



## Forensic Anthropology Population Data

## The clandestine multiple graves in Malaysia: The first mass identification operation of human skeletal remains



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## ABSTRACT

The first ever mass identification operation of skeletal remains conducted for the clandestine graves in Malaysia consisted of 165 individuals unearthed from 28 human trafficking transit camps located in Wang Kelian, along the Thai-Malaysia border. A DVI response was triggered in which expert teams comprising of pathologists, anthropologists, odontologists, radiologists and DNA experts were gathered at the identified operation centre. The Department of Forensic Medicine, Hospital Sultanah Bahiyah, Alor Star, Kedah, located approximately 75 km away from Wang Kelian, was temporarily converted into a victim identification centre (VIC) as it is the nearest available forensic facility to the mass grave site. The mortuary operation was conducted over a period of 3 months from June to September 2015, and was divided into two phases; phase 1 involving the postmortem examination of the remains of 116 suspected individuals and for phase 2 the remains of 49 suspected individuals. The fact that the graves were of unknown individuals afforded the mass identification operation a sufficient duration of 2 weeks as preparatory phase enabling procedural and daily victim identification workflow to be established, and the setting up of a temporary body storage for the designated mortuary. The temporary body storage has proven to be a significant factor in enabling the successful conclusion of the VIC operation to the final phase of temporary controlled burials. Recognition from two international observers, Mr. Andrés Patiño Umaña, from the International Committee of Red Cross (ICRC) and Prof. Noel Woodford from Victoria Institute of Forensic Medicine (VIFM) had proven the mortuary operation was in compliance to the international quality and standards. The overall victim identification and mortuary operation identified a number of significant challenges, in particular the management of commingled human remains as well as the compilation of postmortem data in the absence of antemortem data for future reconciliation. CF Index in this DVI operation is 9%, indicating the primary identifications in this operation were effective. Limitations and further improvements of the mass identification operation will be discussed. This paper details the planning, preparations and management of the mass identification operation on the exhumed human remains which was also a forensic humanitarian service for the dead with dignity and respect.

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## 1. Introduction

For decades human trafficking across borders for sexual, labour and other forms of exploitation is a subject that has captured the attention of international organisations, activists and policy makers. It is a serious crime and a grave violation of human

rights. In Malaysia the Anti-Trafficking in Persons Act 2007 (amended in 2010) prohibits all forms of human trafficking and prescribes punishment of up to 20 years imprisonment [1]. Between May and September 2015, Malaysia was under the global spotlight following the discovery of clandestine multiple graves at several transit camps for human trafficking located in Wang Kelian along the Malaysia-Thai border. The Royal Malaysia Police (RMP) has uncovered 163 clandestine graves in 28 camps, some of which were empty, atop steep hills a few hundred metres above sea level. A total number of 165 human remains were recovered from a total of 8 grave sites (Table 1). Consequently, DVI teams comprising

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**Table 1**

Phases 1 and 2 victim identification operation.

Phase	Grave site	Date received (all in 2015)	Number of body bags received	Number of human remains
Phase 1	Zone A	25th May	3	1
	Zone B	26th–30th May	37	44
	Zone C	5th June	14	14
	Zone D	20th June	20	20
	Zone E	7th June	30	30
	Zone F	8th June	7	7
Phase 2	Zone G	22nd August	6	31
	Zone H	22nd August	18	18
Total			132	165 individuals

forensic pathologists and anthropologists from the Ministry of Health (MOH), forensic odontologists from MOH, Malaysian Armed Forces and academia, forensic radiologists from MOH and academia, and DNA analysts from the Malaysian Chemistry Department were mobilised in response to the discovery of the graves. The Department of Forensic Medicine of Sultanah Bahiyah Hospital, Alor Setar which is approximately 75 km away from Wang Kelian, was designated as the VIC for this operation as it is the nearest forensic facility to the clandestine graves that is suitably equipped for the anticipated mass identification workload. The mass identification operation for the clandestine graves, code named *Operasi Wawasan Khas* by the RMP, can be divided into scene management and body recovery by the police, preparatory phase (before post-mortem), postmortem phase (during the post-mortem) and post-postmortem phase (after the post-mortem). Unfortunately the clandestine nature of human trafficking itself precludes antemortem data collection, and this in turn necessitates temporary controlled burials instead of a final reconciliation phase for this operation. One substantial issue to be addressed is the setting up of a temporary body storage facility to support the existing mortuary which has been a design storage capacity for only 18 bodies.

