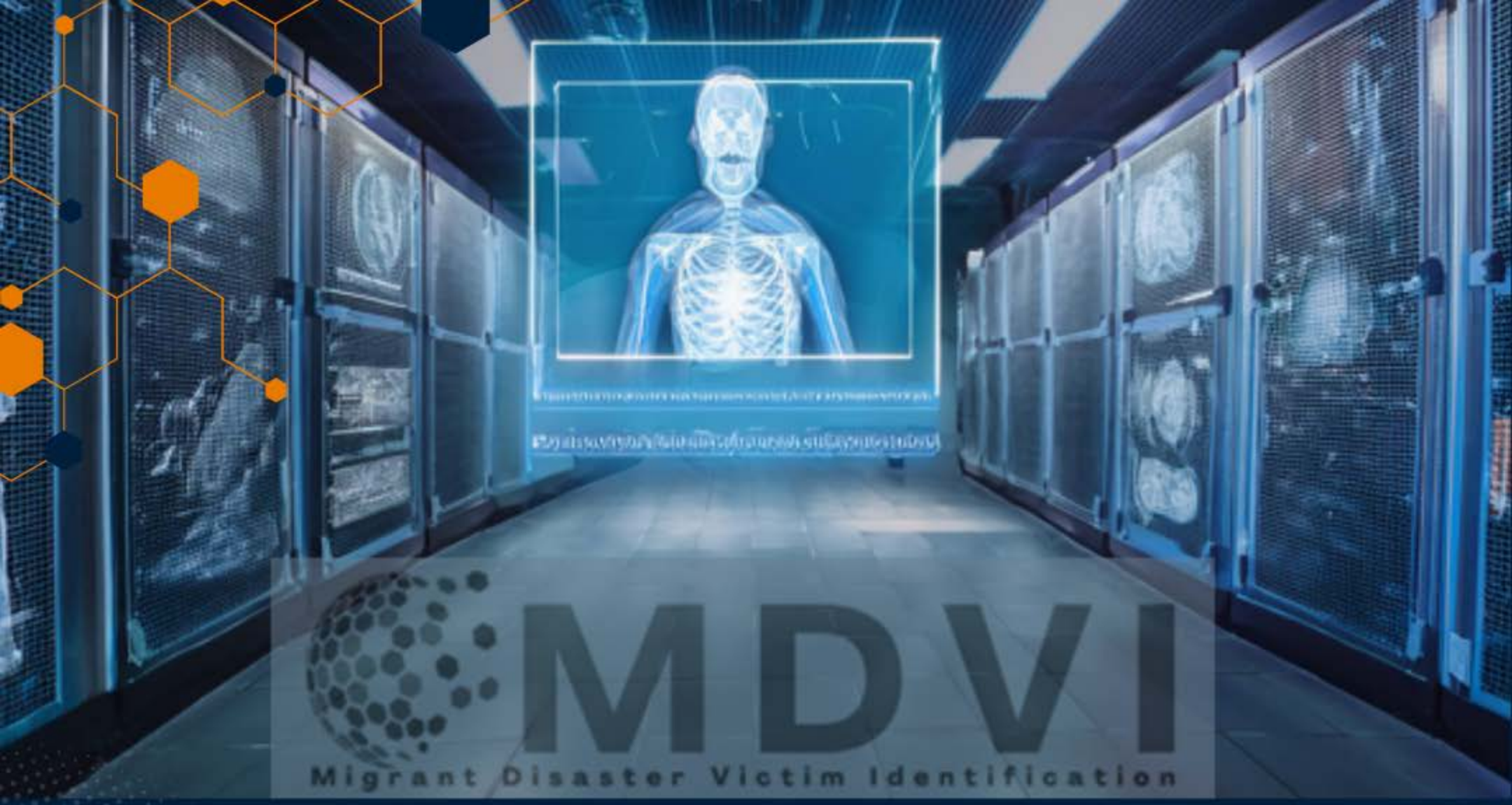

Conference Proceedings:

Migrant Disaster Victim Identification 2024

Technology, Innovation, Collaboration, Co-design, Action

25 September, 2024
Start at 09:30am CET

Online - Teams

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

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Migrant Disaster Victim Identification (MDVI) Action

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Introduction to the COST MDVI Action and Conference

Prof Caroline Wilkinson, Action Chair

Welcome to the first annual conference for Migrant Disaster Victim Identification. This online conference is sponsored by the European Cooperation in Science & Technology (COST) with European Union funding.

The challenge this action aims to address is the global humanitarian crisis related to migrant disasters and the unidentified dead. Thousands of migrants attempt to cross bodies of water and inhospitable land masses between their countries of origin and arrival. Sadly, many migrants lose their lives during the migratory route, and their identities may never be established. It is an international moral necessity to attempt identification for each deceased person for legal and/or family matters, and this can be especially challenging in mass fatalities.

Currently approx. 25% of migrant disaster victims are formally identified. The International Organisation for Migration (IOM) estimates >30k deceased migrants to Mediterranean alone since 2014, and IOM's Missing Migrants Project recorded 200% increase in deaths on Eastern Mediterranean land route between 2021-2022. In addition, the IOM estimates >4k deaths via West African sea route to Canary Islands over last 10 years, and the United Nations states 2023 was deadliest year for migrants in a decade.

In this Action, interdisciplinary research and coordinated initiatives (meetings, training schools, short term scientific missions and online resources) will drive the development and validation of international processes and resources, including the utilization of innovative craniofacial, drone, AI and social media methods.

The Action includes four Working Groups:

1. Physical evidence
2. Digital evidence
3. International policy
4. Continued Professional Development (CPD) programme

Currently we have 177 members from 35 countries made up of 49% from International Target Countries (ITC), 46% Young Researchers/Innovators and 60% female.

The Action has a Management Committee made up of 29 members from 21 COST member countries, of which 67% are ITC.

The Action has a Core group made up of the Chair, Vice-Chair, Grantholder Manager, Science Communication Officer and the Working Group Co-Leaders.

Our action has identified a number of research coordination objectives and capacity building objectives, and these include:

Research Coordination

- Develop common understanding
- Coordinate research and impact

- Focus on new methods/technology – craniofacial, drones, social media, AI
- Produce recommendations/standards/guidelines
- Develop a central shared database

Capacity Building

- Foster knowledge exchange
- Influence international policy and processes
- Provide accessible training
- Collaborate with migrant diaspora and family/community groups
- Act as a stakeholder platform
- Build capacity across Europe

Over this last grant period (Oct 2023 to Oct 2024), the Action has organised two networking and task events:

1) University of Milan, 29 February 2024
2) Impact Hub Athens, 24th May 2024

These events presented speakers (Prof Cristina Cattaneo in Milan; Hellenic DVI and ICRC in Athens), working group tasks and a tour of the Museo Universitario delle Scienze Antropologiche in Milan.

This conference is our final event of the grant period, and we have a wide variety of keynote speakers invited by each working group, along with papers presented by Action members. The Conference keynotes include:

- Tineke Strik - MEP, Netherlands
- Tomasz Dabrowski - Marine Institute, Ireland
- Dana Michalski – University of Adelaide, Australia
- Stephen Fonseca, International Committee of the Red Cross
- Kate Spradley, Texas State University, USA

Welcome to the MDVI conference 2024.

COST MDVI Online Conference

25 September 2024

SCHEDULE

NOTE: All times are CET.

09.45 – Introduction (Caroline Wilkinson)

10.00 – International Policy (Soren Blau/Geoff Boyce)

Keynote: Tineke Strik – MEP, Netherlands
EU's deadly border and migration policies: need for a paradigm shift

10.30 - Papers:

- Valentina Azarova; Noemi Magugliani & Alvaro Remirez March
  Reparations for border deaths as enforced disappearances and the identification of remains.
- Jarvis, C and Bolton, S. *Last Rights*
- Simon Robins
  Beyond the forensic turn: Addressing missing migrants is not solely a DVI issue.

11.05 - Break

11.30 – Digital Evidence (Petra Urbanova/Sarah Shrimpton)

Keynote: Tomasz Dabrowski - Marine Institute, University College Dublin
Ocean Modelling for Forensic Investigations and Search and Rescue Operations

Keynote: Dana Michalski – University of Adelaide, Australia
Facial recognition for disaster victim identification

12.30 - Break

12.35 – Papers:

- Raveena Meempat
  Convolutional Neural Networks in Sex Estimation: Applications and Challenges for Disaster Victim Identification
- Steven Johnson
  Use of Drone Technology to Locate and Identify MDV Remains
- JS Sehrawat
  Potential applications of Artificial Intelligence (AI) in the forensic anthropological investigations and disaster victim identifications

13.05 Break

MDVI Online Conference

25 September 2024

SCHEDULE

NOTE: All times are CET.

14.00 – Professional Development (Jessica Ching Liu)

Keynote: Stephen Fonseca, Head of the African Centre for Medicolegal Systems, ICRC
Drawing on Lessons from Medicolegal System Evaluations regarding the Missing and Dead

14.30 – Papers:

- Emma Johnston
  MDVI: The need for education & training
- Caroline Wilkinson, Martina Pizzolato, Danilo De Angelis, Debora Mazzarelli, Annalisa D'Apuzzo, Jessica Ching Liu, Pasquale Poppa & Cristina Cattaneo
  Facial Image comparison for migrant disaster victim identification

15.00 - Break

15.30 – Physical Evidence (Trine Olsen/Leticia Rubio)

Keynote: Kate Spradley, Texas State University, USA
Recovery and identification of administratively disappeared migrants along the Texas/Mexico border.

16.00 – Papers:

- Andrea Palamenghi, Giulia Caccia, Debora Mazzarelli, Carlo Campobasso, Ruggero Donida Labati, Fabio Scotti, Vincenzo Piuri, Cristina Cattaneo, Daniele Gibelli & Danilo De Angelis
  Investigating Cranial Non-Metric Traits for Identification in a Humanitarian Forensic Case
- Flouri DE, Mavroudas SR, Karydi C, Papadomanolakis A, Moraitis K, Kranioti EF.
  Migration – related fatalities in Greece: From recovery and hypothesis to identification

16.20 – Plenary (Caroline Wilkinson)

16.30 - End

Last Rights. Creating a new framework of respect for the rights of missing & dead refugees and migrants and bereaved family members.

