 (Ala. Crim. App. 1980)

<sup>94</sup> N.J.R.E 702, 703

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

The second way to determine time of death through forensic entomology is the maggot age and development. However, this method requires the body be found within a few weeks of the death because the determination is normally only accurate within a few days (as opposed to hours).<sup>77</sup> As described above, this is the process of flies and maggots laying eggs. The eggs are usually laid in open wounds or “natural openings” such as eyes, mouth, and nose.<sup>78</sup> Forensic entomologists are able to determine the life cycle stage by looking at the size and number of spiracles (or breathing holes) present.<sup>79</sup> While this can be affected by temperature and environment, forensic entomologists can make an estimate the day in which the deceased died by looking at the oldest stage of the insects.<sup>80</sup> It is important to note that once the first adults emerge, entomologists can no longer determine the time of death. Forensic entomology, though a new process, is a major step to making more accurate determinations in time of death cases.

## VI. LEGAL ANALYSIS

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- “Be licensed to practice medicine or osteopathy in a legal jurisdiction within the United States;
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<sup>77</sup> *Id.*

<sup>78</sup> *Id.*

<sup>79</sup> *Id.*

<sup>80</sup> *Id.*

<sup>81</sup> Ed Finkel, *Expert Witness Guidelines for the Specialty of Pathology*, CAP Today (2006), [http://www.captodayonline.com/Archives/feature\\_stories/0706ExpertSide.html](http://www.captodayonline.com/Archives/feature_stories/0706ExpertSide.html)



About 76 years after deciding *Daubert*, the Court was faced with another case that asked them to determine the standard to apply to expert witness testimony that did not involve scientific knowledge. In *Kumho Tire Company v. Carmichael* 526 U.S. 137 (1999), the Supreme Court held that the *Daubert* standard required the trial judge's gatekeeping obligation apply not only to testimony based on scientific knowledge, but also to apply to testimony based on technical and other specialized knowledge.<sup>101</sup> Additionally, the Court held that the factors identified in *Daubert* were not definitive but were meant to be helpful (to a particular case with a particular set of issues) by assisting in determining the reliability of an expert witness's testimony.<sup>102</sup>

Both *Daubert* and *Kumho* provided clarification as well as guidelines on when to admit specific forms of expert testimony. These standards, though flexible, are a good basis for both prosecutors and defense attorneys to use to choose their experts in specific cases. In cases where the time of death is relevant, attorneys can turn to these standards to determine which forensic pathologist may be the most qualified to testify at trial and give an insight into the cause of death, time of death, and the outside factors that may have influenced the deceased following their death.

**e. What type of knowledge do forensic pathologists use?**

The Federal Rules of Evidence require that an expert have one of three types of knowledge in order to testify at a hearing.<sup>103</sup> These include, scientific knowledge, technical knowledge, or special skills. Forensic pathologists arguably possess all three types of required knowledge.

**i. Scientific Knowledge**

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<sup>101</sup> *Kumho Tire Company v. Carmichael* 526 U.S. 150 (1999), See also Fed. R. Evid. 702

<sup>102</sup> *Id.* at 151

<sup>103</sup> Fed. R. Evid. 702

Expert witness' scientific knowledge when testifying is subject to, but not required to meet the five criteria under the *Daubert* standard.<sup>104</sup> Forensic pathologists, with the *Daubert* standard aside, put about 12 years of studying science to receive their certification.<sup>105</sup> After completing such an extensive amount of studying, they are then required to pass not one, but three tests that specify pathological diseases, conditions, causes, as well as specific questions and slides on the deceased.<sup>106</sup> While this does not necessarily qualify them as an expert under a *Daubert* hearing, because forensic pathologists are so often called upon to be expert witnesses, opposing counsel do not often object to their testimony. However, if opposing counsel does object, and the expert forensic pathologist must face a *Daubert* hearing, it is very likely that their methods for determining time of death would be questioned.