## 2. The mass grave site

The scene management and body recovery phase was managed by the RMP with the assistance of General Operations Force (PGA). The graves were either grouped in clusters or arranged in rows within a camp perimeter, and given the terrain, all the camps were completely inaccessible by vehicles. The location of the camps and graves were divided into sectors and zones respectively for search and recovery tasks, enabling the systematic tagging of the recovered human remains. The zones were marked A–F for phase

**Fig. 1.** Grave Zone A.**Fig. 2.** Grave Zone B.**Fig. 3.** Grave Zone C.

1 and for phase 2; G and H (Figs. 1–10). The exhumations were done manually zone by zone by RMP and PGA personnel without direct anthropological supervision. Forensic pathologists or anthropologists were not able to be present during the exhumation and recovery of the remains due to the treacherous terrain of the graves site. Most of the graves were approximately 1 m deep and none have any religious markings on the ground. The majority of the remains had been buried enshrouded in white linen and the graves were generally oriented towards Mecca, in keeping with Muslim burial rites. The exhumed remains were placed in body bags, one body bag to a grave. The body bags were transferred down the hills on foot by RMP and PGA personnel to the PGA base camp, and





Fig 4. Grave Zone D.



Fig. 5. Grave Zone E.



Fig 6. Grave Zone F.

transported from there via police vehicles to the designated victim identification centre (VIC).

### 3. Collection of antemortem (AM) data

AM records consist of original dental records and X-rays, fingerprints and other medical and legal information [2]. There

was no ante-mortem data available in this particular incident. The International Committee of Red Cross (ICRC) had nevertheless offered their assistance to collect this data and to interview family members of the missing persons for the Rohingya community.

### 4. Management of the mortuary operation of the VIC

A mass disaster incident cannot be anticipated and it is almost impossible to predict the magnitude, location and the number of fatalities it may entail. Therefore any promulgated mass disaster plan must be flexible, taking into account the fact that no pre-existing mortuary would have been designed solely to cater for mass fatalities. The designation of the victim identification centre was modified from the existing mortuary setting (Fig. 11). Rooms were reassigned for the different expert teams to work in and to house their equipment. During this preparatory phase, the pre-existing mass identification plan for the mortuary was adapted to handle the anticipated workload, which was initially estimated by the RMP to be more than 130 body bags. The first fundamental issue that needed to be addressed during the preparatory phase was temporary body storage for such an unprecedented number of human remains. The second issue is the anticipated nature of the remains themselves that will be in varying degree of decomposition and skeletonisation; skeletonised remains will require specialised anthropological examination. The third issue is the mobilisation of the various DVI teams from across the country. The next issue is the work area requirements for the various DVI teams within the mortuary of the VIC. Lastly, the fifth issue comprise logistics, procedurals and daily human remains identification workflow that will need to be established by the mortuary management team. Provisions were made to ensure continuation of the routine mortuary and forensic pathology services for Sultanah Bahiyah Hospital in parallel with the DVI operation.

#### 4.1. Preparatory phase

##### 4.1.1. The temporary body storage facility

The existing mortuary of this department has the capacity to store up to 18 bodies. The preliminary plan to rent at least two 40-ft refrigerated containers for temporary body storage proved impracticable due to logistical and financial constraints. As a contingency plan, the clinical waste cold room was converted into a temporary body storage facility for the DVI operation (Fig. 12). The cold room is a 20 × 20 × 8 ft container capable of maintaining a temperature of 2–4 °C. Although 450 meters away from the mortuary, it is within the hospital compound with easy road access, has a secure perimeter, and it is isolated from the public. Two rows of 5-tier, 6 ft wide plywood racks with metal frames were constructed within the cold room over a period of 5 days during the preparatory phase. With a space of 15 in. wide allotted for each body bag on each tier, the cold room has a maximum storage capacity of 129 body bags at any one time (Fig. 13). This has enabled all the 108 body bags that were received during phase 1 of the operation to be stored in the cold room. In order to avoid public attention, the movement of bodies between the mortuary and the cold room were conducted at night using hospital hearse.