Catriona Jarvis
Last Rights
http://lastrights.net

Syd Bolton
Last Rights
http://lastrights.net

***Abstract*— As has been said by the UN Special Rapporteur on the Human Rights of Migrants, as he then was, Francois Crepeau: "Migration itself is a natural part of human existence; it is neither a crime nor a problem, and it has the potential to be a remedy for many social ills. The collective response to date of placing restrictions on mobility is part of the problem, not of the solution".**

INTRODUCTION

The movement of people, both through internal displacement and across borders, is part of everyday life for millions, and in recent years, many people have set out on migrant journeys toward Europe. In the New York Declaration for Refugees and Migrants [1], the UN General Assembly recognized the many and complex reasons for 1 these movements. Every year these movements continue to exact a devastating toll on human life world-wide and far too few of the dead are recovered and identified.

The International Organisation for Migration (IOM) estimates that at least 67,922 people have died or have gone missing on migratory routes world-wide since 2014 (as at 20 09 2024). It is acknowledged that this is an undercount. Such deaths will continue to occur, in particular when States and the international community as a whole fail to meet their moral and legal commitments.

National responses to migrant deaths have mainly been determined by tighter border control policies and anti-smuggling or anti-trafficking strategies. However, little attention has been paid to the respect owed to the dead and the missing and the protection of their bereaved family members, so as to ensure that already traumatic experiences are not made worse.

The names of most of the dead and missing are not known; their families have not been traced; where bodies have been found, they are often piled in makeshift morgues or buried in unmarked graves. Families have no answers to what happened; they do not know whether a missing relative – a parent, spouse, brother, sister or child – is alive or dead.

ABOUT LAST RIGHTS PROJECT

The Last Rights project took form at the end of 2015 and was born out of the need to address this protection gap to help ensure that dead and missing migrants and refugees and their families are treated with respect and their rights are honoured, not breached. [2]

We believed there was a pressing need to produce and highlight international legal norms and principles in relation to migrant deaths and disappearances, to ensure dignity and justice to those who have died or have gone missing and their bereaved families. It is intended that these principles assist States, civil society and others, including those working in the field, to respond to these tragedies in ways which respect human rights and human dignity.

We call on States and other national and international institutions to adopt and implement the standards set out in the Mytilini Declaration for the Dignified Treatment of all Missing and Deceased Persons and their Families as a Consequence of Migrant Journeys ('Mytilini Declaration') [3]

This landmark document was agreed on 11 May 2018 between Last Rights and a working group of about 55 experts, including lawyers, social workers, forensic experts, academics, civil society and migrant and refugee community representatives, who travelled from around the world to contribute and agree on the final text during a historic meeting on the Greek island of Lesbos. Included among the delegates and signatories to the Declaration was the then UN Special Rapporteur on extra-judicial, summary or arbitrary executions, Dr. Agnes Callamard. (I note that some others who participated and are signatories are with us today, 25 September 2024).

The Mytilini Declaration recognises the respect owed to missing and deceased migrants and refugees; defines State obligations in relation to tracing the missing, recovering, identifying, preserving and laying to final rest the deceased; and establishes the rights of the surviving families.

The Mytilini Declaration does not create new rights and obligations but brings together and codifies in one unifying document existing international norms, which are by and large fragmented or have been overlooked. The standards set out draw upon international human rights law, international humanitarian law, international criminal law and international maritime law.

The Mytilini Declaration is, we believe, the first tool that advocates for the creation of independent national mechanisms, to be linked regionally and internationally, not affiliated with border- policing- and law enforcement authorities, dedicated to coordinating States duties and

services in situations of migrant death and loss, ensuring compliance with the standards of the Declaration.

Last Rights has also produced a Legal Statement and Commentary (current version January 2019 on the Last Rights website) analyzing relevant international human rights jurisprudence. We are working to update the Legal Statement and to finish creating a glossary and practical protocols.

What Are The Core International Legal Obligations of States?

Human dignity lies at the core of all international human rights law. The applicable declarations and treaties do not, as a general rule, set out any detailed principles with respect to the treatment of the dead. To some extent, this has been addressed in the case law of international human rights courts and tribunals. Specific rights with relevance in this area include the right to life, the prohibition of torture, cruel, inhuman and degrading treatment, the right to equality, the right to private and family life, and the prohibition of discrimination, the right to property, and the right to legal personality. Special attention is directed to the protection of children, in accordance with the priorities established by international human rights law.

These international obligations are complementary to, and inform, the rights and obligations concerning dead persons and their families set out in applicable national or domestic legislation.

I mention briefly here a case known as the Cotton Field case, a decision of the IACtHR. In its 2009 judgment in the Case of González et al. ("Cotton Field") v. Mexico, the Court held Mexico to be responsible for human rights violations based on the handling of investigations into disappearances and deaths of women and girls in Ciudad Juárez. The state's actions contributed to the atmosphere of impunity surrounding the maltreatment of women in the city.

Various findings are of relevance to the work of identification of a body. I give just one example:

- Collect the bodies and human remains
- Recovery of bodies should be done in an orderly manner by competent authorities. Mishandling a body can destroy important evidence (IACtHR, *Nadege Dorzema et al. v. Dominincan Republic*, paras. 101-114)

- Identify the victim
- The body must be identified by reliable witnesses and other objective methods. Recognition based on general physical data not supported by forensic evidence (DNA, biometrics, odontology etc) violates duty to investigate (IACtHR, *Cotton Field* case, para. 315)
- Scene must be exhaustively searched, personal items must be collected, properly examined, registered and stored. (ECtHR, *Makaratzis v Greece*, para. 74)

I'm aware that there has been recent discussion among those working in the field as to the methods and means through which confirmed identification can be achieved and accepted, with an emphasis on information other than usual forensic evidence. It will be a highly relevant area for this conference and beyond.

MEMORIAL OF GRIEF AND GRIEVANCES

Concerned at ever increasing lack of accountability on the part of states and other authorities that has risen to the level of impunity, Last Rights convened a meeting at the Memorial Camp in Rivesaltes, France, on 24 March 2023 where our Memorial of Grief and Grievances was agreed. Amongst other measures, we say that:

"Evidence in relation to every missing person and every death must be diligently gathered and preserved without delay through transnational cooperation that offers accompaniment to searching-families and seeks to establish the whereabouts of the missing person, and where possible to identify and repatriate their remains.

Deaths on migration journeys must be treated in the first instance as suspicious, non-accidental and investigated and recorded as such until proved otherwise. Failure to conduct adequate forensic procedures leads to impunity for the systems of illegalized migration and violent border regimes, and perpetual injustice for victims, survivors, and their families. It degrades and devalues our communities and society as a whole. **Deaths on migration journeys are made invisible, including through the persecution and vilification of independent investigators and advocates."**

States are obliged, without delay, to investigate, search and recover remains, engage in transnational interstate cooperation with bordering and origin states, establish and maintain family-facing data infrastructure to provide information and assist families in the tracing and identification of their loved ones. It is separately required to provide the means necessary for families to pursue truth and justice for their loved ones' disappearance.

All persons seeking or providing information must be ensured protection and confidentiality. Providing information in relation to tracing and identification of a missing or deceased person must be without any detriment to the provider of the information.

CONCLUSONS

It is today, more widely acknowledged that there is a need to create mechanisms and protocols that will also support all those working with and for, and who should be working with and for, migrants and migrant groups on a daily basis, including; clinicians; forensic experts; lawyers; judges; social workers; advocates; civil society actors; coastguard and police, helping enable best practice to the benefit of wider civil society; states and bodies such as the UN and EU and, it is intended, transform research and legal principles into deliverable, real benefits and respect for human rights.

As highlighted in the Draft Principles and Guidelines on the human rights of migrants in vulnerable situations (United Nations High Commission for Human Rights "UNHCHR" and Global Migration Compact ("GMC"), February 2017) those on the move are entitled to the equal protection of their rights under international human rights law and related standards, in the same way as those who have not moved as are those who are members of specific groups entitled to other existing protections, such as international refugee law.The human 2 rights and particular needs of other groups of individuals, trafficked persons, stateless persons, migrant workers or persons with disabilities have also been recognised in specific international instruments. [4]

The development of mechanisms, protocols and explanatory notes relating to the dead, their bereaved and the missing is without prejudice to the specific rights of particular groups who are part of such movements.

Further, it is acknowledged that there are already guidelines in existence, issued by states, by professional and other non-governmental bodies such as Medicines Sans Frontieres ("MSF") and by those such as the International Maritime Organisation ("IMO"), the United Nations High Commission for Refugees ("UNHCR"), the International Committee of the Red Cross ("ICRC") that set out best practice, for example in relation to clinical examination, diagnosis and treatment, search and rescue duties, or forensic human identification. The Last Rights Declaration and Legal Statement and the Memorial of Grief and Grievances are without prejudice to any such guidelines.

It is our hope and intention that a new, joint effort, will emerge from the work of this research programme, one result of which will be a mechanism or mechanisms that will achieve respect for the rights of migrants and their loved ones.

REFERENCES AND COMMENTS

[1] The outcome document of the high-level plenary meeting on addressing large movements of refugees and migrants convened by the General Assembly, adopted by the Assembly in its resolution 71/1 of 19 September 2016.

[2] The Last Rights Mytilini Declaration – English – 11 May 2018 https://drive.google.com/file/d/1n9ZZ5LjI9KkEf7Lfzqv_yB1R9bAy0G8B/view

[3] Last Rights Extended Legal Statement and Commentary 30 January 2019 https://drive.google.com/file/d/1P7RGtTQw95gFL-o6iBzxmVRsDngxpHHc/view

[4] Including the Convention relating to the Status of Refugees and its 1967 Protocol.

[5] Specifically, the Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children, supplementing the United Nations Convention against Transnational Organized Crime; the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families; ILO Migration for Employment Convention (Revised), 1949 (No. 97); ILO Migrant Workers (Supplementary Provisions) Convention, 1975 (No. 143); the Convention relating to the Status of Stateless Persons and the Convention on the Rights of Persons with Disabilities.