Forensic pathologists, who often use a variety of methods to determine time of death, use scientific knowledge to assist them in making this determination. Though this may not be true for each mode of determining time of death, specific methods require more scientific knowledge and tests than others. These tests include the study of bugs, the study of stomach contents, the study of internal organs, bone density (which is often linked to decomposition), muscle size (which may be linked to rigor mortis), observation of tissue, and often testing of the blood.

The most obvious use of scientific knowledge would be present when the forensic pathologist performs autopsies to look at the stomach contents as well as the presence of bugs (though this can be performed without an autopsy). As previously discussed, digestion ceases at the time of death and forensic pathologists are able to make an estimation as to time of death based on the presence or lack thereof of food or liquids in the stomach. Additionally, based on

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<sup>104</sup> See *Supra.* at 151

<sup>105</sup> See *Supra.*

<sup>106</sup> See *Supra.*

the type of food consumed – vegetables, meats, carbohydrates, proteins, fats – forensic pathologists can potentially make a more accurate determination. These experts need to know the breakdown of each type of food and the time it takes to digest prior to death. The breakdown of carbs for instance, requires an understanding how the body breaks down this type of food as opposed to a protein rich food.<sup>107</sup> This includes an understanding of the acids and enzymes that are part of digestion, the way in which the food moves through the body from one internal organ to the next, how long it stays in each, the effect of fluid on the type of food consumed, and the effect of exercise and body size and metabolism on each type of food.<sup>108</sup> Additionally, the blood may need to be tested or other organs may need to be tested and observed under a microscope to determine if the deceased had any diseases that may affect how the specific body metabolizes and digests the consumed food. Other tests performed would consist of looking for gut bacteria, parasites or stomach ulcers, all of which can either speed up or slow down the digestion of food, allowing forensic pathologists to make a more accurate, though not conclusive assessment of the time of death.<sup>109</sup> Finally, when it comes to looking at stomach contents, the forensic pathologist would benefit from knowing the form of death because something such as a head trauma may completely inhibit the body from performing the proper steps to digest food.<sup>110</sup>

The study and observation of bugs is also arguably one of the largest uses of scientific knowledge when it comes to determining time of death. Those who are able to make an estimation of time of death by studying the presence and life cycle of bugs require a more specific and different level of scientific knowledge. These experts need to understand the

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<sup>107</sup> Manpreet Kaul, et al., *Digestive Status of Stomach Contents – An Indicator of Time Since Death*, 27, 34-35 (16 IOSR-JDMS, Oct. 27, 2017).

<sup>108</sup> *Id.* at 34

<sup>109</sup> *Id.* at 27

<sup>110</sup> *Id.* at 35



environment, the bugs that can survive in the environment where the deceased was found, the stages of decomposition, and the life cycles of the present bugs. The procedure often associated with forensic entomology begins with the measurement and the examination of the immature specimens (generally fly larvae or maggots). These specimens are placed in jars with both food and sawdust to grow. Once they pupate they are removed, and the date and emergence are then noted. Upon the emergence of the adults, they are killed to assist in calculating the age at the time of collection.<sup>111</sup> Additionally, forensic pathologists can perform a variety of tests such as “thin-layer chromatography, gas chromatography, and mass spectrometry,” when present bugs have been feeding on a deceased with drugs present in their system.<sup>112</sup> These tests separate compounds that assist the forensic pathologist in identifying samples, such as drugs or other intoxicants.<sup>113</sup>

While many of the other methods of determining time of death do involve some form of scientific knowledge, it is the scientific tests that are performed that qualify them as experts. These tests are commonly used and well known to trained forensic pathologists. Most of these tests rely on examining slides of muscle and organ tissues or blood to detect the presence of bacteria, disease, or changes in organs.<sup>114</sup> Expert forensic pathologists will also have to be well versed in the chemical breakdown of the human body and the chemical changes that occur

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<sup>111</sup> Investigating Forensics, *Forensic Entomology or the use of Insects in Death Investigations*, SFU Museum of Archaeology and Ethnology (2010), [http://www.sfu.museum/forensics/eng/pg\\_media-media\\_pg/entomologie-entomology/](http://www.sfu.museum/forensics/eng/pg_media-media_pg/entomologie-entomology/)

<sup>112</sup> LeBlanc HN, Logan JG, *Exploiting Insect Olfaction in Forensic Entomology*, Netherlands Springer at 205-221 (2010). These are all chemical procedures for analyzing compounds or separating compounds.

