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Quality management considerations in the development of the DPAA's isotope testing program for unidentified human remains

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Isotopic compositions of human tissues, such as bone or tooth enamel, are related to sources of diet or drinking water and allow investigators to potentially predict the geographic origin of an unknown individual. Some organizations, including the Defense POW/MIA Accounting Agency (DPAA), use isotope testing as part of the identification process. Isotope testing of unidentified human remains has multiple positive down-stream effects, such as reducing the need for DNA testing and potentially separating commingled remains.

The DPAA Laboratory is developing an isotope testing program and associated data quality management system in support of the identification of unknown individuals. Here we describe the efforts underway to establish the isotope sample preparation and analysis capabilities of the DPAA. Our focus is collecting data of sufficient quality to answer several questions:

• How variable are the samples (i.e. isotopic variation within samples)?
• Have the samples been inadvertently isotopically fractionated since time of collection (e.g., during storage, preparation, analysis, etc.)?
• How comparable are samples prepared and analyzed at different times / locations (i.e. traceability of isotope data to the appropriate delta scales)?
• How variable are the populations of interest?
• Is it possible to isotopically differentiate the populations of interest?

Prior research in collaboration with California State University-Chico has demonstrated that it is possible to isotopically differentiate U.S. Americans from residents of Korea and Vietnam; the development of additional reference datasets for other regions of interest—such as Japan and Australia—is in progress. To support the comparison of samples tested recently to reference datasets published previously, we are directly assessing isotope data comparability by analyzing samples prepared in different years and at different facilities. The preparation of samples at different times / locations will allow us to detect unintentional isotopic fractionation during sample preparation, including bone bioapatite, bone collagen, and enamel bioapatite. Results will also allow us to set limits on material yields for quality control purposes. Some unique conditions encountered in casework will be investigated to assess the potential for isotopic fractionation, including treatment of remains with formaldehyde powder and burning. To determine isotopic variability of samples, we are testing multiple bones within a skeleton and repeating this for multiple skeletons.

Together, the data collected by the DPAA Laboratory during the buildout of its isotope sample preparation and analysis capabilities will be useful in ensuring measurement results are fit-for-purpose and of sufficient quality; estimating measurement uncertainty; and defining real interpretative differences for sample comparisons made during casework. In addition to the aforementioned sample data collection efforts, we are identifying animal bones that could be used as in-house standards to monitor long-term performance of both sample preparation and analysis to provide quality control and assurance. The efforts outlined in this presentation will generate validation data needed for future accreditation of the DPAA's isotope testing program.