##### 4.1.2. Essential logistics and resources

Additional mortuary equipment such as mortuary trolley, body lifts, cameras, personal protective clothing, hand sterilising gels, labelling equipment, specimen containers and body bags were supplied. More computer workstations for documentations, reporting as well as quality control were set up for the various expertise teams to be able to function smoothly. With the assistance of the radiologist, mobile X-ray machines were set up as triage and radiology reporting system workstations were





Fig. 7. Grave Zone G.



Fig. 8. Grave Zone H.



Fig. 9. Depth of the grave.

positioned in the autopsy room for easy viewing of X-ray images during autopsy. To ensure the wellbeing and morale of the staff were maintained, a local catering company was engaged to supply food and beverage to all personnel involved in the mortuary operation throughout the duration of a month. Additional hearses were required to transport the human remains from the temporary body storage facility to the operation centre (M) and return for storage at after examination (Fig. 14).

## 4.2. Postmortem (PM) phase

### 4.2.1. Roles within the mortuary operation

During the response to a disaster, it is imperative that the routine workload continues in tandem with the DVI operation. To ensure adequate coordination of routine and DVI operation, the following roles were allocated to all relevant staff at the victim identification centre for smooth running of the whole operation.

- **DVI Coordinator:** Responsible for mobilising and coordinating the involvement of pathologist, anthropologist, odontologist and radiologist from various government agencies and institutions, throughout the whole country.
- **Dedicated Mortuary Manager:** To be in charge of the mortuary operation, liase among various expert teams working in a mortuary, determining work hours, allocating cases and issues of the teams.
- **Senior Forensic Technician:** Responsible for registration of body bags received as well as to ensure adequate mortuary supplies and disposables for all the expert teams throughout the operation.
- **Quality Officer:** Responsible for the quality checks of all documentation within the mortuary DVI operation.
- **Body movement controller:** Responsible for the movement of the bodies within the mortuary and the temporary mortuary facility.
- **Welfare Officer:** Responsible for the welfare of the teams, i.e. meals, health issues, accommodation, etc.

### 4.2.2. Admission or registration of the remains

The human remains were received in body bags upon admission. Each body bag was labelled with a unique case number generated by the victim identification centre. The numbering system indicated the location of the centre, the different grave sites, and total human remains recovered as well as the year of the DVI operation (see Fig. 15). When a commingled human remains are recovered from a body bag, the duplicated body parts or bones will be isolated and marked by the pathologist during the examination as not associated with the primary case. A small case alphabet starting with 'a' will be assigned to the body part and added to the recurring number of the primary case, i.e. A162a, A162b, A162c, and so forth (Fig. 15).

### 4.2.3. Triage by pre-X-ray and X-ray procedure of remains

Radiology is used for a number of purposes in a mass fatality incident as it can provide information to help with the detection of foreign bodies that may pose a hazard to on-site investigators. It is also used to uncover and pinpoint the exact location of material evidence and to aid victim identification [3]. In this operation, mobile X-ray machines were set up as triage. The pre-X-ray step was done for every body bags scanned to rearrange the bones to avoid overlapping before X-ray procedure (Fig. 16). The radiology reporting system workstations were positioned in the autopsy room for easy viewing of X-ray images during autopsy. As the hospital is a 'paperless' hospital with its own technology information system (HIS or Hospital Information System), the radiology reporting system integrated in it enabled the pathology team in the autopsy room to view the X-ray images simultaneously during the postmortem examination.

### 4.2.4. Postmortem examination

**4.2.4.1. Pathology.** The postmortem examination was conducted by the expert team with detailed documentation available of the grave site and condition of burial of the human remains (Fig. 17). Photographs were taken and remains will be cleaned for further



