Mass Disaster

• Identify the remains of victims in events such as:
  – Plane crash
  – Terrorist attack
  – Large fire, etc

• These types of disasters leave the victim’s bodies in pieces, burned beyond recognition and remains mixed together

• Cannot be visually identified
Destroyed Evidence

• Many of these cases the body has been destroyed, especially if it wasn’t found immediately:
  – Body parts are separated
  – Body parts are missing/destroyed
  – Body parts are burned
  – Body is scavenged by animals/organisms
  – Body is submerged in water where tissues break apart quickly
Identifying a Body

• First option:
  – Visual identification

• Second:
  – Medical and Dental records

• Third:
  – Fingerprints

• Final:
  – DNA evidence
Medical and Dental Records

• Fingerprints may be retrieved off body
• If DNA sample can be retrieved – DNA is most powerful way to ID a body
• However, what is the problem with either fingerprints or DNA?
• Most people don’t have fingerprints or DNA records stored in system
• Everyone in middle class has medical or dental records
Advantage to DNA

What are the advantages to using DNA to identify the remains?

• Each body part/piece can be identified
• Does not require an intact features:
  – Fingers, jaws, etc
• Pieces that are intermixed between different individuals can still be separated and uniquely identified
Reference Samples

DNA profiles can be taken as reference samples from two main sources:

1. Close relatives of the victims
   - May be unknown who are victims, especially immediately after a major event
   - Missing people’s parents, children, siblings

2. Victim’s person items
   - Toothbrush, hair, razor, dirty laundry
Direct Reference

• When a reference sample is taken off the victim’s personal effects
• Collect items that were used exclusively by the victim
• That would contain biological material
• Preferable evidence – why?
• Obtain a direct match
  – 100% of alleles will be identical
Direct Reference

- Direct reference DNA profile compared to all body parts from disaster site

Direct comparison

<table>
<thead>
<tr>
<th>DNA profile from mass disaster victim</th>
<th>DNA profile from direct reference (toothbrush believed to have belonged to the victim)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5S818</td>
<td>D5S818</td>
</tr>
<tr>
<td>D13S317</td>
<td>D13S317</td>
</tr>
<tr>
<td>D7S820</td>
<td>D7S820</td>
</tr>
<tr>
<td>D16S539</td>
<td>D16S539</td>
</tr>
<tr>
<td>CSF1PO</td>
<td>CSF1PO</td>
</tr>
<tr>
<td>Penta D</td>
<td>Penta D</td>
</tr>
</tbody>
</table>
Kinship Reference Sample

• Living biological relatives can also provide reference samples
  – Especially if DNA cannot be obtained from personal items

• Requires that alleles be assumed based on relationship between individuals
  – Chapter 23

• Closer the relationship – better evidence of a match to victim
Kinship Reference Sample

- Using relatives DNA profiles to compare against body parts from disaster
- Can only predict the victim’s profile

Kinship Reference Sample

• Immediate family members:
  – Parents, children, siblings

• Extended family members can be used if Mitochondrial or Y Chromosome testing is performed:
  – mtDNA – any maternal relatives
  – Y-STRs – male, paternal relatives

• Kinship can also be used to validate the personal item used for direct DNA analysis
Kinship References

- Grandmother
  - Aunt
  - Cousin
    - Sister
    - Niece
- Uncle
- Mother
  - Brother
  - Nephew
- Father
  - Spouse
    - Son
    - Daughter

Who is involved?

- Disaster Mortuary Operational Response Team (DMORT)
  - Federally funded
  - CME, forensic pathologists, funeral directors, etc
- Visual ID is done first if possible
- Dental and medical records are collected
- DNA samples are collected at the scene
  - Sent to DNA analysis centers for extraction and genotyping
(A) Material Flow – Example from 9/11 Attacks:

(B) DNA Profiles Data Flow

Why Identify the remains?

Three main reasons:

1. Help reconstruct the crime scene
   • By determining everyone that was present

2. For the official death certificate to be issued
   • Requires positive proof that the remains were found and identified

3. Giving the victim’s family members closure and information
Challenges

There can be many challenges to identifying the victims remains:

• Unknown victims
  – Don’t always know who/where to collect reference samples from

• No known living relatives
  – Perhaps because all living relatives were killed in the same mass disaster
  – Cannot find the relatives that are remaining
Challenges

• Family members in the middle of personal disputes
  – Fighting over the remains, how to handle them, what tests should be allowed

• Discovery of illegitimate biological relationships
  – Especially non-paternity

• Collection of the biological evidence from the disaster site
Real Cases

• Rest of the chapter works through three real cases of mass disasters
• Not covering September 11th victims
  – Student’s assigned case
• Branch Davidian – Waco, Texas
  – High-temperature fire
• Swissair Flight 111 – Atlantic Ocean
  – Severe water damage
Branch Davidian Cult

• Over 80 people were killed in a raid on the Waco, Texas compound of the cult
• Remains were severely damaged by a fire
• About half the bodies were identified from dental or fingerprint comparison
• Other half identified from DNA analysis
• Living relatives provided kinship reference samples
Branch Davidian Cult

- Shortage of living relatives allowed only 26 remains to be identified this way
  - Entire families lived together in the compound
  - Many living relatives could not be identified or found because victims had cut ties
- No direct reference samples could be taken because everything owned by victims was destroyed in the fire as well
- Many bodies were never identified
Swissair Flight 111 Crash

• 229 people were killed when flight 111 crashed into Atlantic Ocean
• Plane was raised out of more than 60 meters of cold ocean water
• Two important parts of the investigation:
  – The reason for the plane crash
  – Identifying the victims remains
• A missing or extra person on board could be evidence of terrorism
Swissair Flight 111 Crash

- Entire families were traveling together
- Therefore close relatives needed to not only be identified, but distinguished from each other
- Only one body was able to be visually ID’d
- 43 victims were ID’d from fingerprints
- Medical and dental records ID’d 102 victims
- Remaining victims were ID’d from DNA only
229 VICTIMS

1277 crash scene samples

9 STR loci tested (Profiler Plus)

Sorted groups

9 STR loci typed (Profiler Plus)

310 Relative Reference Samples

Collections using FTA paper (from 22 countries)

89 Personal Effects

4 additional STR loci tested (COfiler)

4 additional STR loci tested (COfiler)

Database query

RELATIONAL DATABASE

Identification of 229 victims

Summary

• Mass Disasters cause:
  – Many victims need to be identified
  – Body parts may be separated and mixed up

• Identification of bodies:
  – Visual ID if possible
  – Medical and Dental records if possible
  – DNA profiles last (most cost and time)

• Remains usually severely damaged
Summary

• Remains have to be collected and sorted
• DNA extracted from each piece of biological evidence
  – DNA profile determined
• Reference samples collected
  – Either from victims personal effects
  – Or from close biological relatives
• Comparisons between reference samples and victim’s remains
Any Questions?

Read Appendix VII

Example Cases