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[7] Blau, S. Roberts, J. Cunha, E. Delabarde, T. Mundorff, A.Z. and de Boer, H.H. (2023). Re-examining so-called 'secondary identifiers' in Disaster Victim Identification (DVI): Why and how are they used? Forensic Science International, 345

[8] Cappella, A., Solazzo, R., Mazzarelli, D., Gibelli, D., Dolci, C., Sforza, C., & Cattaneo, C. (2024). The potential of facial nevi in personal identification. Scientific Reports, 14(1), 6206.

Beyond the forensic turn: Addressing missing migrants is not solely a DVI issue

Simon Robins
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***Intro* — Will be aware that this is a bit of a hobby horse of mine – want to expand on my implicit critique of an exclusively DVI-driven approach to MM; Want to raise some issues that challenge how we think about and approach addressing the issue of missing migrants – what is the problem we are trying to solve?; This is not a critique - but a provocation; An expression of some of the discomfort I feel with how much of the work in this area is framed**

FIRST POINT: WHO IS THIS WORK FOR?

In all my work with victims of violence, including families of missing persons, I have referenced a v-c approach: what does this mean?

Where the missing are dead, it means we work with the dead to aid the living – people are missing because they are missed – I would start by asking what the living want? What value does our work hold if we fail to address such needs?

Do we know what they want? In all our discussions, there is relatively little engagement with the needs of the families of missing migrants.

- Reflects a lack of data – but also a lack of interest in collecting that data, compared to data from the dead;
- Maps onto challenges with collecting AM data – same source!
- We can make assumptions – families want answers, want to know the 'fate and whereabouts of their loved ones.
- Additionally, we can expect a range of other impacts – this is evident from our work with other FoM and the limited work with FoMM.
- MHPSS, social stigma, and economic needs – since these often drive migration

SECOND POINT: IF FAMILIES WANT ANSWERS, HOW DO WE MAXIMISE THE NUMBER OF ANSWERS WE CAN GIVE?

Where do migrants die? All over the world – that is one of the challenges of the issue – it is delocalized – a migrant from W. Africa could have died anywhere between there and Europe

I understand we choose to work where we can…. But must understand we are sitting at one end of multiple long migrant routes [Map?]

- What does it mean to only seek to engage with bodies found at one end of those routes? Can we / should we confront this?

What fraction of bodies of dead migrants do we – i.e. anyone with forensic capacities - have access to?

- Not clear
- Those dying in the Sahara / Sinai / most of Africa – close to 0%
- Those who die in Med – can only guess – but significantly less than 100%
- How many missing migrants are still alive – e.g. in Europe 100K children?

As soon as we define the problem of knowing the fate of missing as being a DVI problem, we exclude many (a majority?) from consideration. That doesn't mean we shouldn't do it – but it demands we be humble about what we can achieve.

THE LIMITS AROUND AM DATA

Typically, DVI approaches, even where we do have PM data, are limited by challenges to access AM data: e.g. The Oct 3rd, 2013 Lampedusa shipwreck – enormous resources devoted to it – 31/361 IDd bodies recovered - but around 6% of all deaths (Oliveri, 2013) NOTE – NEWER FIGURES ARE AVAILABLE FOR THIS!

- Most cases have a far lower success rate.
- Is a DVI approach a statement that we are aiming to reach this 6% level for all cases? Is that the height of our ambition?

Cases in the Med that are solved tend to be where families are involved – i.e. if they can access the context where deaths occurred. When I was collecting data in Greece most IDs were made from photos, not from DNA - not sure if that is still the case

Barriers include:

- A lack of interest from authorities in Europe
- Fear of migrants in Europe
- It is hard to access some countries of origin (e.g Eritrea) – but almost no-one ever tries!
- What are the obstacles – and why is there essentially no research effort do so? Not this project, but globally…

Only efforts to systematically engage with FoMM tend to be made by diaspora or other groups

Remains the greatest obstacle to forensic DI of MM

In practice we see that in Europe the integrated approach is really absent – lots of data are not collected

How do we help families of those whose bodies are not found? Have we given up on these?

BEYOND GENETIC IDENTIFICATION

The DVI focus has also de-emphasised the collection of other forms of data that can both 'solve' cases and be highly meaningful to families. In particular, here I mean witness testimony: in the many cases where there are survivors when others die (not just shipwrecks but trips by land, notably…)

- Such information is often more accessible and easier to collect and process than forensic data.
- Not unproblematic to collect from traumatised survivors – but little efforts made…
- And it is often more readily understood and accepted by families – particularly if it comes from someone they know or share language & culture with
- And yet, such data are not systematically collected in most contexts.

Lots of other forms of data can constitute what might be called 'partial answers' to families, i.e. they strongly suggest a fate but are not definitive, e.g. documents found in a shipwreck, photos of a body posted on social media, etc

One operationalisation of the use of such data has been made by J-P Barayabar in an ICRC study, using complex network analysis to leverage multiple disparate data sources (2021-22)

- Boat that departed W. Sahara for the Canaries found with 3 bodies, 3 phones and 3 identity documents
- Used data from: families, survivors, other travelers, witnesses, smugglers, social media, authorities…
- Fuzzy matching used to make connections
- Passenger list of 33 persons reconstructed
- Labour intensive – but shows what is possible
- An event-based approach to leveraging all possible data about a missing migrant

Possibilities for using social media

- An example of this is the Forensic Missing Migrant Initiative – Jan Bikker:
- using social media data, including that shared systematically by smugglers,
- Can identify candidate identities for bodies held by Greek authorities

Huge potential to use social media and AI approaches – i.e. facial recognition, but technically challenging and real data prot issues.

These will not replace a DVI approach – but can complement it

APPROACHES THAT FAMILIES UNDERSTAND

A broader critique of a DNA approach;

In many contexts, families don't understand genetic ID

- Demands intensive 'capacity building', this scientific knowledge rather than engaging with the epistemologies of the people and cultures who have to process the experience of 'missingness'.

Families prefer methods that they relate to – such as witness statements or evidence of documents found on bodies, even where these are 'partial' and not definitive scientifically

- more meaningful and relevant for local communities
- whose subjectivities and epistemologies are centred in the production of such knowledge

Intersects with a broader critique of the forensic turn:

- forensic knowledge as the globalisation of 'modernity'
- corporeal epistemology & the privileging of bodies and their material relics as being the principal route to substantiating truth claims after death
- Has replaced traditional culture of witnessing as a route to truth
- There is a need for forensic practitioners to engage with local ways of knowing the missing

In some contexts, families have their own approaches that leverage their own epistemologies

- e.g. 'spectral forensics' - Spirits as epistemic resources in responses to the dead and missing (Robins & Kent, 2024)
- These are crucial where there are no resources - they can't do genetic ID
- Not suggesting this as an alternative to DNA – but we need to acknowledge that many of the people we work for do not share our privileging of forensic truth.

REORIENTING AN APPROACH

Whilst I want to point out that there are lots of challenges with a DVi approach to MM, and many other sources of data we should consider.

I am really advocating for a reorientation of how we approach the problem of missing migrants.

The approach the project takes - which is a dominant one – starts from who and where we are:

- We are in the Global North and we experience missing migrants primarily as bodies on our beaches – so we work with those bodies, with the technologies we have and with all the limitations I have outlined
- Since we have resources and families in countries of origin, these are not the dominant approaches.
- We use the technologies with which we are familiar

Do we risk reproducing elements of an anti-migrant narrative that sees migration solely in terms of how it impacts states of the Global North that are migrant destinations?

I am advocating for starting not (only) from the bodies we find, but also from the family that is missing someone. This is an articulation of a VC approach in this context.

What if we rather started from the families whose needs we are trying to address, how would that change things?

- If we start from AM data - not PM – then we don't automatically exclude lots of relevant data
- We start with a more compete / less incomplete record of who is missing – who we are looking for
- We are better able to ground ourselves in families' needs, and ensure that families are a part of the process – which in turn will optimize the quality of the data we can access

CONCLUSONS

I again am not critiquing the project as much as saying it is not enough;

We need to centre families and the living, not only to go beyond DVi approaches but even to collect they AM data that will enable a DVI approach;

We need to think about all the bodies to which we do not have access in contexts where there are no capacities – how do we begin to address those?

How do we decentre our own perspective and rather centre those of families?

Ocean Modelling for Forensic Investigations and Search and Rescue Operations

Tomasz Dabrowski
Marine Institute, University College Dublin
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***Intro* — The Ireland's Marine Institute (MI) was set up under the Marine Institute Act 1991: to undertake, to coordinate, to promote and to assist in marine research and development and to provide such services related to research and development, that in the opinion of the Institute, will promote economic development and create employment and protect the marine environment. The oceanographic services team maintains a suite of operational forecasting models for Irish waters and develops downstream services for various marine sectors. Amongst the services provided are the ones supporting search and rescue and forensic investigations. These are based on forecasted ocean currents and use so called particle tracking models, whereby objects (the particles) can be releases at any location and time in the ocean and their trajectories tracked.**

INTRODUCTION

The presentation covered four cases, where the MI were asked for assistance with ongoing forensic investigations:

1. Forensic investigation #1 Dublin Bay – most likely entry points for a body part

Case:

- Body part found on the beach in Dublin Bay on 8th Feb 2011

Question: is it possible to identify most likely entry points at sea for this body part? Outcome: The MI presented the range of scenarios based on different entry times and locations and were able to identify most likely entry points.

2. Forensic investigation #2 Fanore Beach – pathways from known entry point

Case:

- Body of a woman found on Fanore Beach at 07:50 on 31 March 2011
- Arrested suspect admitted to killing and disposing of the body on 28th of March between 00:00 and 02:00
- Based on all evidence, Police identified the most likely entry point (see Map 1) and time 28 March 2011 between 00:00 and 07:00

Question: is it possible that the body of the woman was transported from the entry point to the discovery location.

Outcome: The MI confirmed that it was likely with highest likelihood being for the entry time between 00:00 and 02:00.

