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Research Article

Who are they? A retrospective study of unidentified bodies in Institute of Medical-Legal Paris from 2018 to 2023

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Abstract

"I still don't realize that he's dead.... I cried over it. It makes me sad to know that he was buried unaccompanied on his last trip. We were all shocked." This testimony corresponds to a family whose relative was buried in an anonymous grave 6 months after his disappearance was reported to the police. It is estimated that between 1 000 and 3 000 unidentified bodies are buried in anonymous graves in France each year. Most of these decedents have passed through the medico-legal system. However the identification of these bodies, outside the context of mass disasters, remains a complex problem. Several national and international publications have highlighted the prevalent problem of unidentified burials and the consequences for families who do not know the fate of their loved ones, specifically, whether they are alive or deceased. This 6-year retrospective study (2018–2023), covering a total of 2 324 unidentified decedents admitted to the Institute of Medical-Legal Paris (IMLP), aimed to assess the impact of the identification protocol implemented in 2017 on the number of bodies that remain unidentified ($n = 164$). In addition, this study aimed to establish profiles for individuals who remained unidentified with the objective of identifying the factors that hinder their identification and developing correlated methods to address these issues. The results of this study were compared with other published studies to highlight the global problem and the ongoing need for collaboration between forensic practitioners and relevant authorities.

Key points

- Despite great advances in human identification, unidentified decedents remain a global problem.
- This 6-year overview study covering a total of 2 324 unidentified bodies admitted to the IMLP provided relevant information about the unidentified decedent population and assessed the impact of a protocol established in 2017 on the rate of deceased buried without identity in Paris.
- The need to establish a national database in France to properly document and disseminate information on missing persons and to centralize the biological profile of unidentified bodies is key, as without antemortem information or a biometric database there can be no matching.

Keywords: human identification; unidentified bodies; missing persons; forensic anthropology

Introduction

With the exception of mass disasters, in which international guidelines for providing timely identifications are followed, so-called routine cases of unidentified bodies admitted into forensic institutes remain a complex problem [1–5]. In the case of deceased who experienced natural or accidental deaths, which are the majority of the deceased admitted into forensic institutes/hospital mortuaries, investigations are carried out by local police stations, which often have limited resources. When the decedent is not formally identified, the search for identity is time-consuming and requires legal knowledge, and therefore many unidentified deceased persons who die of natural or accidental causes are buried without a name. Moreover, people who die without identity in hospitals can also be buried unidentified without going through the medico-legal system. Several national and international publications have highlighted the widespread problem of deceased persons buried without identity and the consequences for families who do not know the fate of their loved ones, specifically, whether they are alive or deceased [6–8].

In France, 40 000 to 50 000 cases of missing persons are reported each year, and between 1 000 and 3 000 bodies are buried unidentified [9, 10]. The Paris Medical-Legal Institute (IMLP), which performs the highest number of autopsies in France, admits more than 3 000 bodies per year from Paris and the departments of the Petite-Couronne (92, 93, 94, 77). This region has 8 million inhabitants. Around 500 bodies per year arrive at IMLP without a formal identity. An internal survey was conducted on the number of deceased admitted at the IMLP without identity from 2014 to 2016. There were a total of 1 215 unidentified deceased admitted during these 3 years, and 182 deceased were buried without formal identity during that time. Most of the unidentified deceased buried were not systematically fingerprinted, photographed, or radiographed, and no samples for DNA analysis were systematically taken.

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The Brigade de Répression de la Délinquance contre la Personne is the police service that deals with the disappearance of vulnerable adults in Paris and the Petite-Couronne area, and they occasionally work on unidentified bodies at the request of the magistrates when the initial investigation has not been completed. When this service is called upon, the deceased are often buried. In the absence of fingerprints, photographs, or genetic samples, the chances of identifying the deceased are minimal, and exhumations must be carried out to obtain genetic samples. Thus, the IMLP forensic team proposed a protocol for the management of unidentified bodies that was established in 2017 under the aegis of the Paris Prosecutor Office in consultation with all police services and magistrates.

This study was based on 2 324 decedents who were admitted without formal identification at the IMLP between 2018 and 2023 and aimed to evaluate the impact of its protocol on the rate of bodies buried unidentified in Paris. Our goal was also to establish profiles for unidentified decedents, with the hope of triggering the identification process and enabling future identification.

Materials and methods

In Paris, the deceased arriving at the IMLP are registered with a presumptive identity (X pouvant être, XPE) if they are found at home or with identity documents, but the decomposition of the body does not allow its visual identification by the judicial authorities at the time of its discovery or the elements that have been found are not relevant enough to establish a formal identity. If no element of identity is found, the deceased is recorded as (X) male, female, or undetermined. The protocol established in 2017 is summarized in Table 1.