**Fig 10.** Human remains recovered in parallel position side-by-side to one another wrapped in white cloth.

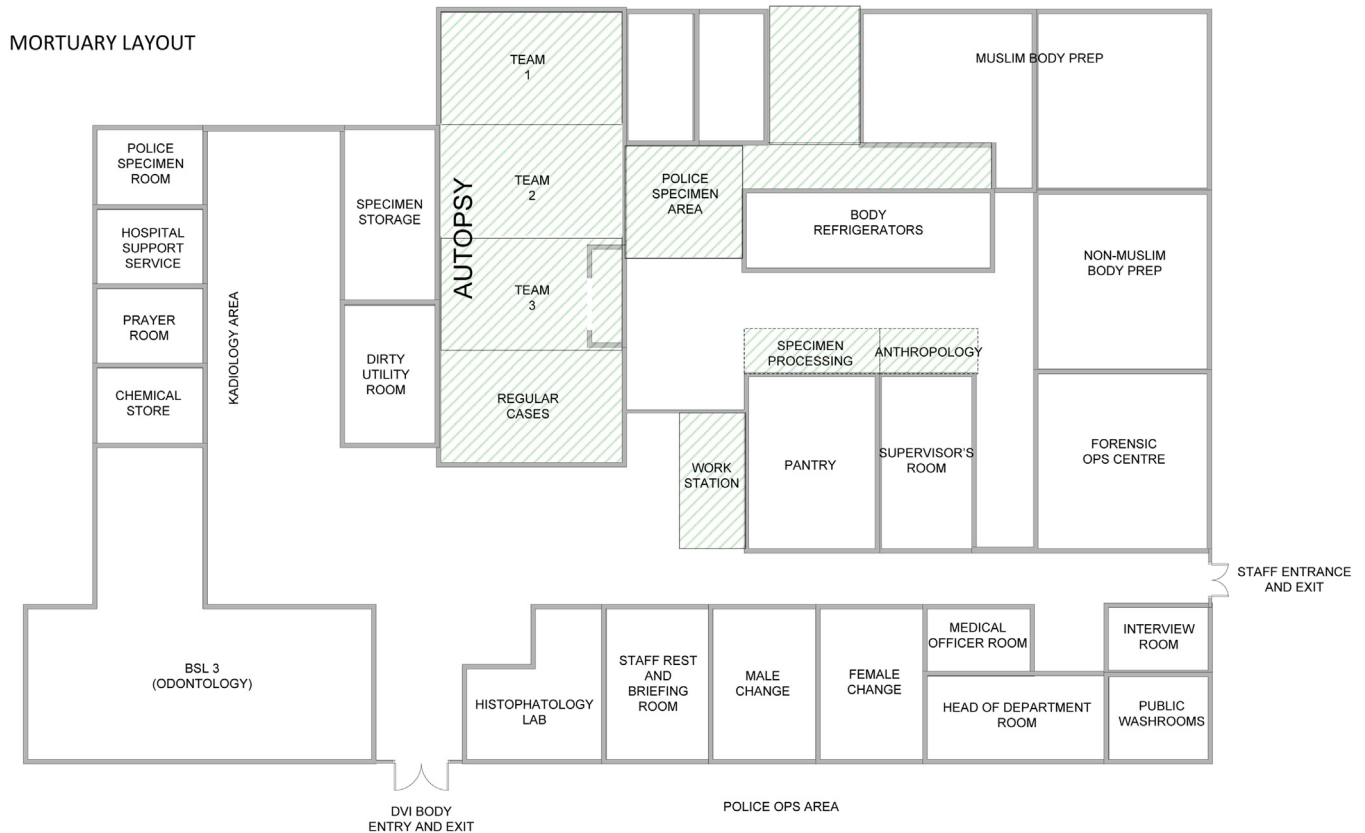
examination. When commingling remains were discovered during the post-mortem examination, the particular case must then be re-examined by a forensic anthropologist and particular body part assigned a new number. The pathologist then isolates the body parts or bones that appeared to be duplicated and not associated with the primary case and subsequently requests the Quality Officer to allocate a new number.

**4.2.4.2. Anthropology.** In this DVI operation, as victims recovered were mostly skeletonised, the role of the forensic anthropologist was more prominently in demand. Forensic anthropologists

assisted in the investigation of mass grave by determining the minimum number of individuals present, establishing a biological profile (ancestry, sex, age and stature) of those individuals as well as providing opinion on the ante-, peri- and post-mortem trauma [4]. A body bag may contain anything from a fragment of non-human bone to commingled human remains, where re-examination needs to be performed in detail. Besides, a forensic anthropologist's expertise was needed to determine which bones were preferred for sampling, in particularly in disasters involving fragmented remains [5]. In this operation, conditions of the remains and skeletal inventory of the skeletonised remains were carefully documented. The biological profile of the remains were determined from a combination of methodology and formulas as shown in Table 2.

**4.2.4.3. Odontology.** Forensic odontologist in disaster operation is to ensure collection, collation and preservation of the maximum amount of available dental data and the appropriate interpretation of the data to achieve outcomes to a standard expected in DVI operation [6]. In this operation, forensic odontologist was available to identify jaw, tooth, dental restorative components as well as perform post-mortem dental charting, radiography and photography of the human remains. Odontologists produced interpretation on the living conditions, bite habits and oral hygiene of the human trafficking victims at the camp sites.

