THE ROLE OF DNA IN BRAZIL'S LARGEST AVIATION TRAGEDY

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BACKGROUND

To solve a puzzle consisting of 356 thousand parts is not an easy task, especially when the parts are the key for identification of human lives. But on July 17, 2007, a terrible aviation accident forced a team in Brazil to demonstrate that it is possible when working with DNA profiles. An Airbus 320 of TAM Airlines operating flight 3054 from Porto Alegre to Sao Paulo lost control during the landing process at Congonhas airport. The airplane flew over a large avenue and crashed into a TAM Airlines building. The explosion that followed led to the death of all 189 passengers as well as 10 employees that were working in the building.

The human remains were exposed to a temperature that reached about 2000°C, which led to a big question: would it be possible to find any biological material with viable DNA for genotyping? Despite the complexity of the samples, the Sao Paulo Criminal Institute (IC) team believed that it was possible.

SOLUTION

The Sao Paulo Criminal Institute contacted Applied Biosystems and a partnership was established.* The agreement defined that the vendor would help the IC in two different ways: at a technical level, with one Field Application Specialist helping with the DNA quantifications and electrophoresis at the IC DNA lab; and at the data management level, with the creation of a database to input the profiles of the victims and their relatives using the SQL*LIMS software. The software would also be required to compare the profiles in the databases through a kinship statistical analysis.

At that time, laboratory information management systems (LIMS) had not been used for Human Identification kinship analysis, and were primarily configured for pharmaceutical, food, and chemical industry applications with the major aim of reducing time spent in the management of information during the quality control and assurance process. For this special project in Brazil, the software was redesigned by the LABVANTAGE team with a tool for data searching and matching DNA profiles based on kinship analysis. A statistical calculation was created with the purpose of comparing the DNA profiles. Basically, groups of family information for each victim was created according to the blood sample collected.

LIMS IN ACTION

The victims' samples were collected from any biological material available, such as blood, bone, tissues and muscle, combining for a total of 280 lots that were submitted to a DNA extraction process suited to each type of material and its preservation/burning state. Approximately 570 DNA extractions were performed total, including repetitions of the extraction procedures and resampling. After DNA isolation, the DNA quantity of each sample was measured through real-time PCR, using the Quantifiler® Human DNA Quantification Kit, and the DNA concentration was adjusted for optimal efficiency during the PCR amplification process. The same protocol was used for DNA genotyping of samples from the victims' families. About 550 amplification reactions were performed with the AmpFlSTR® Identifiler® PCR Amplification Kit and 200 with the AmpFlSTR® Yfiler® PCR Amplification Kit. Following capillary electrophoresis and data interpretation, the resulting profiles were stored in the LIMS database. The

samples which exhibited a major degree of DNA degradation, approximately 55, were also submitted to amplification using the AmpFISTR® MiniFiler™ PCR Amplification Kit, in order to complement the partial profiles obtained with the other reagents. This methodology proved to be successful. Of the 280 lots received at the IC DNA lab, just 2 had the results reported as inconclusive because not even a partial profile was obtained.

All of the information was stored in the LIMS database so that the relatives' profiles could be compared with the victims in order to determine the victims' identity. Each database search took about 1 minute.

All the technology used allowed the whole process (from extraction to database search) to be completed within 48 hours. For each case, the database stored information including the relative's registration, relationship between the victims and their relatives, the DNA profiles, basic information about the victims and the search methods that should be used. Each search method was specific for the type of relationship between the victims and their relatives, i.e. maternity (23.93%), paternity (21.43%), reverse paternity (26.07%) and sibship (with 1 sibling 2.86% and with 2 siblings 2.50%). Some victims were identified by forensic anthropology or other methods; thus 22.86% of the victim profiles did not have any match in the database because the relatives hadn't provided their biological sample for comparison.

MEASURING SUCCESS

This work has generated two unique situations. First, the database could only be used because of the specific tool developed by the team. Second, this was the very first time a DNA database was used for human identification purposes in Brazil. This work was completed jointly with the National Chain of Forensic Genetics consisting of different State labs that sent data, samples and genetic profiles of victims' relatives, using a national chain of custody process created for this purpose. The two biggest collection centers were in the States of Sao Paulo and Rio Grande do Sul, but some collections were also made in Ceara, Amazonas, Minas Gerais, Parana and Paraiba.

During 30 days, a team consisting of 8 field application specialists, IC experts and police physicians from the Forensic Medicine Institute worked very hard, and were able to use DNA to identify 126 victims of the 185 bodies identified. Even though the partnership had been established for 60 days, all the DNA identifications were made within one month. During the first 15 days LABVANTAGE's software was developed, the workflow was established, the profiles were inputted and the majority of victims were identified.

Thanks to the technology and the team's commitment, it was possible to learn a great deal about how to manage risk situations by doing great work and overcoming myths and unfavorable statements; and it was also possible to prove that the use of genetic profiles for identification of mass disaster victims is essential.

*In August 2009, LABVANTAGE acquired Applied Biosystems's SQL*LIMS business. More details about this acquisition are available at www.labvantage.com.

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