To ensure that all deceased persons registered in the IMLP without a formal identity were fingerprinted and photographed, the first major step of the protocol was the creation, in 2018, of a special police group within the Paris Judicial Identity Department. In 2017, <40% of bodies without formal identification were fingerprinted. The fingerprints of the deceased are compared with those in the national Automated Fingerprint Database (FAED), but only persons known from police files appear in this database. If the fingerprint comparison in FAED is negative, the fingerprints are then compared with those in secure credentials (national identity cards, biometric passports, and residency permits) if an identity is presumed. However, people without a presumed identity or those with old identity documents cannot be identified based on fingerprint comparison.

For bodies that remain unidentified after fingerprint comparison, the second step is the use of medical information and/or imaging. During the medico-legal examination, each pathologist reports on a form all medical elements useful for identification (tattoos, scars, implantable material or osteosynthesis, dental care, etc.). When an identity is presumed, a request is made by the police/gendarmes to search for practitioners and retrieve medical records that allow identification either by a dental expert if a dental record is found or by reference number on medical device and by imaging comparisons. Elderly people who died in isolation and without recent identity documents, as well as homeless people who passed through hospitals, have been identified using these techniques. Since 2020, an agreement has been signed between the IMLP, the Paris Tribunal, and the Paris Hospitals Group (APHP) to allow the exchange of imaging data between hospital radiologists, who have access to patient records, and the radiologists in the Imaging Department of Ste. Anne's Hospital, who must participate in postmortem computed tomography (PMCT) examinations. For bodies without any element of identity, a complete biological profile is established by a forensic anthropologist and/or odontologist using PMCT or direct examination. The results of all these examinations are made available to judicial authorities to facilitate the identification process.

The final step of the protocol is genetic analysis. In the absence of a family to provide reference DNA samples for comparison, it used to be common for the police to collect an object used by the deceased from the place (house/apartment) where the deceased was found and obtain a DNA sample from it. However, cases of undeclared rentals or illegal occupations have led to misidentifications based on this strategy. The genetic profiles are compared with those in the national DNA database (FNAEG), which is a centralized collection of genetic information from people who have been convicted of the most serious sexual crimes (rape, sexual assault) or have been

Table 1. Protocol with different stages for management of bodies admitted at Institute of Medical-Legal Paris (IMLP) without formal identity.

No.	Protocol with different stages
1	Registration: X for body without any element of identity and XPE (X pouvant être) when a potential identity exists but needs to be confirmed.
2	Forensic examination of the body according to judicial request: external examination or autopsy, including a separate form to be filled with any useful information for the identification process.
3	Fingerprints and photographs of bodies and personal belongings are taken by the Paris Judicial Identity Department.
4	Anthropological examination in cases of skeletonized remains or complete recently deceased/decomposed remains if unidentified.
5	Imaging: full body and dental scanner and biological profile established in collaboration with anthropologist and odontologist.
6	Quarterly meetings with judicial authorities including the Paris Judicial Identity Department, magistrates, and investigators to trigger identification of challenging unidentified cases.
7	If the body is buried unidentified, a file gathering all the information (physical characteristics and identifying features, fingerprints, photographs, imaging) will be created, and will remain accessible for missing persons investigations.
8	Request to authorities to register unidentified profiles in a national DNA database to ensure further comparison with relatives or a possible match.

arrested for minor reasons and documented. It also includes the genetic profiles of the next of kin of some missing people. However, not all missing people are included in this database, so the chance of genetically identifying an initially unidentified body when it is not in this police genetic file and a genetic profile from the next of kin is unavailable for comparison is small.

The IMLP protocol includes the requirement to collect a tissue sample using Fast Technology for Analysis (FTA) of nucleic acids cards or bone samples when cases are highly decomposed, which allows for comparison if relatives are found, even if months or years have passed. Given that identification techniques are based on comparisons, the chances of identifying a deceased are significantly limited if that person was never reported missing.

Since 2013, French law has abolished the administrative procedure of "search in the interest of the family". Associations therefore play an important role for these families, who often find it difficult to submit a search request to the judicial authorities because of the difficulty for police officers in assessing whether the disappearance of the adult is worrying and the high number of disappearances each year (4 000 worrying disappearances were recorded by the police in Paris and the Petite-Couronne in 1 year) [10]. For this reason, the protocol also includes quarterly meetings between the IMLP and the judicial authorities to monitor the files of the deceased who could not be immediately identified. The goal of these meetings is to review and assess the existing possibilities for triggering identification (e.g. search for medical/dental files, search for relatives and information) and comparing these files with missing persons files. When a deceased is buried unidentified, the burial is assisted by the mayor of the place where the individual died. In Paris, unidentified individuals are buried in the Thiais cemetery in single graves for a period of 5 years. After the burial, a file is created at the IMLP that contains all the information and all the examinations carried out to allow future identification.