**4.2.4.4. DNA sampling.** DNA typing is a serological technique to aid in identification of human remains. DNA typing has a major advantage over many traditional identification methods because it can be recovered from any biological material. In fact, this will not only aid in individual identification of disaster victims but also



**Fig. 11.** The floor plan of the mortuary of the victim identification centre.





Fig 12. Clinical waste cold room of the hospital before modification.



Fig 13. 5-tier racks constructed in the clinical waste cold room used as a temporary body storage facility.



Fig 14. Location of the temporary body storage facility from the operation centre (M).

allow for the reassembly of heavily fragmented remains and commingled human remains that would not be possible by any other means [7]. A DNA sampling protocol developed by the DNA

expert in the team was used. The bone sample taken for DNA was at least 4 in. long with both cortices and marrow included (Fig. 18).

#### 4.2.5. Quality review of documentation

A quality check ensures that a centralized log of all cases is kept which documents all steps in this identification exercise from admission through to examination and storage of the human remains. The quality control also standardises the use of the anthropology proforma and ensures consistency and correctness in its use in the examination of the human remains throughout the PM phase. Similarly the quality check ensures the body bag labelling and tagging conforms to the required standard.

#### 4.2.6. Debriefing session

Debriefing sessions chaired by the mortuary manager were held daily at the end of the mortuary operations. Latest information was circulated and updates on the progress of the DVI and mortuary operation were conveyed to the team. Issues and problems faced by team members were brought forward for consensus and solution. Daily report was generated at the end of the day.

### 4.3. Post-mortem phase

#### 4.3.1. Temporary controlled burial (TCB)

The TCB is a burial procedure for all human remains according to their Global Positioning System (GPS) location in an identified site, to facilitate future exhumation in the event of the availability of and the request from the next-of-kin for the remains to be repatriated. There were 19 individuals interred in a 6 ft depth grave and each individual was placed side-by-side 2 ft apart (Fig. 19). The last rites were performed for all individuals as per the Muslim way and 3 stainless steel tags were allocated to each individual—one fixed to the body shroud, one to the coffin and one to the GPS coordinate plate at the head of the grave. All victims of this human trafficking crime were laid to rest at a chosen TCB site in a village in Pokok Sena, a district north of the state of Kedah.

#### 4.3.2. Writing the report

After the completion of the PM phase, each expert involved in this operation will produce a complete report for every individual examined. A main report called the Patho-Anthro report is written and this report is supported by supplementary reports by various other experts in radiology, odontology, DNA as well as toxicology, tissue histology and entomology. The cause of death and findings from the examination will be incorporated in this report. All these reports were compiled by the Mortuary Manager. Due to advanced decomposition and skeletalisation, cause of death for almost all the cases were unascertained. Examination of the bodies unearthed from the graves also revealed that some remains sustained old fractures. In addition, there were signs of malnutrition found on the remains shown by the appearance of Harris lines on tibia and skull X-rays. However, signs of malnutrition by no means a cause of death. The summary of the identification of the individuals are provided in Table 3.

## 5. Re-examination and CF index

The total number of body bags received and examined was 132 (108 bags from phase 1 and 24 bags from phase 2). However, due to the commingled remains found among some of the body bags, the actual number of potentially identifiable individuals was 165 (phase 1: 116 individuals and phase 2: 49 individuals). Byard and Winskog [8] proposed a method for measuring the error rate of an identification exercise, called the **Correction of Failures Index** (CF Index), which is calculated as the total number of cases/specimens that have had to be re-examined as a percentage of the total

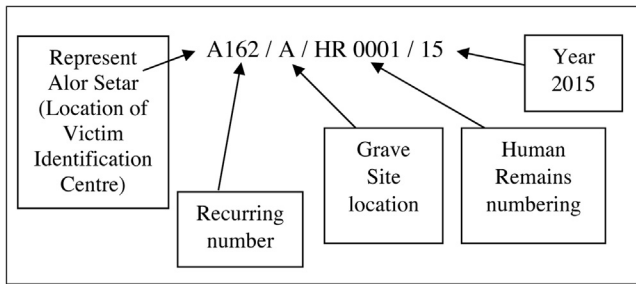


Fig. 15. Numbering system used in allocating case numbers for the human remains.