<sup>113</sup> Wood, M et al, *Recent Applications of Liquid Chromatography-Mass Spectrometry in Forensic Science*, 3-15 (J. Chromatogr. A, 2006).

<sup>114</sup> 5 Cyril H. Wecht, § 40.05 *Direct and Cross Examination of a Forensic Pathologist Regarding Time of Death of a Homicide Victim*, Forensic Sciences Matthew Bender & Company, Inc. (2019). See also 2 Cyril H. Wecht § 25.03 *The Timing of Death and Injuries*, Forensic Sciences Matthew Bender & Company, Inc. (2019) where the chapter discusses the scientific methods and breakdowns that occur in all forms of decomposition such as the inhibiting of hydrolytic enzyme action and cellular dissolution. There is also discussion of autolysis which is the body's self-destruction by its own enzymes.

following death. Because rigor mortis normally begins with the smaller muscles, the forensic pathologists will need to understand the muscle size, the lactic acid buildup in each muscle, the presence or lack of presence of adenosine triphosphate (ATP) and the level of glycogen in the deceased.<sup>115</sup> For example, when determining when rigor mortis (which is the result of chemical changes in the muscle) sets in, the forensic pathologist will need to know how the person died, the deceased's activity prior to death, the environment death occurred in, and any infections that the deceased may have had, to determine if rigor mortis set in within a few minutes or within a couple of hours.<sup>116</sup>

Though taking the deceased's temperature may not be considered scientific, the equations required to determine the temperature in comparison to the individual's size, appearance (clothing, shoes, etc.), and the surrounding environment make it more difficult to determine time of death. Additionally, chemical testing is often performed to determine if there was a presence of drugs or increased/decreased levels of bodily chemicals (i.e., vitamins) that may assist in concluding the time of death.<sup>117</sup> For instance, forensic pathologists may collect blood, urine, gastric contents, hair, tissue from underneath the eyeball, and more to test for the presence of substances such as drugs, alcohol, or even heavy metals.<sup>118</sup> Some of these tests include testing for reactions in the collected samples to specific substances and using one test against another to achieve the same result, thus verifying any findings.<sup>119</sup>

Finally, though currently only being performed on lab rats, forensic pathologists have begun performing a "Sturmer Test" which requires the examiner to determine the level of potassium in

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<sup>115</sup> *Id.*

<sup>116</sup> *Id.*

<sup>117</sup> *Id.*

<sup>118</sup> NFSCT, *A Simplified Guide to Toxicology*, Forensic Science Simplified, 2013

<http://www.forensicsciencesimplified.org/tox/how.html>.

<sup>119</sup> *Id.*



the vitreous humor (chamber of the eye) to estimate the number of hours since the deceased has passed.<sup>120</sup> Once again, while these tests are currently only being performed on rats and would likely not be useful in court at this time, this is an additional step in the direction of classifying forensic pathologists as expert witnesses who possess a greater level of scientific knowledge.

## ii. **Technical Knowledge and Special Skills**

If opposing counsel does not believe a forensic pathologist possesses the scientific knowledge required to pass a *Daubert* hearing, the same standards apply to technical knowledge and special skills under *Kumho*.<sup>121</sup> Every method that forensic pathologists use to determine time of death require either a technical knowledge or special skill, thus qualifying them to testify as expert witnesses. While there are some proficiency tests that if given to a lay person, could easily be passed, the tests that forensic pathologists perform require a level of higher and more experienced knowledge. Those who are not forensic pathologists, such as cops, detectives, and some forensic specialists are trained by qualified forensic pathologists to receive certifications in determining time of death.<sup>122</sup> However, it is important to note that these individuals already have experience with investigative techniques a lay person does not possess.