This 6-year retrospective study was carried out thanks to the implementation, in 2018, of software for monitoring the deceased that arrived at the IMLP. All the dead bodies are registered in this software, called COPERNIC, which brings together all the administrative, legal, technical, and medical information available.

Because this software does not allow specific queries to be made for unidentified bodies, the first author of this article used Microsoft Access Database to create a database with information from the IMLP software, with the goal of retrospectively studying the files of deceased patients admitted with or without presumed identity from 2018 to 2023. A range of data (Table 2) were then processed using Excel to obtain descriptive statistics.

Unknown foetuses and newborns were not included in this study, as these represent a small proportion of unidentified bodies and pose a different identification challenge. Children and teenagers were also not included, as they were usually identified in a timely manner due to being admitted with presumptive identification.

Results

Individuals arriving without formal identity represented 13% of the cases admitted by the IMLP in the 6 years covered by this study, corresponding to 2 324 bodies and 18 326 admissions (Table 3). Among our corpus of 2 324 unidentified

Table 2. Categories of information collected and processed for deceased admitted with or without presumed identity from 2018 to 2023 at Institute of Medical-Legal Paris (IMLP).

No.	Categories of information
1	IMLP identification number (used as primary key to avoid duplicates).
2	Sex of the individual.
3	The age of the individual (after identification).
4	Condition of the body.
5	The place where the body was found.
6	The examination performed (in the form of an external examination or autopsy).
7	The cause of death.
8	The manner of death (which complements the cause of death information, for example, suicide by "firearm").
9	The registration of the body (with presumed identity or without identity).
10	Identification status (whether the body was identified after admission or not).
11	The identification technique.
12	The status on departure of the body (inhumation in administrative procedure).

Table 3. Number of bodies admitted at the Institute of Medical-Legal Paris (IMLP) with presumptive identity and without any identity from 2018 to 2023.

Year	Total number of bodies admitted	Admitted with presumptive identity (%)	Admitted with no identity (%)	Total of bodies without formal ID (%)
2018	2 930	203 (7)	62 (2)	265 (9)
2019	3 099	212 (7)	56 (2)	268 (9)
2020	3 012	335 (11)	70 (2)	405 (13)
2021	3 004	385 (13)	99 (3)	484 (16)
2022	3 323	345 (10)	142 (4)	487 (15)
2023	2 958	297 (10)	118 (4)	415 (14)
Total	18 326	1 777 (10)	547 (3)	2 324 (13)

decedents, 76.5% were individuals registered with an XPE, whereas the remaining 23.5% were registered with no identity. Most of the bodies were complete. However, a few incomplete skeletal cases were included because they represented a person despite their incompleteness. In addition, sometimes they can be identified more quickly than a complete fresh body if the disappearance has been reported.

As shown in Figure 1, the number of decedents admitted to the IMLP without a formal identity increased over the 6 years selected for the study. More specifically, the rate of bodies admitted without any element of identity increased, whereas the total number of bodies remained stable.

Demographic data

Of the total number of unidentified individuals, 25.3% (589/2 324) were females, of whom 86.6%(810/589) arrived with an XPE and 13.4% (79/589) had no element of identity. Of the 74.7% (1 735/2 324) that were males, 73.0% had an XPE, whereas 27.0% did not (Table 4).

The average age of bodies without formal identity was 58 years old (age was determined after identification was achieved). Our statistics showed that the number of unidentified females increased with age for those who died between 46 and 50 and decreased for those who died over 90. This meant that most unidentified females were between 46 and 90. The age curves for unidentified males were more homogeneous than for females: 20% of unidentified males were between 18 and 40 years old (compared to 10% of females). Most of the unidentified males were between 41 and 75 years of age, and the numbers gradually decreased with age until the 96–100 age group was reached. Of the male bodies that arrived unidentified, 15% were between 21 and 35 years of age, compared to only 7% of female bodies (Figure 2).

As illustrated in Figure 3, the proportion of females is consistent with expectations for a medico-legal population. However, they were more frequently identified than males: 1% of females remained unidentified, whereas 5% of males remained unidentified.

Place of discovery

Individuals admitted without formal identity into the IMLP were found in a variety of indoor and outdoor contexts. For decedents with XPE, over half (69.9%) were found at home and 14.1% were found in public places including highways, transportation stations, and gardens (Figure 4). A small percentage (2.7%) of individuals with XPE were found in an aquatic context (river, pond, etc.), 3.5% were discovered in hospitals and care centers, and 1.9% were found on private property, such as the homes of other people, construction sites, subway tunnels, etc. Finally, 0.1% of decedents admitted without formal identity came from natural areas, such as forests or hiking trails. For 9.1% of the individuals in our corpus, it was impossible to determine where the body was found because of a lack of information. For individuals admitted without any elements of identity, 48.1% were found in public spaces, 21.3% were found in water (in the Seine and numerous canals that exist in and around Paris), 8.4% were found in care centers and hospitals, and 6.3% were found "at home" (squatting) (Figure 5).