Fig. 16. Pre-X-ray procedure to rearrange the bones.



Fig. 17. Examination of the human remains.

number of cases/specimens examined. A total of 12 cases were re-examined by the forensic anthropologist. The CF Index in this DVI operation was 9%, indicating the primary identifications in this DVI operation were effective.

$$\text{CF Index} = \frac{12 \text{ body bags}}{132 \text{ body bags}} \times 100\% = 9\%$$

## 6. Discussion

The discovery of mass graves along the Malaysian-Thai border, believed to be those of Rohingyas fleeing sectarian violence in Myanmar, revealed the extent of the human trafficking scourge in

this region. The United Nations defines a disaster as a serious disruption of the functioning of a community or a society, where disasters involved widespread human, material, economic or environmental impacts, which exceed the ability of the affected community or society to cope using its own resources [9]. Although human trafficking is technically not covered under disaster, however, DVI investigations have again proven to be significant not only in mass fatality incidents but also in clandestine mass grave incident. Examination of bodies exhumed from graves in camps used by human traffickers have revealed the signs of malnutrition and poor living conditions as well as illnesses. Neglect is a passive form of abuse, including the failure to provide sufficient supervision, nourishment or medical care. Thus, violence were, indirectly inflicted towards the victims. With the findings from the DVI investigations, the enforcement agencies will be able to have perpetrators prosecuted and trial for justice.

In this case, during the scene phase, the main obstacle at the mass grave site was the challenge to bring down all human remains using gurneys by the personnel from a rocky and steep terrain which made it impossible to use the services of helicopter or 4-wheeled drive vehicles (Fig. 20). Furthermore, the mortuary operation encountered the limitations of space constraint as well as the setting up of the temporary body storage facility. Another limitation to this operation was the fact that forensic pathologists and anthropologists were not able to be present during the exhumation and recovery of the remains due to the treacherous terrain of the graves site. The recovery tasks were fully dependent on the RMP and PGA. As suggested by Blau and Briggs [4] as well as Mundorff [5], forensic anthropologists should be an integral part of the DVI site assessment team, in which proper searching, mapping, preservation, excavation and recovery of remains, site reconstruction, as well as the anthropologist-directed triage at site, including the identification of human from non-human remains. With the expertise from the anthropologists, recovery-induced type commingled remains occurs when separate remains are mistakenly grouped together in a recovery bag at the scene, can be avoided.

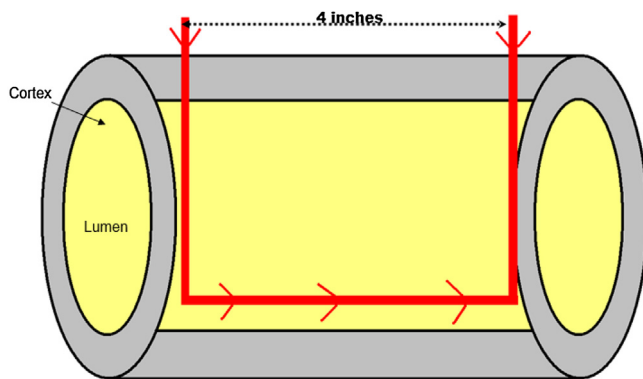
In this situation, as there is no AM data available, comparison of the AM with the PM data could not be done and thus the reconciliation phase was not included in this DVI operation. DVI does not necessarily result in successful identification according to the process of scene, AM, PM and reconciliation phase. What matters is the DVI investigations and outcome. TCB is a known ideal method for long-term body storage in a similar DVI setting in future. The victims were buried in a proper burial site (the TCB site) with GPS coordinate in which the particular human remains can be exhumed in future if family members were to come forward for identification.