Many of the tests these experts perform include measurements of body temperatures and body sizes, observation of the eyes, skin, and any coloration of the deceased (including, but not limited to the color of the skin, the color of the eyes, and the color of internal organs), observation of the position of the body, interpretation of reports and photographs taken by crime

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<sup>120</sup> *Id.*

<sup>121</sup> See *Supra.* at 526

<sup>122</sup> Law Enforcement Learning, *Determining Time of Death – A Forensic Overview*, (2019) <https://lawenforcementlearning.com/course/determining-time-of-death-a-forensic-overview/> This is a course that allows police officers, medical examiners, crime scene and forensic technicians, and coroners to train on the steps used to determine time of death as well as explore the science and investigative skills required to make a proper determination. While the argument here is not that coroners and police officers are considered expert witnesses, it is important to note that the individuals who are enrolled in these courses require some previous form of certification and have a higher level of knowledge related to similar techniques.



scene investigators and first responders, and observation/interpretation of environmental factors or outside factors (including but not limited to clothing and movement of body following death).<sup>123</sup>

While forensic pathologists may argue these are scientific methods, there is still some opposition. Some forensic pathologists do not go to the scene of the crime and must rely on the observations, descriptions, and photographs given to them by those who were present.<sup>124</sup> These observations are used to analyze the condition the deceased was found in – meaning the position of the body – the clothes or lack of clothes the deceased had on, the weather conditions at the time of discovery, what type of environment the body was found in, the presence of bugs or animals at the time of discovery, any weapons, and the amount of blood or other bodily secretions. This information, along with the observations the forensic pathologists makes after examining the body require a set of either technical knowledge or special skills. Though a lay person can observe the color of skin, organs, bones, etc., it takes someone with advanced technical knowledge and special skills coupled with their scientific knowledge to narrow down the reasoning for their observations. For example while a lay person may be able to look at a body and determine if the skin is discolored, only someone with specialized skills such as a forensic pathologist would be able to look at the color of the organs and tissue as well as the state the tissues are and be able to determine if the deceased has shown signs of putrefaction. Furthermore, when determining if the body has reached livor mortis or lividity, a forensic pathologists doesn't only observe the color of the skin to determine where the pooling of the

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<sup>123</sup> *State of New Jersey v. Bryden Robert Williams, N.J., A.3d (2014).*

<sup>124</sup> Steven A. Koehler, *Estimating Time of Death from Postmortem Changes: Forensic Sciences* § 25B.07 (2019)

blood has occurred, but also determines what effect clothing or mode of murder has had on the particular stage of livor mortis.

Each method used to determine time of death does require observation, touch, smell, and measurements. For example, taking the temperature of the deceased to determine the stage of algor mortis, or looking at and touching the skin to determine the potential stage of decomposition would likely not be considered scientific to everyone. However, scientific knowledge aside, a forensic pathologist must first know the types of methods of determining death, their stages, their life span, and their proper descriptions prior to making conclusions simply based on the above. Furthermore, rigor mortis, algor mortis, and livor mortis (amongst other modes of determining timing of death) can be associated with other diseases or conditions.<sup>125</sup> In these circumstances only someone with the technical and scientific knowledge of a forensic pathologists would be able to make such a distinction.