3. Forensic investigation #3 Galway Bay – is displacement possible in a given timeframe?

Case:

- Body found around the Lettermullen Island in Galway Bay on the 16th of August 2012
- Request from the police to investigate if any particles released from Galway Harbour on the 10th of August reach Lettermullen before the discovery date

Outcome: Most particles arrived at the discovery location in less than 2 days. Number of scenarios proposed.

4. Forensic investigation #4 Galway Bay – reconstruct displacement of a body.

The Marine Institute received a request from Garda XX, Oranmore, for assistance in reconstructing the movement of a body of a local fisherman, Mr YY, in Galway Bay during the period 22-23 November, 2017. This request originated from coroner, Dr ZZ, who wished to know how the meteorological and tidal conditions during this period would have contributed to the transport of a body which entered the water off Silverstrand, Galway and washed up at Rinville, Oranmore on the 23rd November.

Outcome: The simulations confirmed that the currents were likely to transport the body to the discovery location within the timeframe.

ADRIFT

The presentation then concerned a web application called ADRIFT (https://adrift2.marine.ie/), developed by the MI and used by Galway Lifeboat Station and some stations of Ireland's Coast Guard. In the web app, the user can set up a simulation and track c.90 different objects floating at the sea surface and an object being transported at seabed. The simulation can be set up in few simple steps and the results can be viewed within minutes.

The MI also provide on-request tailored simulations for An Garda Síochána Missing Persons Bureau, usually between 5-10 requests per annum. We need information as accurate as possible as to the timing and location of entry to the water. We also take information on clothing to determine the likelihood of the person to remain afloat, but we routinely run a surface and seabed scenario. We also consider a scenario of a body to remain at seabed and being transported by seabed currents for a period of 10 days and resurface and being transported at sea surface. As part of this service, we also studied connectivity between Ireland and the UK taking into account wide range of tidal and weather conditions and produced connectivity maps and tables providing information on most likely points of arrival along the UK coastline of the missing persons entering the sea along Ireland's coastline and the average time it takes.

CONCLUSONS

Finally, details of a model skill assessment study were presented for five different cases as well as a GSM tracker that the MI uses to study likely trajectories of objects in the areas not covered by the numerical models.

Convolutional Neural Networks (CNNs) for Sex Estimation in Disaster Victim Identification (DVI): A Review

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***Abstract* — Convolutional Neural Networks (CNNs) have emerged as a promising deep learning tool for sex estimation from skeletal remains. However, their application in Disaster Victim Identification (DVI) presents unique challenges due to the often fragmentary nature of remains and the need for rapid, accurate identification. This review aims to provide an overview of the current state-of-the-art in CNN-based sex estimation using various biomedical imaging techniques, while also highlighting the specific challenges and opportunities within the context of DVI.**

A review of existing literature was conducted to evaluate the accuracy, methodologies, and limitations of CNN models applied to different skeletal elements for sex estimation. Key findings include a predominance of studies utilising orthopantomograms (OPGs), which may skew overall accuracy due to the selection bias in data collection. While OPGs offer high accuracy, their reliance on intact maxillae and mandibles makes them less feasible in DVI scenarios where remains are often fragmentary. Computed tomography (CT) scans, on the other hand, consistently demonstrate high accuracy across various skeletal elements, except for vertebrae. Photographs, while less accurate than CT scans, show promising results for certain skeletal elements like lumbar vertebrae and humerus.

Several challenges were identified in the application of CNNs to DVI. Population data bias, a common issue in many studies, raises concerns about the generalizability of models to diverse populations. The majority of studies focus on intact skeletal remains, limiting their applicability to DVI cases where remains are often fragmentary. Additionally, The limited availability of post-mortem training data further restricts the generalizability of models to real-world DVI scenarios.The Lack of transparency and explainability in many CNN models hinders their adoption in forensic practice.

To address these challenges, future research should focus on expanding training datasets to include post-mortem samples and fragmentary remains. Cross-validation studies across diverse populations are essential to ensure the generalizability of models. The potential of photographs as input images should be explored due to their practicality and accessibility in DVI contexts. Integrating explainable AI techniques can enhance the transparency and interpretability of models, fostering trust and adoption in forensic practice. Finally, fostering interdisciplinary collaborations between forensic anthropologists, computer scientists, and other relevant experts is crucial for advancing the application of AI in DVI. By addressing these challenges and leveraging the potential of CNNs, significant progress can be made in improving the efficiency and accuracy of victim identification in disaster situations.

Use of Drone Technology to Locate and Identify MDV Remains

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***Abstract* — Migrant Disaster Victim Identification (MDVI) is a growing problem in Europe and the Southwest United States. People fleeing oppressive regimes or seeking economic improvements to their lives are entering European countries and the U.S., avoiding traditional ports of entry. Many of these migrants never make it to their dreamed-of destination, and still more are lost, their remains awaiting discovery by happenstance. With existing drone and "machine learning" technology, there may be opportunities to assist in discovering and recovering these lost souls. Depending on the size of potential areas of interest and the availability of financial resources, drones can search remote areas to record potential human remains and return that data to human analysts for confirmation. At a higher level, drones can be "trained" to recognise potential human remains and mitigate the need for human intervention. This paper intends to, at a high level, address the left and right limits of drones and Artificial Intelligence as a tool to locate and identify migrant disaster victims. Through the technology and algorithms developed and deployed by AeroVironment, adaptation for MDVI.**

Current Use Cases and Applications from the U.S. perspective

The United States military and intelligence community, not surprisingly, are big consumers and deployers of Surveillance, Persistent Observations, and Target Recognition (SPOTR) drone technology and algorithms. This User Interface (UI) approach to provide force protection, overhead imagery analysis, airborne computer vision surface target detection, object detection & recognition, surface hazard assessment and data annotation are mission essential elements of military and covert operations to mitigate threats to deployed and engaged personnel as well as assess the "ground space" wherein operations may occur. The technology that would best adapt to the MDVI enterprise would be the airborne computer vision platforms and supporting algorithms with SPOTR-Edge Drone Control UI visually-guided navigation. This technology can:

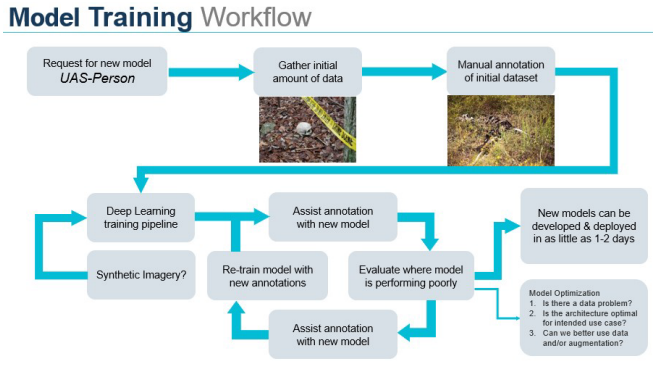
- Process video onboard the Unmanned Aircraft System (UAS) to detect, track and re-identify objects of interest
- Navigate in GPS denied areas via visual terrain matching
- Access areas of interest that are difficult to access by vehicle or on foot or may be completely inaccessible

It's the "detect objects of interest" element of the SPOTR-Edge algorithm that could be "trained" to locate and identify human remains.

SPOTR-Edge is a video-analytics software solution designed specifically for embedded processors (robotic systems, edge devices, etc.) and has been integrated and demonstrated with a wide range of UAS drones as well as larger manned and unmanned platforms. The software can consume video and sensor/platform metadata providing outputs of object detects with geolocation and key points. It can generate orientation in standard data formats and/or as visual overlays for an operator to review and assess. This proposed capability could be delivered as a processing solution (with drone technology supplied by the requestor) or as a complete package including the UAS platform.

Model Training Workflow

Adapting the existing algorithm to the requirements for the MDVI mission would involve utilization of Artificial Intelligence (AI) and Machine Learning (ML) to "train" the UAS to be "human remains-centric". As shown in in the flowchart below, this would include gathering and manually annotating "data sets" that included examples of human remains in various states of decomposition.



(workflow chart courtesy of AeroVironment, Inc.)

Since these images originated from real DVI casework involving migrants, they provide a realistic simulation, and the digital images associated with each subject reflected typical unstandardised AM images provided by relatives, social media or personal devices. The PM images reflected controlled images collected during PM examination or the recovery of the body.

IDENTIFYING RESEARCH AND UAS TRAINING PARTNERS

The U.S. currently has seven (7) working "body farms" that are affiliated with universities across the country. They are (in no particular order):

- University of Tennessee Forensic Anthropology Center, Knoxville, TN (the original 'Body Farm')
- Sam Houston State University Applied Anatomical Research Center, Huntsville, TX
- Texas State University Forensic Anthropology Research Facility, San Marcos, TX
- Southern Illinois University Complex for Forensic Anthropology Research, Carbondale, IL
- Colorado Mesa University Forensic Investigation Research Station, Whitewater, CO
- Western Carolina University Human Identification Laboratory, Cullowhee, NC
- University of South Florida Facility for Outdoor research and Training, Tampa, FL (the newest)

Should funding be available to conduct the research and training necessary to adapt the existing technology and algorithms to locate and identify human remains, outreach to one (or more) of these prestigious institutions would be essential to the mission's success. Additionally, the program would have to include forensic subject matter experts who would work with the algorithm engineers to articulate what the UAS should be looking for that would be anomalous to the surrounding terrain. All of these institutions would offer elements of diversity of terrain and climate that would assist with the transition efforts.

CONCLUSONS

In similar applications of this technology, the AeroVironment team has shown excellent results. There is always a trade-off between accuracy and the number of false "alarms" (false positive) results that has to be considered given the challenges and difficulties locating unknown deceased from altitudes of nearly 1000 feet. That trade-off can be optimized to meet the mission requirements. Additionally, the follow elements speak to the likelihood of success for such a mission:

- Computer Vision & AI-Based Video Analytics can dramatically reduce operator time and increase viability for large-area searches.
- Common Approach for Image Processing allows for great flexibility and data sharing across multiple platforms.
- Low-Power / Edge / Onboard Processing is key given typical constraints in bandwidth.
- Real-Time Alerting allows for multiple UAS to be cooperatively working on mission sets.
- Flexible Architecture allows for model changes/updates based on active research and development efforts.
- Construction of a Data Pipeline and a continual learning solution is the key to success.