According to the INTERPOL guidelines [10], primary identifiers used for positive identification are DNA, dentition and fingerprints. In this particular operation no fingerprint experts were engaged because the remains unearthed from these graves were skeletal material. Meanwhile, forensic radiology and imaging is also strengthening its role in disaster victim identification. This operation had also emphasized the role of the forensic pathologist as the leader of a multidisciplinary team of experts in a disaster situation. The investigation of war crimes is a complex work. Medicolegal investigations make it possible to determine the number of individuals at the site, their demographic characteristics, and their civilian or military origin. It allows investigators to make an assessment of the time the bodies have been at the site and to determine whether malnutrition, torture or other pathological lesions played a role in the death. Investigators can compile a listing of the different injuries, be it from firearms, sharp weapons, blast or combinations of them, secure evidence for ballistic examination, and discover any common traits of the individuals composing the group of victims [11]. In this case the



**Table 2**  
Summary of the methodology of biological profile determination.

Biological profile	Morphology	Measurement	Formula/reference	Profile category conclusion
Sex	<ul style="list-style-type: none"> <li>• Pelvis</li> <li>• Skull</li> </ul>	<ul style="list-style-type: none"> <li>• Diameter of femoral head</li> <li>• Diameter of humeral head</li> </ul>	Maximum diameter (Tennessee Forensic Data Base) [15]	<ul style="list-style-type: none"> <li>• Male</li> <li>• Female</li> <li>• Indeterminate</li> </ul>
Age	<ul style="list-style-type: none"> <li>• Sternal rib end</li> </ul>	NIL	Pubic symphyseal face (Suchey–Brooks cast) [16]	<ul style="list-style-type: none"> <li>• &lt; 20 years old (non-adult)</li> <li>• 20–40 years old (young to middle age)</li> <li>• &gt;40 years old (mature adult)</li> <li>• Indeterminate</li> </ul>
Ancestry	<ul style="list-style-type: none"> <li>• Orbital shape</li> <li>• Nasal bone</li> </ul>	Cephalic index	Ancestry approximation (Krogman & Iscan) [17]	<ul style="list-style-type: none"> <li>• White (Caucasoid)</li> <li>• Asian (Mongoloid)</li> <li>• Black (Negroid)</li> <li>• Indeterminate</li> </ul>
Stature	NIL	<ul style="list-style-type: none"> <li>• Femur</li> <li>• Humerus</li> </ul>	Stature regression formula (Modified Trotter & Gleser and Thai Reference Tables) [18,19]	<ul style="list-style-type: none"> <li>• Estimation stature</li> <li>• Indeterminate</li> </ul>



**Fig 18.** DNA sampling protocol.



**Fig. 19.** Temporary controlled burial.

examination of the bodies exhumed from the graves revealed the cause of death as malnutrition due to poor living conditions and illnesses. No evidence of violence and unnatural death were seen in these cases.

The United Nations Global Initiative to Fight Human Trafficking (UN.GIFT), an alliance of six organizations committed to

combatting human trafficking on 31st December 2014 has forged a strong network of partners and allies in the fight against human trafficking and placed the issue high on the global policy agenda. UN.GIFT served as a unique mechanism for developing a wealth of technical tools and influential publications, including the first ever global report on trafficking in persons, establishing pioneering partnerships with the private sector to highlight the responsibility of private business, launching public awareness campaigns to alert and sensitize the public to the nature and prevalence of human trafficking, strengthening the role of civil society to support and assist victims, and finally implementing joint programmes designed to support the efforts of Member States in eradicating this crime [12]. The Malaysian Deputy Inspector-General of Police, said “Human trafficking is the most lucrative illegal activities besides illegal drug trade in terms of revenue. It is now one of the top five crimes related to money laundering activities in the world, involving more than USD100 billion. The Royal Malaysia Police (RMP) operating procedure along border areas has been revamped and improved. Better training programmes are being designed for personnel to assess and identify victims and trafficking activities. In fact, there is an upgraded cross-border cooperation between the RMP and the Thai authorities moving hand-in-hand to shut down human trafficking networks” [13].

## 7. Conclusion

The objective of exhuming mass graves is to provide evidence of war crimes, crime against humanity, and genocide. The intent to destroy a particular group has to be demonstrated in order to prosecute these cases and forensic investigation focuses on collecting data to reconstruct the events in question. Every disaster is a learning experience. Many of the plans and protocols described above and the need for adaptability of the DVI and mortuary operations were developed from experiences in other disaster operations [14]. When a disaster occurs in a particular region, it is essential that forensic specialists from other jurisdictions are invited to observe, learn and advise so that the knowledge is shared and future operations can continuously improve. In a nutshell, mortuaries operating around the world facilitate the storage, the pathology examination and the identification of the dead. The fundamental protocols for the mortuary operation should not change, instead be intensified and institutionalised challenges. As contingency and alternative plan for the temporary body storage in which renting a cold storage container is beyond the financial