**f. Legal Issues with Forensic Pathologists Knowledge**

Though forensic pathologists are excepted as expert witnesses, they do face criticism. The major backlash these individuals face is due to the inability to make an exact determination of time of death. As a result, the time of death can be minutes, hours, or days off leaving little room for absolute reliance on their testimony. This can be extremely controversial when it comes to acquitting someone of a murder charge or contradicting a defendant's alibi in a murder case. Because there is often fear of persuading the jury on such little concrete determinations, judges may but are not required to give limiting instructions.<sup>126</sup> Additionally, these fears are overcome

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<sup>125</sup> *Id.*

<sup>126</sup> *Id.*

with extensive cross-examination and ability for opposing counsel to bring in an expert to refute the time of death testimony.<sup>127</sup>

i. **Would a forensic pathologist pass a *Daubert* or *Kumho* hearing?**

Given the knowledge a forensic pathologist possesses, if required to face a *Daubert* or *Kumho* hearing, it is more likely than not that they would be able to testify as a time of death expert witness. After finding that their knowledge is sufficient, the next thing to determine would be whether or not their testimony would be upheld under the *Daubert* standard.

First, both parties would have to consider the method the forensic pathologist used to determine time of death. If this is more than one method, each method would need to be observed as well as the technique used under the method(s). If the forensic pathologist, for example, used putrefaction, decomposition, and lividity to estimate time of death, each party would need to look at the specific technique used. They would then have to determine if the technique used for each method was one that has been tested previously.<sup>128</sup> Due to the fact that all forensic pathologists are required to receive the same standard education, perform the same standard residency, perform the same number of autopsies, and take the same exams to receive certification it is likely that the method used by the forensic pathologist is one that has been tested. Most of these methods and techniques have been subjected to significant peer review as well as publication and many of the experts have used the same techniques to determine time of death.<sup>129</sup> Though the estimated time is not always the same nor within the same time length,

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<sup>127</sup> See *Supra*. See also *State v. Israel*, 353 N.C. 211, 213 (2000) where a court allowed both the State and the defendant to call upon an expert witness, specifically a forensic pathologist, to bring forth conflicting evidence regarding the time of death. Both were able to cross-examine the witnesses and question them about any inconsistencies.

<sup>128</sup> See *Supra* at 280.

<sup>129</sup> National Institute of Justice, *Forensic Science Publications and Multimedia*, USAGov, (2019). The National Institute of Justice is an organization that forensic pathologists can join to do a number of things. These individuals are able to sign up for classes, lectures, and speeches, they can receive updates on publications and research and development, and they can access publication in the field as well as put forth their work for publication.



these experts use the same techniques and attempt to consider the same outside and internal factors in making their determination. Note, that the variations in determining time of death is likely due to the fact that each forensic pathologist has to make observations and determinations of outside factors.<sup>130</sup>

Furthermore, while there is a potential error rate when determining time of deaths, forensic pathologists, especially those who are testifying, clarify that it is impossible to make a concrete determination regarding time of death.<sup>131</sup> In fact, many forensic pathologists, while testifying, will explain the many factors that made them come to the conclusion they did and explain why the window they have given is as broad or narrow as it is.<sup>132</sup> Additionally, many forensic pathologists belong to not only the board of which exam they passed to become certified, but also additional organizations. Many of these organizations receive funding to maintain the standards as well as develop standards that control the operations of autopsies and science/technique behind determining time of death. Finally, both counsels would want to ensure that the methods used by the expert has attracted widespread acceptance within the relevant community.<sup>133</sup> Here, the community would be other forensic scientists, including coroners, pathologists, police officers, medical examiners, technicians, and more. While the community may not be able to agree on the estimated time of death on a case by case basis, there is widespread acceptance within the community or useful methods, which is illustrated by the

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<sup>130</sup> Steven A. Koehler, *Estimating Time of Death from Postmortem Changes: Forensic Sciences* § 25B.07 (2019)

<sup>131</sup> *Rogers v. Pearson*, 6 E.D. Va. (2012). See also *Sutton v. Bell*, 62 E.D. Tenn. 63 (2011). See also *State v. Israel*, 353 N.C. 211, 213 (2000).