REFERENCES

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Ryan Burns, AeroVironment, Inc.

Karsten Steinhaeuser, AeroVironment, Inc.

Potential Applications of Artificial Intelligence (AI) in Forensic Anthropological Investigations and Disaster Victim Identifications

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***Abstract* — Artificial Intelligence (AI) is revolutionizing forensic sciences, especially in disaster victim identification (DVI) and forensic anthropology. Digital tools now outperform traditional methods in speed, accuracy, and reliability.**

APPLICATION OF AI IN FORENSICS

The technological advancements have revolutionized the science for human welfare; be it physical, chemical or biological sciences. Digitalisation of evidence acquisition, analysis and reporting utilising digital tools and technologies has effectively and reliably replaced the traditional forensic investigations, particularly the evidence management in disaster victim identifications. Artificial intelligence (AI) is the simulation of human intelligence in machines which, in turn, are programmed to think, automate and interpret things like humans to mimic human brain in its actions. AI deep learning algorithms/models in forensics are primarily developed for prediction and decision-making in different forensic pursuits. Such models are designed and trained to overcome the variabilities and cognitive human errors or biasness and then applied for problem-solving and decision makings based on logical mathematical reasoning (Agrawal and Nikhade, 2022).

AI has removed human subjectivity/biasness of traditional forensic anthropological approaches like annotation of facial landmarks, estimation of soft-tissue thicknesses on MRI/CT scans, automated facial reconstructions and identification using comparison algorithms, cataloguing and studying human remains, estimation of age, sex and ethnicity from morphological features, reconstruction of skeletal and dental features, interpretation of traumatic lesions and ballistic injuries, quick and easy identification of taxonomic categorization of insects, pollens and diatoms, processing and interpreting DNA data etc.

Artificial Neural Network (ANN), General Adversarial Network (GAN), Convolutional Neural Network (CNN), Deep Neural Networks (DNN), Deep Convolutional Neural Network (DCNN), Backpropagation Neural Network (BPNN), Bayesian Convolutional Neural Network (BCNN), Decision Tree (DT), Random Forest (RF), Support Vector Machine (SVM), k-nearest neighbor (k-NN) etc., are the main AI models applied in forensic sciences.

The accurate and rapid age estimation of living individuals like migrants or asylum seekers and the refugees is a very serious challenge for the border states. Chronological age estimation is prone to uncertainties owing to biological variations and intra- and inter-observer errors, and the same can be eliminated by utilising automatic age estimation AI software/s. The AI deep learning-based bone assessment software, like BoneAge (version 1.0.3) and BoneXpert, provides precise and standardised observations and delivers automated bone age estimates for accurate forensic anthropological identifications. Such software can automatically provide bone age assessment from a child's left-hand X-ray, delivering precise and standardised readings. Morphological feature extraction, classifications and recognition based on trained neural networks is automated, extremely rapid, and independent of human expertise and biases.

Applications include:

1. Deep Learning in Victim Location and Mass Casualties

Tools like ResNet-50 and MobileNet achieve up to 99.53% accuracy in detecting trapped victims. AI can handle large amounts of data in disaster scenarios, allowing forensic experts to quickly determine the time of death for multiple victims, aiding in faster identification and investigation timelines.

2. Forensic Odontology

AI analyzes dental structures, bite marks using ANNs and CNNs for identification with expert-level precision. Advanced Image Analysis for Identification: AI-powered systems analyze dental radiographs, such as X-rays, OPGs and 3D scans, by detecting key features like tooth shape, alignment, and jaw structure. Precise Age and Sex Estimation: AI algorithms can evaluate wear patterns, tooth development, and jawbone structure to estimate the age and sex of an individual with greater accuracy than traditional methods. AI uses data from dental records to create detailed 3D models of teeth and jaws.

3. Facial Recognition

Technology assists in identifying victims, especially those with facial injuries, by reconstructing damaged facial features and comparing them to available databases, making it a critical tool in Disaster Victim Identification

4. Facial Reconstruction

AI-driven tools for skeletal identification are highly reliable for identifying victims from skeletal remains,

especially when bodies are poorly preserved. These methods offer up to 99% accuracy and can process data much faster than traditional techniques, with tools like OsteoID,ĄĘ being commonly used in this area.

5. Skeleton-Based Identification

Tools like OsteoID,ĄĘ offer up to 99% accuracy, efficiently identifying skeletal remains. AI analyzes biological markers such as body temperature, rigor mortis, and decomposition to estimate the time of death more accurately and quickly than traditional methods. AI processes multiple data points simultaneously, including microbial activity, insect presence, and tissue degradation, to refine the estimation of time since death. AI incorporates environmental factors like ambient temperature, humidity, and body exposure to enhance the precision of PMI estimation, accounting for variations that affect decomposition rates.

6. Age Estimation Tools

Software like BoneAge and BoneXpert deliver standardized age estimates from X-rays with high precision.

7. Trauma & Burn Analysis

AI aids in interpreting ante-/peri-/post-mortem injuries. Identifies bullet-specific fracture patterns and taphonomic changes.

8. War Crime Scene Analysis

AI reconstructs crime scenes, assesses injury patterns, and links victims to events or perpetrators. Helps in digital evidence management and trend identification.

9. DNA and Biomolecular Analysis

AI significantly speeds up the process of DNA analysis by quickly identifying complex genetic patterns that would take much longer using traditional methods. This is especially valuable in mass casualty events where time is critical, allowing for faster victim identification through DNA profiling. AI-powered tools enhance the accuracy of determining familial relationships and ethnic backgrounds based on DNA data. These tools can analyze genetic markers to predict kinship ties or ancestral origins. In large-scale disasters, handling huge amounts of DNA data can be challenging. AI helps by quickly analyzing and organizing this data from multiple victims, making it easier for forensic experts to match samples and identify victims faster.

Challenges: Limited datasets, variability in post-mortem factors, and need for large skeletal samples for model training.

Ethical & Legal Considerations:

AI's integration in forensic anthropology must balance technological capabilities with ethical boundaries and legal protocols, particularly in sensitive applications like war crime investigations. AI systems in forensic investigations must prioritize the protection of personal data. This means ensuring strict privacy measures are in place to safeguard sensitive information, especially when identifying victims of war crimes or disasters. AI models need to be trained on diverse datasets to avoid bias in identifications. By representing different demographic groups, these models reduce the risk of misidentification and ensure fair treatment of all individuals, regardless of race, gender, or other characteristics. Establishing international regulations is essential for the ethical and legal use of AI in forensic investigations. These frameworks should cover data privacy, transparency of algorithms, and accountability, ensuring responsible use of AI technologies worldwide.

Drawing on Lessons from Medicolegal System Evaluations regarding the Missing and Dead

Stephen Fonseca, Head of the African Centre for Medicolegal Systems, ICRC
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***Abstract* — XXX**

ICRC AND HUMANITARIAN FORENSIC ACTION

ICRC is a humanitarian institution focused primarily on conflict but also responding to needs of vulnerable persons in disasters and migration.

For 20 years, the ICRC has promoted humanitarian forensic action, building capacity of State and non-State actors to address consequences of conflict, migration and disasters, including the need to resolve missing persons, implement respectful death care, and support to affected families

CTA's ACMS is a team that develops such capacity in Africa

WHO IS A DECEASED MIGRANT IN AFRICA?

1. Migration routes in Africa go in multiple directions; migrants become part of communities along the way and at destination
2. Lack of accurate national reporting on dead migrants
3. Lack of national data on unidentified bodies and human remains
4. Lack of centralization of regional data for transnational casework
5. Policy not in-sync with practices

CONSIDERATIONS WHEN ADDRESSING MISSING MIGRANTS

Missing migrants

- Families usually don't have access to reporting missing persons cases
- Families not sure if relative dead, fear of reporting leading to arrest of missing person
- Poor family interview techniques lead to unusable information if comparison to a dead body is required
- Follow-up with family is seldom carried out; families not confident in the identification later
- Families may be concerned that claiming body will require payment
- Consulates sometimes reluctant to get involved for fear of repatriation costs for body return
- Missing persons data is seldom nationally centralized to be shared with other countries

Dead Migrants

- Migration is heavily politicized; migrant specific projects may not be a welcomed by authorities and impacted communities
- Many migrant bodies are unidentified -their nationality is unknown; where does one start looking for families
- Authorities may not have mass fatality plans nor capability –hasty burials!!
- Families may report when given access later –but need to collect ID data from dead bodies is now before burial
- Forensic authorities and municipalities need to engage on burial being temporary storage
- Missing migrants are an ongoing issue that pre-dates improved management of unidentified bodies
- Multidisciplinary to identification not always conducted
- Unidentified body data is seldom centralized to be shared with other countries

ICRC - FORENSIC RESPONSE TO MIGRATION IN AFRICA

Ensure professional death care and support of families and communities while promoting improved national reporting on missing persons and U/I bodies

Convening and guiding policy level events on preventing and responding to missing migrants

Transnational Missing and Dead Program in Southern Africa – addressing bigger issue of large numbers of unidentified bodies rather than migrant deaths

Serve as an intermediary between countries in multi-national responses to migrant dead

Guidance, training and support to wide range of authorities and civil societies addressing large case loads (policy and practice) – a systems approach

Providing equipment needed to respond effectively and to show dignity and respect to the dead and their families

Addressing legal remedies for families of missing persons

Developing and promoting tools that will allow better standardization and centralization of casework (Resolve Platform; I-Familia; trg videos)

RESOLVING THE PROBLEM REQUIRES PARTNERSHIPS AND COLLABORATION

1. African Forensic Community

Connect with local champions working in many countries along migrant routes towards regional cooperation

ACMS's African Forensic Community is now 4000+ members;

ASFM continues and the emergence of AFSA for all forensic scientists allows for additional showcasing of African expertise

2. National Societies

Isotope Project in SA

Role of National Societies to support missing persons enquiries in transnational project

3. DNA Symposiums

Partnering with DNAforAfrica to identify opportunities to improve DNA laboratory capabilities, promote regional coordination, increase support for developing countries

4. Academic Institutions

Working with many across the world training and research (forensic isotope, Missing count in Africa, scarification)

5. State Actors

Justice, Police, Forensic, Health, Military, Disaster Mgmt

International Organization Consortium (25 organizations)

IOM, UNODC and other UN entities

WHO

EAAF

INTERPOL

MDVI: The need for education and training

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I worked for ~8 years for LGC Forensics in the DNA laboratories, interpreting DNA evidence, writing statements and presenting DNA evidence in court. I then worked for 2 years with the Forensic Anthropology Foundation of Guatemala. I have worked at DMU for nearly 10 years, where I have been involved in teaching and research in Forensic Science. I have been on a journey from being a lab scientist to a social scientist.

