



## Pathology Biology Section – 2010

### G77 Precision of Autopsy Body Length Measurements

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After attending this session, attendees will learn the precision of body length measurements at autopsy and its importance in medicolegal death investigation. In addition they will learn how this compares to height determination precision in antemortem clinical practice.

This presentation will impact the forensic science community by introducing quantitative measures of error in an important determination made at autopsy.

In many cases, the height of a decedent is important in the investigation of his or her death. For instance, prosecutors may wish to posit hypotheticals and ask if it is physically possible for a person of a given height to commit suicide with a particular weapon, such as a long gun. In these cases, autopsy body length measurements are sometimes used as ground truth for antemortem height. This study attempts to provide a bounds on the precision of autopsy body length measurements in one facility.

**Methods/Data collection:** For a period of approximately two and one-half months (83 days) as cases were sequentially brought into the morgue facility, all staff members on duty and available in the autopsy area were asked to independently measure the length of each body. Measurement was done with a standard metal tape measure (Metric/English, 8m/26'). This particular facility is an academic facility with permanent staff members, student workers, resident physicians in training, and attending physicians. In most cases, only one or two staff members were available, but for those cases in which three or more were available, the body length measures were recorded. Each observer was blinded to the measurement results of other observers. The measurement by the assistant assigned to the case was recorded as the nominal "correct" body length measurement for the autopsy report. The bodies were weighed on a calibrated scale, and body mass index (BMI) was calculated using the official length recorded in the autopsy report. Visual evaluation was done to estimate the degree of body deformation due to rigor or pugilistic pose in charred remains, and recorded on a subjective scale of one (straight) to five (full fetal or pugilistic pose) by the second author, blinded to the measurements.

**Study Population:** A total of 74 cases had three or more measurements. Of these, 73 were adult cases. A total of eight observers were involved, including two certified Pathology Assistants, two full-time staff members, two student workers and two resident physicians. Twenty-six cases had three measurements, 33 cases had four measurements, 12 cases had five measurements, two cases had six measurements, and one case had seven measurements.

**Results:** The average range of measurements was 1.86 inches (4.72 cm) with a standard deviation of 1.2 inches (2.99 cm). The range varied from 0 to 5.5 inches (0-13.97 cm, Figure 1). No individual observer displayed significant systematic error (Table 1). The average range did not vary significantly with the number of measurements (Chi-square  $p=0.54$ ), body length (Pearson's  $r = 0.08$ ), or body deformation (Spearman's  $r = 0.15$ , two-tailed  $p = 0.2$ ). There was a moderate correlation with BMI (Pearson's  $r = 0.27$ , two-tailed  $p=0.019$ ).

**Discussion:** Autopsy body length measurements are prone to numerous errors. There are issues of posture, with some bodies being straight and other being held in flexion by rigor, heat effect, or other constraints. Obese bodies may have an artificially increased body length if the tape is laid over the panniculus. Charred and fragmented bodies may not have all body parts. The position of the feet may cause the heel to rise or fall. Hair may cause observers to incorrectly estimate the exact

position of the top of the head. Different observers may measure with different care.

This study attempted to evaluate the precision of body length measurement within one facility. This was specifically not an attempt to estimate accuracy, not merely because the nominal antemortem height was generally not known, but also because antemortem height measurements are themselves variable. The concept of "ground truth" in body length measurements may be inappropriate.

Studies on antemortem height measurement show significant variation for measurements of a single individual. Antemortem height can vary over time. It can vary significantly with posture. Further, antemortem height measurements are themselves fraught with error. Studies of the measurement of height routinely show that observer variation provides enough error to make them uninterpretable for some purposes.

**Precision, Error, Autopsy**