DNA Analysis in Air India Crash: How Victims Are Identified

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DNA Identification in Disaster Latest News

- Following the Air India Boeing 787 crash in Ahmedabad, authorities are using DNA analysis to identify victims' remains.
- Family members' DNA samples have been collected, and some matches have been made.
- Since each person's DNA is unique (except in identical twins), it serves as the most reliable method for identifying bodies, especially in mass fatality incidents where visual or physical identification is difficult.

About DNA

- Deoxyribonucleic Acid (DNA) is the hereditary material in almost all living organisms.
- It carries the genetic instructions used in growth, development, functioning, and reproduction.

Structure

- DNA is composed of two long strands forming a double helix, made up of repeating units called nucleotides.
- Each nucleotide contains a sugar, a phosphate group, and one of four nitrogenous bases — Adenine (A), Thymine (T), Cytosine (C), or Guanine (G). The specific sequence of these bases encodes genetic information.

Location

- DNA is primarily located in the nucleus of cells (nuclear DNA), while a small amount is also found in mitochondria (mitochondrial DNA or mtDNA).
- Nuclear DNA is unique to each individual (except identical twins), whereas mtDNA is inherited maternally and found in multiple copies per cell.

Function

- DNA controls cellular functions by coding for proteins, and it passes genetic traits from one generation to the next.

Role of DNA in Identifying Crash/Disaster Victims

- In mass fatality events like plane crashes or natural disasters, physical features may be unrecognizable.
- DNA becomes the most reliable method of identification in such cases.

Challenges

- **Decomposition and Damage**: Disasters can severely damage or decompose remains, making DNA extraction and profiling challenging.
- **Contamination:** Contamination of samples from other sources can complicate the process.
- **Time and Resources**: The process can be time-consuming and require significant resources, especially for large-scale disasters.

DNA Collection and Storage After a Plane Crash

- **Ideal Storage Conditions**
    - DNA survives best in cold, dry environments.
    - Samples should be frozen at -20°C or stored in 95% ethanol (for soft tissues).
    - Soft tissues degrade faster than hard tissues like bones and teeth, which are more resistant to decomposition.
    - Forensic teams prefer bones and teeth as DNA sources due to their protection from environmental damage and decomposition.
- **Timeline for Sample Collection**
    - Post-crash recovery and collection can take weeks.
    - Example: It took 10 months to collect DNA from victims of the 9/11 attacks due to the scale of destruction.
- **Importance of Reference Samples**

- To match unidentified remains, DNA from biological relatives—especially parents or children—is collected, as they share 50% of their DNA with the victim.

DNA Analysis Methods in Identifying Human Remains

- Once samples are collected, DNA is extracted. The quality and condition of the DNA determine which analysis method is used.

Short Tandem Repeat (STR) Analysis

- STR analysis examines repeating DNA sequences that vary between individuals.
- It is highly accurate for identification and family matching when at least 15 STR regions are analyzed.
- Since STRs are found in nuclear DNA, this method requires **non-degraded** nuclear DNA for effective results.

Mitochondrial DNA (mtDNA) Analysis

- Used when nuclear DNA is degraded, mtDNA is easier to recover as it exists in many copies per cell.
- Since it's passed unchanged from mother to all children, identification is done by matching remains with maternal relatives like the mother, siblings, maternal grandmother, or maternal uncles/aunts.

Y Chromosome Analysis

- This method examines STRs on the Y chromosome, which is passed from father to son.
- It helps identify male victims by matching their DNA with male relatives in the **paternal line**—such as brothers, paternal uncles, or male cousins.
- It is especially useful when close relatives are unavailable for comparison.

Single Nucleotide Polymorphisms (SNPs) Analysis

- SNP analysis is used when DNA is highly degraded. It identifies variations at single base points (A, C, G, or T) in the DNA sequence.
- Though less accurate than STR analysis, it can still aid identification using reference samples from personal items like toothbrushes or hairbrushes.

Source: IE | IE | TNM