The role of Forensic Science in Identifying Missing Migrants in Europe

My doctoral research was a qualitative study examining the role of forensic science in identifying missing migrants in Europe. I explored how forensic science is being used in this way; why this approach is being taken and how effective it is; what an ideal infrastructure to deal with the forensic identification of missing migrants in Europe might look like. I interviewed key stakeholders in the space, including those from policing, academia, forensic science, policy & civil society. Themes which emerged from the research data:

1. Terminology
2. Identification Rates
3. Complexity
4. Data
5. Politics

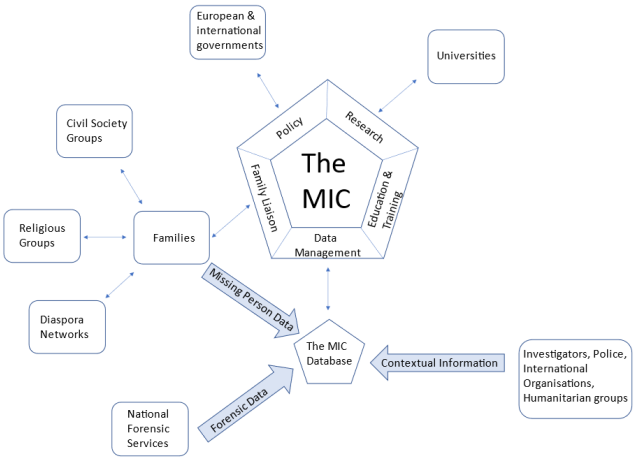
DVI Methodology (DNA)- to date there has been a reliance on this methodology, which has been proven in other contexts but may have limitations in migrant cases. Given my background, it was interesting to explore the specific limitations of DNA profiling in these cases. I believe that education about what DNA can and cannot do is important, especially as a "myth of DNA" pervades.

Trust- there may be a lack trust between migrant communities and authorities in their country of origin or destination. If the process for reporting a missing person involves reporting it to police, this is problematic. Additionally, I observed instances of mistrust between other actors in the space, particularly around data sharing.

Interdisciplinary- I argue that any attempt to address the forensic identification of missing migrants needs to be truly interdisciplinary. We need to move beyond the boundaries of the traditional disciplines. We may need to re-evaluate exactly what is considered forensic evidence and consider contextual information. Efforts must include researchers, case workers, civil society and the migrant communities themselves.

Migrant Identification Centre

This was a recommendation from my research which brings together the different strands of the project. I have to acknowledge it is a "blue sky idea" and the practical constrains, particularly given the complex political context. I believe the COST Action CA22106 Migrant Disaster Identification (MDVI) fulfils some of these functions of the MIC e.g. WG3 Policy & WG4 CPD.



(Organisation of the MIC and collaborators)

Since these images originated from real DVI casework involving migrants, they provide a realistic simulation, and the digital images associated with each subject reflected typical unstandardised AM images provided by relatives, social media or personal devices. The PM images reflected controlled images collected during PM examination or the recovery of the body.

MDVI: Education & Training

COST WG4 Continued Professional Development

In my thesis, I argued educational projects relating to the forensic identification of missing migrants need to take place on three levels:

1. Internal education among MIC divisions/ COST working groups and key stakeholders about each other's roles, responsibilities and requirements.

2. Education programmes with migrant communities which would allow the opportunity for families to learn about forensic methods and the identification processes so that they can make a truly informed decision about whether and how they participate.
3. External education work to publicise and raise awareness of the issue of migrant deaths and the lack of identifications, particularly the impact on families.

As part of the internal education, I proposed an exchange of people & ideas. Examples included:

- A forensic scientist from Tunisia would have the opportunity to spend time with a colleague in Italy to learn a new method.
- A member of the family liaison team could spend time in a forensic DNA laboratory to understand what happens to DNA mouth swabs taken from family members.
- A lab scientist could spend time in the field on a community engagement project to understand the challenges that families are facing.
- Representatives from NGO collaborators could spend time with the data management team to see how any data they share is handled and uploaded to the database.

Remaining entirely within our disciplinary siloes may be preventing progress in the field of migrant identifications.

I linked the above with the opportunities available within COST:

- Short-Term Scientific Mission Grant;
- Virtual Mobility Grant;
- Inclusiveness Target Countries Conference Grant.

I also discussed the potential role of students in the MDVI space and how WG4 could explore the creation of educational resources, as an output from the group, to support migrant communities in their decision-making processes, bridging the gap between experts and communities.

I introduced a new research project I am involved with:

Trust in forensic science evidence in the criminal justice system: The experience of marginalised groups

- ESRC-funded project; collaboration between seven UK universities.
- Considering the perspective of those who may have less of a voice in the CJS.
- Aim: co-design of a tool to mitigate distrust
- May be of relevance to MDVI

LINKS TO FURTHER INFORMATION

blog post on PhD research: https://criminaljusticenetwork.net/using-forensic-sciences-to-restore-lost-identities/

PhD Thesis: https://dora.dmu.ac.uk/items/050e33c9-bfb1-4ca7-8983-6abd91ba57db/full

Trust Project Website: https://fass.open.ac.uk/research/projects/trust-in-forensic-science

Trust Project Launch Report: https://oro.open.ac.uk/98210/

Post-mortem to ante-mortem facial image comparison for deceased migrant identification

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***Abstract*— The identification of deceased migrants is a global challenge that is exacerbated by migration distance, post-mortem conditions, access to ante-mortem data for comparison, inconsistent international procedures and lack of communication between arrival and origin countries. Due to low technology requirements, fast speed analysis and ease of transferring digital data, facial image comparison is particularly beneficial in those contexts, especially in challenging scenarios when this may be the only initial ante-mortem data available to identify the deceased. This paper describes a study using 29 forensic cases from the University of Milan, replicating a migrant identification scenario. The overall accuracy rate was 85%, with the majority (79%) of ante-mortem non-targets correctly excluded from the identification process. However, two ante-mortem targets were incorrectly excluded (one at the first stage of the protocol) and therefore changes to the protocol were implemented to mitigate these errors.**

INTRODUCTION

What is craniofacial identification? Several useful forms of analysis can be utilised for human identification. The most common analysis is the morphological comparison of a post-mortem facial image with an ante-mortem facial image. This analysis follows the international standards set out by the Facial Identification Scientific Working Group (FISWG) and involves the matching of facial detail (such as moles, scars, hair patterns on eyebrows, face and hairline, crease pattern, ear detail and facial modifications). This can be particularly useful in cases where there are no dental records or DNA profiles and appears to be frequently used for deceased migrant comparisons with passport and social media images.

FISWG publish guidelines and COPs for facial image comparison – mostly related to the living rather than the dead.

There has been some research out of the UK and Italy highlighting the importance of facial detail for the identification of deceased subjects [1-8].

In a recent study [6] into the reliability of PM-to-AM facial comparison using manual and automated comparison methods, a high reliability was demonstrated for manual 2D comparisons (100% correct ID rate and 0% false ID rate) when matching 6 PM subjects to a face pool of 30 AM faces. However, the tested automated face recognition systems struggled to register the PM images as faces at all. This suggests that currently manual comparisons are more reliable than automated comparisons.

METHODOLOGY

In this study, a protocol was developed for PM-AM facial image comparison utilising an Excel document with drop-down boxes and a guidance document with reference images. The protocol was evaluated via an inter-observer study alongside an identification study, using AM and PM data chosen from a database of forensic cases (2001–2020) from the University of Milan, provided by the Laboratory of Forensic Anthropology and Odontology (LABANOF). The images were acquired as part of forensic judicial investigations and in accordance with the Italian Police Mortuary Regulation, approved to by the Milan prosecutor's office (Pubblico Ministero) and signed by the relatives and medical examiners. LABANOF received ethical approval from the Public Prosecutor (Milan), and the ethical committee of the University of Milan. Full ethical approval for image utilisation was gained from Liverpool John Moores University and the human participants (observers) provided informed consent. Only facial images were utilised in this research.

The identification study was carried out using a single-blind approach. The supervisory team (from LABANOF and Face Lab) selected subjects from a DVI database where the deceased had been identified previously. The supervisory team selected subjects from an archive of 105 unidentified Italian forensic cases and identified migrant cases, for which AM photographs of the face were available. The final 29 cases were over 18 years of age with at least one available AM and

PM facial image. The supervisory team anonymised the data using alphanumeric code for each subject.

Since these images originated from real DVI casework involving migrants, they provide a realistic simulation, and the digital images associated with each subject reflected typical unstandardised AM images provided by relatives, social media or personal devices. The PM images reflected controlled images collected during PM examination or the recovery of the body.

The protocol included:

Phase 1.1— Antemortem Image Analysis: including subject factors (such as gender, skin tone and age), image factors (such as noise, exposure, camera distance) and identifiable features (such as moles and scars).

Phase 1.2— Postmortem Image Analysis: including the same subject factors, image factors and identifiable facial features (either from the autopsy report or from visual analysis), along with additional decomposition stage scores and any other PM modifications recorded. Decomposition scores were based on published standards.

In Phase 2, a review was undertaken where exclusion of non-matching AM subjects was based on phase 1 records. Excluded AM subjects did not progress to phase 3.

In Phase 3, full comparisons were undertaken, including PM-to-AM analysis to identify similarities and differences or to determine features that could not be compared. Differences that may be due to PM changes or image factors were recorded.