**Table 3**  
Summary of identification.

Sites	Remains	Sex			Ancestry				Age			
		Male	Female	Indeterminate	Mongoloid	Caucasoid	Negroid	Indeterminate	<20	20–40	>40	Indeterminate
A	1	1	–	–	–	–	–	1	1	–	–	–
B	44	33	3	8	19	5	–	20	7	17	11	9
C	14	14	–	–	6	5	3	–	1	10	3	–
D	20	18	1	1	17	2	–	1	3	14	3	–
E	30	29	–	1	19	9	–	2	4	14	12	–
F	7	7	–	–	2	4	–	1	–	6	1	–
G	31	6	2	23	1	1	–	29	13	5	–	13
H	18	13	2	3	5	4	–	9	7	7	2	2
Total		121	8	36	69	30	3	63	36	73	32	24



**Fig. 20.** Human remains were carried down the steep terrain using a makeshift stretcher.

means, it is recommended to make clinical waste cold room as a basic infrastructure for all hospitals. It provides practicality and flexibility for the DVI team to be able to readily convert clinical waste cold room into temporary body storage.

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### References

- [1] Laws of Malaysia Act 670, Anti-Trafficking in Persons Act, 2007.
- [2] E. De Valck, Major incident response: collecting ante-mortem data, *Forensic Sci. Int.* 159 (2006) 15–19.
- [3] A.L. Brough, B. Morgan, G.N. Rutty, The basics of disaster victim identification, *J. Forensic Radiol. Imaging* 3 (2015) 29–37.
- [4] S. Blau, C.A. Briggs, The role of forensic anthropology in disaster victim identification (DVI), *Forensic Sci. Int.* 205 (2011) 29–35.
- [5] A.Z. Mundorff, Integrating forensic anthropology into disaster victim identification, *Forensic Sci. Med. Pathol.* 8 (2012) 131–139.
- [6] A.W. Lake, H. James, J.W. Berketa, Disaster victim identification: quality management from an odontology perspective, *J. Forensic Sci. Med. Pathol.* 8 (2012) 157–163.
- [7] E.A.M. Graham, Review: disaster victim identification, *J. Forensic Sci. Med. Pathol.* 2 (3) (2006) 203–207.
- [8] R.W. Byard, C. Winskog, Quality assurance in disaster victim identification (DVI) exercises, *J. Forensic Sci.* 55 (2010) 1135.
- [9] UNISDR, 2005, Hyogo Framework for Action (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters, Extract from the final report of the World Conference on Disaster Reduction, A/Conf./206/6: United Nations International Strategy for Disaster Reduction.
- [10] INTERPOL, Disaster Victim Identification DVI Guide, The International Criminal Police Organization, 2014.
- [11] Y. Schuliar, P.J.T. Knudsen, Role of forensic pathologists in mass disaster, *Forensic Sci. Med. Pathol.* 8 (2012) 164–173.
- [12] [www.ungift.org](http://www.ungift.org). (Accessed 16 April 2016).
- [13] The Star, 2016, 15 April.
- [14] J. Leditschke, S. Collett, R. Ellen, Mortuary operation in the aftermath of the 2009 Victorian bushfires, *Forensic Sci. Int.* 205 (2011) 8–14.
- [15] R.L. Jantz, P.H. Moore-Jansen, A Data Base for Forensic Anthropology: Structure, Content and Analysis, Report of Investigations, The University of Tennessee, Department of Anthropology, Knoxville, 1988 47.
- [16] S. Brooks, J.M. Suchey, Skeletal age determination based on the os pubis: a comparison of the Ascádi-Nemeskéri and Suchey-Brooks methods, *Hum. Evol.* 5 (3) (1990) 227–238.
- [17] W.M. Krogman, M.Y. Iscan, *The Human Skeleton in Forensic Medicine*, 2nd edition, Charles Thomas Publisher, USA, 1986.
- [18] R.L. Jantz, Modification of the Trotter and Gleser female stature estimation formulae (1992), *J. Forensic Sci.* 37 (5) (1995) 1230–1235.
- [19] P. Mahakkanukrauh, P. Khanpetch, S. Prasitwattanseree, K. Vichairat, D. Troy Case, Stature estimation from long bone lengths in a Thai population, *Forensic Sci. Int.* 210 (2011) 271–277.