<sup>132</sup> *Commonwealth v. Brown*, 474 Mass. 576, 579 (2016), see also *Commonwealth v. Cassino*, 474 Mass. 85, 92 (2016), *Commonwealth v. Tories*, 469 Mass. 398, 403 (2014), *Commonwealth v. Issa*, 466 Mass. 1, 7 n.8 (2014), *Commonwealth v. Cruz*, 88 Mass. App. Ct. 206 (2015), *Commonwealth v. McCowen*, 458 Mass. 461 (2010), *Commonwealth v. Linton*, 456 Mass. 534, 537 (2010), *Commonwealth v. Thomas*, 439 Mass. 362, 364 n.1 (2003), *Commonwealth v. Knight*, 437 Mass. 487, 503 (2002). All cases look at examples where the testifying forensic pathologist/expert had a window into the time at which the deceased could have died, given different methods, factors, and conditions.

<sup>133</sup> See *Supra* at 279

continued use and attempted improvement of those methods. After looking at the *Daubert* standards, which also apply to *Kumho*, a forensic pathologist would pass at least one, if not both of these hearings.

**g. What relevance does a time of death expert witness's testimony have?**

Once a forensic pathologist has been accepted to testify as an expert witness, the court may still be faced with legal issues under the Federal Rules of Evidence; that being the testimony is relevant and has been reliably applied to the principles to the facts of the case.<sup>134</sup> Time of death testimony is relevant in a number of cases, most commonly civil cases where insurance claims are at issue and criminal cases where someone is being tried for murder.

Time of death, in civil cases, is most often relevant when a family member is attempting to collect a work insurance claim or life-insurance after their loved one has died. Because many insurance policies have specific terms and conditions as to when money can be given to a surviving member, these cases will often go to court to get settled. These types of cases may also arise in wrongful death cases where the deceased was killed in a car accident or their death was a result of a product defect. While the latter may not be as common, when time of death is an issue of fact in the case, both prosecutors and defenders are able to bring in expert witnesses to testify to their estimations. For example, in worker's compensation cases, where dependency is a question of fact, time of death may be relevant to determine if benefits can be received by the surviving dependent, spouse, or parents.<sup>135</sup> Most importantly, in the above cases, courts have

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<sup>134</sup> Fed. R. Evid. 702(d)

<sup>135</sup> *Rico v. Industrial Commission of Arizona*, 177 Ariz. 197, 866 P.2d 865 (1994), see also *Dunn v. Industrial Commission of Arizona*, 177 Ariz. 190, 866 P.2d 858 (1994), *Lalonde v. Associated Pipeline Contractors, Inc.*, 496 F.2d 1175 (5<sup>th</sup> Cir. 1974), *Thomas v. Industrial Commission of Arizona*, 87 Ariz. 238, 350 P.2d 392 (1960), *Exeter Drilling v. Industrial Claim Appeals Office of State of Colorado*, 801 P.2d 20 (Colo. Ct. App. 1990), *Delaware County Trust Co. v. General Chemical Co.*, 44 Del. 598, 64 A.2d 608 (super. Ct. 1949), *King v. Keller*, 141 So. 2d 259 (Fla. 1962), *Handcrafted Furniture, Inc. v. Black*, 182 Ga. App. 115, 354 S.E.2d 696 (1987).

held that time of death is a fact that is to be proved as any other fact and may be established by circumstantial evidence.<sup>136</sup> Thus, in civil cases if a forensic pathologists estimated a time of death and his basis for such estimation was not disqualified or disproven, it could be inferred that the deceased's family either qualified or did not qualify for insurance benefits.

The more controversial and criticized cases that forensic pathologists testify in are criminal cases where a defendant is on trial for murder. While courts have been known to give instructions regarding time of death testimony, and though there are many safeguards in place to cast doubt on such testimony, these cases still involve identifying an assailant, eliminating suspects, and negating, or even supporting an alibi.<sup>137</sup> The relevance of such testimony comes in when time of death is an issue of fact in the case. Though it does not come in automatically, the above situations are when time of death becomes relevant; however, courts have been divided on this.<sup>138</sup> Some courts do not believe that time of death is ever relevant in criminal cases because it is never an issue of the case while other courts believe that counsel has the right to call an expert witness to dispute an alibi raised in such cases.<sup>139</sup> Furthermore, where time of death evidence has been relevant, defendants generally try to appeal convictions using time of death evidence not based on the lack of relevance but based on ineffective counsel.<sup>140</sup> These situations, the defendant believes they had ineffective assistance because their attorney failed to find an independent expert forensic pathologist to dispute the evidence of the prosecutor's expert.<sup>141</sup> In these circumstances, the courts will generally hold that because of the adequate cross-