Phase 4 included evaluation of phase 3 results to determine a level of support for each phase 3 AM subject being the target for the PM subject. The level of support refers to the degree of confidence that can be attributed to a match and measures the strength of the available evidence. The 5-point scale used for the level of support is adapted from Moreton (2021). Pairs scored as 1–4 (limited to strong) level of support for a match were recorded as a potential match. Pairs scored as 0 level (no) of support were recorded as non-matches.

We analysed the true positives, true negatives, false positives and false negatives in order to establish the accuracy rate following the equation below.

$$\text{Accuracy rate} = \frac{\text{True Positives} + \text{True Negatives}}{\text{True Positives} + \text{True Negatives} + \text{False Positives} + \text{False Negatives}}$$

RESULTS

Most cases had one or more antemortem images of moderate quality and some images demonstrated photo-retouching or filters. Most postmortem subjects recorded low levels of decomposition. The large majority of subjects were excluded at phase 2 and only 71 full comparisons were carried out. One target was excluded at phase 2 and one at phase 4. 71% of correct matches demonstrated high levels of support (3 or 4).

The true positive rate was 93.1% (27 of the 29 AM targets were matched to the correct PM subject) and the true negative rate (specificity) was 79.1% (34 of the 43 non-targets were excluded). The false positive rate was 21% (9 of the 43 non-targets were matched to PM subjects) and the false negative rate was 7% (2 of the 29 AM targets were excluded). Therefore, the overall accuracy rate was 84.7%.

After phase 4, the PM subjects were recorded with between 1–3 potential matches, with 79.3% (n = 23) recording only one potential match and only one PM subject (3.4%) recording three potential matches. If an identification decision had been made based on the AM subject that received the highest level of support for a potential match at each PM subject, three of the PM subjects would have been incorrectly identified (false positives). This would produce a true positive rate of 89.7%, a true negative rate of 93%, a false positive of 6.9% and an accuracy rate of 91.7%.

For the PM subject who received three potential matches after phase 4 (the target and two non-targets), the target received a lower level of support (limited) than one of the non-targets (moderate). However, in a real DVI situation, the target would not be excluded, and confirmation of identity would be attempted using primary identifiers where possible for all potential matches.

After phase 4, 72.4% of the PM subjects (n = 21) were only matched to the targets (no non-targets as potential matches). In total, 71.4% of the true positives were recorded with high levels of support (support or strong support), whilst 29.6% were recorded with low levels of support (limited or moderate). The false positives were all recorded with low levels of support (limited or moderate). In the two cases where false negatives (targets excluded) were recorded, the non-target matches were scored at the lowest level of support (limited). One target was excluded in the review phase due to facial mark inconsistency (tattoo and mole present at PM and not visible AM). The other target was excluded at the evaluation phase and this subject presented only one AM image and did not have any visible identifying marks. Both excluded targets recorded low numbers of AM images (1–2) with low image quality and one image presented alterations.

Subjects with a low number of AM images available were more likely to receive an inconclusive level of support. This contributed to both false negatives and false positives. The highest level of support was recorded more frequently where the AM subject had at least one high-quality image.

During the comparison phase, it was noted that inherent PM changes made certain features less useful for analysis than in living facial image comparison. For example, in the majority of comparisons, assessment of the eyes or skin colour was not possible, and photo-retouching negatively affected the assessment of skin colour. In addition, nasal shape appeared different between AM and PM images for a number of subjects, even when other identifying features suggested high levels of support for a match; the PM nasal tip shape appeared more downturned than in the AM images.

In the large majority of cases (80%), all three practitioners recorded similar levels of support with only one level distinction between practitioners. The inter-observer reliability was calculated using the Intraclass Correlation Coefficient (ICC) and Kendall's Coefficient of Concordance. The ICC two-way mixed model on absolute agreement was used to analyse inter-observer reliability for the level of support expressed by all 3 observers [79]. The values of the ICC range from 0 to 1, with a higher value signifying better reliability. ICC less than 0.40 was considered poor, between 0.40–0.59 as fair, 0.60–0.74 as good, and greater than 0.75 as very good [79]. The ICC was 0.813 with a 95% confidence interval between 0.620–0.923, which is considered a good inter-observer reliability score. In addition to the absolute

agreement, Kendall's Coefficient of Concordance (W) was calculated to take into account the degree of agreement among the three observers [80]. In other words, the test helps to differentiate between levels of supports with only one point of difference versus not close at all. Kendall's coefficient ranks from 0 to 1 with higher values close to 1 highlighting a strong inter-observer agreement. Kendall's coefficient was found to be 0.885, which suggests good inter-observer agreement.

Practitioner/observer 1 recorded 100% true positives, 87.5% true negatives, 6.7% false positives and 0% false negatives. The overall accuracy rate was 93.3%. Practitioner 1 had the most experience (30 years) in facial image comparison.

Practitioner/observer 2 recorded 100% true positives, 37.5% true negatives, 33.3% false positives and 0% false negatives. The overall accuracy rate was 66.7%. Practitioner 2 had moderate (two years) experience in facial image comparison and was the most cautious in the choice of level of support, never recording the highest level of support (4) and less likely to record no support (0).

Practitioner/observer 3 recorded 100% true positives, 75% true negatives, 13.3% false positives and 0% false negatives. The overall accuracy rate was 86.7%. Practitioner 3 was newly trained in facial image comparison.

Overall, the practitioners/observers recorded 100% true positives, 67% true negatives, 17.8% false positives and 0% false negatives, and the overall accuracy rate was 82.2%.

CONCLUSONS

There were a number of recommendations from this research and the protocol and excel chart are provided with the open access publication for practitioner use.

- We suggest that only subject factors should be utilised for exclusion at phase 2 to limit false negatives.
- We also suggested a 4-point scale instead of a 5-point scale to limit observer variation.
- The eyes, nasal tip shape and skin colour were found to be unreliable even at early decomposition stages and therefore should not be included in the analysis.
- We recommend a focus on highly distinctive features such as marks, ears, teeth and modifications.

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Investigating Cranial Non-Metric Traits for Identification in a Humanitarian Forensic Case

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***Abstract*— Personal identification is a scientific procedure that evaluates the concordance and uniqueness of AM and PM data based on primary and secondary identifiers, according to their reliability. However, it has been demonstrated that primary identifiers may fall short specifically in extreme scenarios which have unfortunately become routine for forensic anthropologists, such as the migration crisis. Moreover, in forensic anthropology, AM-PM comparison allows only a qualitative assessment. This was recently addressed by Forensic Anthropology Society of Europe (FASE) which reported the need for novel tools to interpret findings and strengthen the ID activity within a support statistical framework.**

Some attempts in this sense have been previously made using frequencies of morphological variants. The study by Watamaniuk and Rogers provided the first example where probabilities that an individual present a combination of variants were produced, based on the calculation of frequencies and compound frequencies which are then multiplied by the ID universe, which is the group in which I am looking for the possible identification.

Moreover, it is possible to calculate the likelihood ratio of an identification using again compound frequencies.

My group and I have recently attempted to apply this approach to cranial non-metric traits. As frequencies of non-metric traits can be calculated in a population group or skeletal sample, non-metric traits seem a suitable tool for this kind of quantitative approach. In our tests on 100 crania and 12 traits, we obtained rather satisfying results with considerably low values of compound frequencies.

The study I am presenting today extends this research line and applies this approach to a sample of crania from the 18 April 2015 shipwreck, for which LABANOF is appointed as the scientific coordinator of the identification activities. Over 500 people travelled on this boat and we have recovered 28,000 commingled bones, including 323 isolated crania. Circumstantial evidence suggest that the individuals came from Subsaharan countries and anthropological and genetic analyses determined that only males are represented by the remains.

I just want to stress that everything we do on the skeletal remains of this shipwreck aims to collect data that will be possibly used to identify the victims. All data included here were thus collected with the intent of reaching identification.

So this research stems from a larger project which was recently funded by the European Union, called FRANTIC, which aims to analyse cranial non metric traits to find a key for their use as personal identifiers. Among the samples considered by the project, is that of the shipwreck of 18 April 2015 which provides frequencies of non-metric traits in a modern-day skeletal sample from the Sub-Saharan region. For this study, we collected data on the traits, calculated related frequencies and applied the statistical approach to investigate the possible application of a novel tool that may provide a quantitative value to identification.

So for this study we took 119 crania that had been already tested for DNA and for which the data collection of the variants was available. We considered 35 traits scored by presence or absence, which created a binary code for each cranium. The frequencies of the variants were calculated as well as the compound frequency of each cranium indicating the pattern of variants present in the cranium. Finally, we calculated probabilities and likelihood ratio of a cranium to present a specific set of traits.

Moving on to the results, this is the frequency distribution of the traits. Mastoid foramina and a single hypoglossal canal were most commonly present, whereas bipartite parietal bone and temporal squama were most commonly absent as they were never observed.

We also performed a correlation analysis to assess the independence of the variants, which is preliminary to the calculation of probabilities and LR. These 6 variants shown a correlation value between 0.7 and 1 between the right and left

side, therefore we preserved only one side for the calculation of the compound frequency.

Most of the compound frequencies were between the order of magnitude of 1 to E-10 and 1toE-13. The arrows indicate the highest and lowest compound frequencies.

Probabilities of a cranium to present the set of variants recorded were calculated by multiplying the compound frequency and the size of the ID universe, which corresponded to the number of missing reports we collected in the last 10 years for this disaster. In this example, it is clear that even the highest compound frequency resulted in a remarkably low probability to find another individual with that set of traits within a group of 289 people.

The calculation of likelihood ratios yielded very promising results as all the LR were above 1 million, which is the highest threshold that indicates an extremely strong support to the hypothesis that a specific cranium presents a specific pattern of traits.