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<sup>136</sup> *Johns v. Burns et al.*, 67 So.2d 765, 767 (2006), see also 25 C.J.S., Death, §§9, 10

<sup>137</sup> Darren Drake, *Determining Time of Death*, Coroner Talk (2018), <https://coronertalk.com/28>

<sup>138</sup> *People v. Eulo*, 63 N.Y.2d 341 (1984).

<sup>139</sup> *People v. Legeri*, 239 App. Div. 47 (1933).

<sup>140</sup> *Hughes v. State*, 892 So.2d 203 (2004).

<sup>141</sup> *Id.* at 210.



examination of defense counsel, obtaining a time of death expert is not required and lack thereof does not show insufficient assistance.<sup>142</sup>

While these types of cases are the cases in which time of death is considered relevant, there is still the issue of reliability. Courts have held that in both criminal and civil cases, the testimony is reliable if it was previously recorded and may be testified upon by either the person who performed the autopsy (this can be a coroner, medical examiner, or forensic pathologist), a forensic pathologist who participated in or observed the autopsy is considered competent to testify as an expert at trial.<sup>143</sup> Additionally, courts have held that forensic pathologists who did not perform, participate in, or observe the autopsy may be reliable based on the report conducted by the performing forensic pathologist and only if the report was actually admitted at trial.<sup>144</sup>

Overall, based on the Federal Rules of Evidence and the extensive knowledge that forensic pathologists possess they are arguably qualified to testify as experts. Forensic pathologists' testimony becomes relevant when time of death is a fact at issue in the case, and this is seen in both insurance and benefit cases, wrongful death cases, as well as murder cases where time of death becomes a fact at issue when trying to identify an assailant or support an alibi. Because of these experts scientific and technical knowledge as well as the support behind their testing, forensic pathologists are qualified expert witnesses who can provide limited testimony as to time of death.

## VII. CONCLUSION

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<sup>142</sup> *Id.* at 210.

<sup>143</sup> *Commonwealth v. Benoit*, 410 Mass. 506, 520 (1991), see also *Wiggins v. State*, 352 Md. 580, 585 (1999).

<sup>144</sup> *Commonwealth v. Williams*, 475 Mass. 705, 719-720 (2016).

Forensic pathologists are highly trained, educated, and qualified expert witnesses. Though their knowledge concerning death is broad, they receive a great deal of backlash when testifying to time of death. This is due to the inaccuracies and impossibility to determine a concrete time of death. In both civil and criminal cases, discussing time of death can be considered extremely relevant. To receive money from an insurance company, to obtain title to land, or to receive benefits following the death of a family member, time of death is often detrimental. Likewise, in cases where a defendant is being tried for murder but has an alibi, a prosecuting attorney may call a forensic pathologist expert witness to testify that time of death occurred outside the time at which the defendant had an alibi. On the other hand, a defense attorney may call an expert witness to testify that it was possible the time of death occurred within that time frame. While their testimony is both relevant and reliable due to widespread support of techniques used to determine time of death, there is still issue with the inaccuracies. However, this is overcome by the possibility of extensive cross-examination and the ability of opposing counsel to bring in an expert to dispute the testimony. Finally, it is important that the expert witness who is called upon to testify explain that time of death is not accurate, and when the judge and counsel find it significant, to give jury instructions emphasizing this. In the end, forensic pathologists are qualified to testify as expert witnesses regarding time of death, but their testimony should be heard and used cautiously.