This pilot study demonstrated that combinations of cranial non-metric traits have an individualizing potential which is worth of further investigation to provide a statistical framework to personal ID based on anthropological identifiers, hence producing a quantitative value supporting the ID. The results presented here produced more satisfactory results than previous tests which applied the same statistical approach to nevi. However, to fully understand the concrete significance of the results we have to extend the analyses to the remaining crania from the disaster. Moreover, we may improve the results by reducing the ID universe based on other age-at-death for example, which would lead to lower probabilities and likelihood ratios. This approach may be strongly hampered by the lack of antemortem material showing these traits, a considerable setback for this scenario. However, it could have a potential application to other individuals already on the territory that had been hospitalized. Nevertheless, we may never know the origin and type of data that would lead to Identification, therefore continuing this research line by collecting data on known populations may benefit the possible development of this novel tool.

To conclude, we have seen that non-metric traits represent ideal candidates to apply the probabilistic approach for identification. However, this does not want to be a standalone ID method or a replacement to well-established identifiers, rather an additional tool to screen potential identities and provide quantitative evidence to the investigators and the judge. Despite the challenges, what if we can combine the LR from non- metric traits with the other identifiers? Would this change the paradigm of morphological identifiers?

CONCLUSONS

There were a number of recommendations from this research and the protocol and excel chart are provided with the open access publication for practitioner use.

- We suggest that only subject factors should be utilised for exclusion at phase 2 to limit false negatives.
- We also suggested a 4-point scale instead of a 5-point scale to limit observer variation.
- The eyes, nasal tip shape and skin colour were found to be unreliable even at early decomposition stages and therefore should not be included in the analysis.
- We recommend a focus on highly distinctive features such as marks, ears, teeth and modifications.

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Migration–related fatalities in Greece: From recovery and hypothesis to identification

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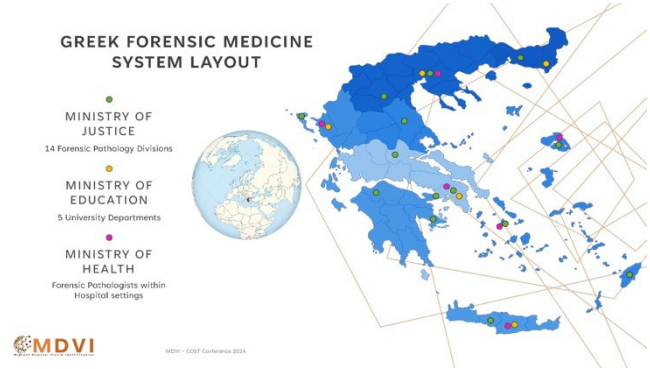
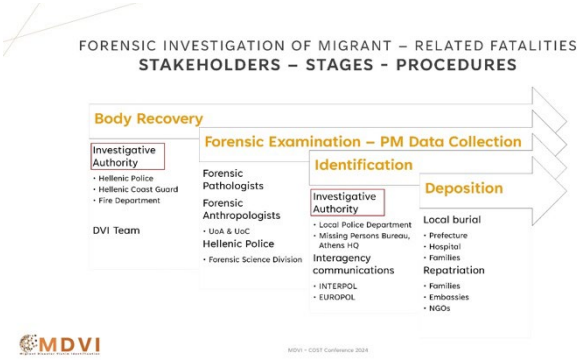
***Abstract* — Greece is a country located on the southernmost part of the Balkan Peninsula at a location frequently referred to as a crossroads of three continents. As such, over the past several years, Greece has become the recipient of multiple migration–related influxes. Migration–related fatalities are always subject to legal investigations, including the performance of a postmortem examination (autopsy) as per Greek legislation. However, the scale of this humanitarian crisis is considered to be grossly underestimated due to the low recovery rates, especially in marine settings.**

Forensic Departments & Procedures

In Greece, the Medicolegal System is divided between three different Ministries: the Ministry of Justice, Transparency & Human Rights, the Ministry of Education & the Ministry of Health. The Ministry of Justice is providing forensic medical services for most of the country through 14 Forensic Pathology Divisions. Additionally, 5 University Departments are in place: in Athens, Thessaloniki, Crete, Ioannina and Alexandroupolis. Those departments also offer Residency Positions for the training of Resident Doctors specializing in Forensic Pathology. Finally, several Forensic Pathologists are employed by the Ministry of Health and can be affiliated to any of the aforementioned departments, operating within hospital settings.



Regardless of the department, in order for a forensic investigation to be conducted, an official inquiry must be issued by an Investigative Authority, most commonly the Hellenic Police or the Hellenic Coast Guard. The postmortem examination, conducted by Forensic Pathologists with or without the contribution of Forensic Anthropologists, includes a full autopsy, toxicological analysis and for some cases histopathological examination. In the Forensic Medicine Unit of the University of Crete a full body post mortem CT scan is also performed on all cases involving migration fatalities, unknown and / or decomposed remains. Identification is a comparative process which, in Greece, falls under the jurisdiction of the Hellenic Police. Forensic Specialists, including Forensic Pathologists, collect and analyze postmortem data but they do not make official decisions regarding positive identification.



Data Collection: Types of Migration-Related Fatalities

Since 2021, the authors have been collecting data for unidentified human remains in Greece, with a special focus on migration–related fatalities. So far, data has been collected from three State Forensic Departments: the Forensic Medicine Unit of the University of Crete (East Crete), the Forensic Pathology Division of Crete (West Crete) and the Forensic Anthropology Unit of the National & Kapodistrian University of Athens (anthropological casework, mainland Greece and islands). All cases of originally unknown remains were collected from the physical archives and digitized. Information regarding recovery date and location, state of decomposition, identity status, etc, was imported into a digital database. Photographic evidence of the deceased during recovery and autopsy were collected, as well as of personal items associated with the remains when present.

i. Confirmed migration fatalities

Out of over 600 cases collected, only 57 pertained to confirmed migration – related fatalities with a positive identification rate of slightly over 50%. Those cases almost

exclusively pertained to mass casualty events: four migrant shipwrecks from the years 2004, 2010, 2020 and 2021. Most of the deceased individuals were young adult males (<40) from multiple countries of origin including Syria, Afghanistan, Iraq and others.

ii. Presumed migration fatalities

Additionally, a constantly expanding cohort of fatalities is being identified through the dataset (approximately 12% of all cases), pertaining to singular bodies recovered from the sea in mostly advanced stages of decomposition. In such instances, identification attempts become more complex due to a lack of context, obvious identifiers and unknown origins of the bodies. No positive identifications have been achieved so far for cases examined during the years 1988 - 2022. From a medicolegal perspective, all such cases are considered and handled as presumed migrants once the possibility of the remains belonging to local persons or tourists has been excluded.

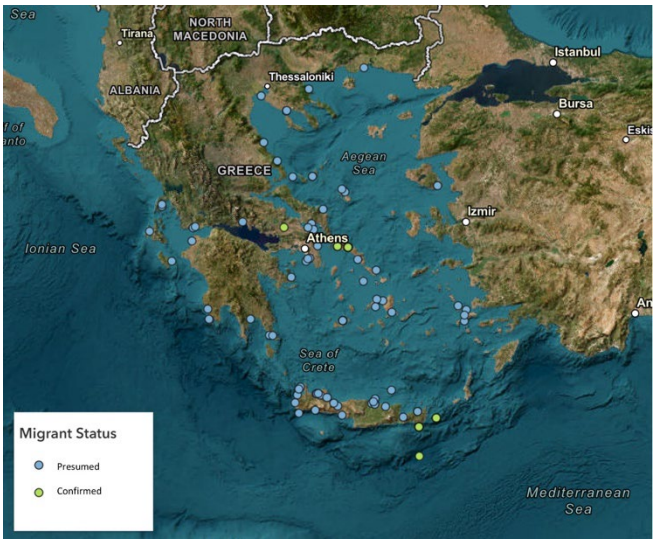
iii. "Invisible" migration fatalities

Another, often ignored, category of migration–related fatalities pertains to undocumented migrants already residing in Greece. A typical manifestation of such casework involves individuals whose families are either not in the country or are afraid to report the individual's disappearance or death to the authorities out of fear for deportation and other legal repercussions. As a result, bodies can be discovered even at advanced stages of decomposition in residential areas or abandoned buildings. Identification of such individuals can be especially challenging as communities are often reluctant to come forward to the Police but do occasionally contact Forensic Departments.

CAPACITY BUILDING: POST-MORTEM MIGRANT DATA REPOSITORY

1. Digitization & Centralization

The Forensic Medicine Unit team (EK - DF) have been working on the design, development and beta testing of a digital forensic information system (IPPASOS – add publication) to facilitate day to day casework handled by the Department. A special feature has been added for the input of data (forensic reports, photographic evidence, imaging data) pertaining to unknown remains which leads to the creation of an automatically renewable database of unidentified individuals. The information from the aforementioned database can easily be extracted to be shared with investigative authorities and other pertinent stakeholders for purposes of one to many or many to one cross – referencing. New collaborations are being developed for the expansion of the database to include casework from other Forensic departments in order to address casework dispersion and produce a clearer image of the full scale of the phenomenon. At the same time, a mapping endeavor of recovery and depositional locations is in progress for all cases.



2. Cross–referencing attempts

An ongoing collaboration with the Missing Persons' Bureau of the Hellenic Police has been underway since 2021 for purposes of interagency data cross–referencing. The department above is the reference and coordination point for all investigative authorities when it comes to missing persons and unknown remains. A digital database for all pertinent information stemming from the police investigations is in place, only accessible to Law Enforcement personnel for the time being. Data extracted from both databases is being compared and updated to include both forensic and investigative data. Preliminary results suggest that there is a major data loss along the way which is potentially hindering identification attempts for both migrant and non migrant deceased individuals.

3. Introduction of novel methodologies: Imaging & Craniofacial Approximation

Currently, the Forensic Medicine Unit of the University of Crete is the only Forensic Department in Greece to routinely perform post mortem computed tomography scans. This kind of imaging data is invaluable, especially in cases of unidentified individuals and presumed migration – related fatalities as it "immortalizes" skeletal information otherwise lost with burial. At the same time, 3D renderings and segmentations of the skulls are being produced and craniofacial reconstruction attempts are underway, in collaboration with the Face Lab of Liverpool John Moores University. Finally, discussions are being initiated with Law Enforcement Officials to introduce the concept of craniofacial identification while actions to raise public awareness are being planned.