Cause of death

Except for a small number of cases (0.1%) that were admitted without an examination requested by the judicial authorities, all deceased who are not formally identified are subject to a forensic examination (autopsy or an external examination). In the cases reviewed for this study, 57% of unidentified corpses were subjected to an autopsy and 43% to an external examination. Finally, 0.1% of cases were subjected to a "hygiene and decency" procedure, which consists of simply admitting the deceased without carrying out an examination in the absence of a judicial request. For those cases, the IMLP

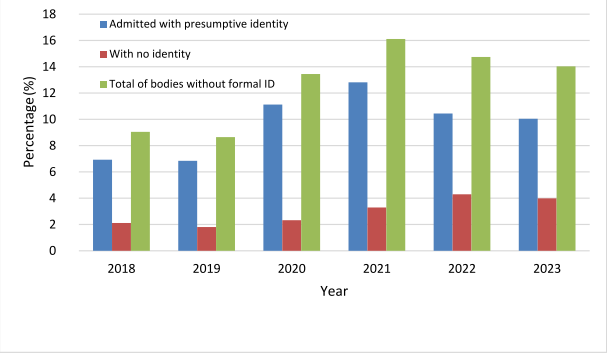

Figure 1 Rates of decedents admitted at the Institute of Medical-Legal Paris (IMLP) without formal identity between 2018 and 2023.

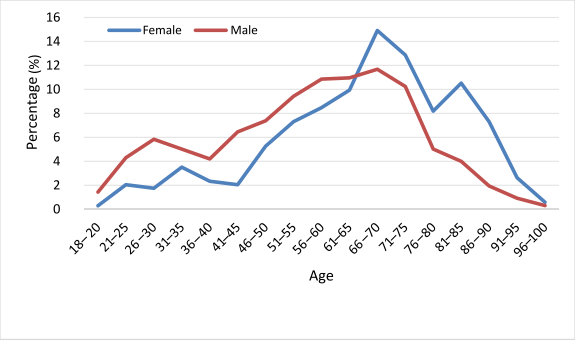

Figure 2 Ages of initially unidentified decedents as determined after identification.

Table 4. Number of male and female bodies admitted with presumptive identity and without any identity from 2018 to 2023.

Sex	Admitted with presumptive identity (%)[a]	With no identity (%)[a]	Total (%)[b]
Males	1 268 (73.0)	468 (27.0)	1 736 (74.7)
Females	510 (86.7)	78 (13.3)	588 (25.3)
Total	1 778 (76.5)	546 (23.5)	2 324

[a]Percentages of admitted with/without identity out of the total. [b]Percentages of males/females out of the total.

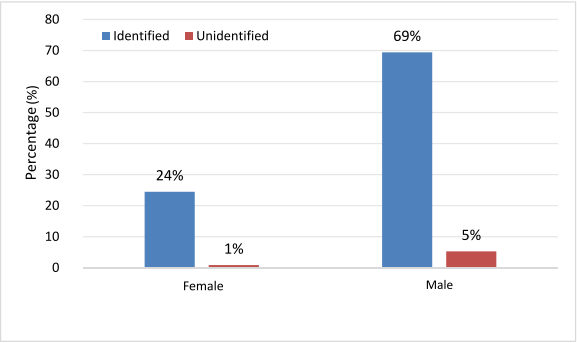

Figure 3 Identification rates of males and females who remained unidentified (after admission without formal identity). Percentages may not add up to 100 due to rounding.

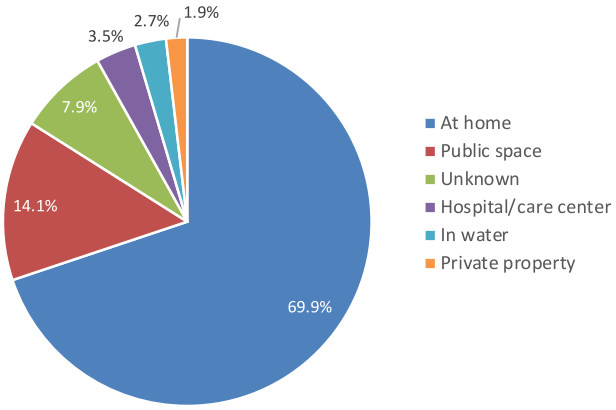

Figure 4 Place of recovery of bodies found with presumptive identity.

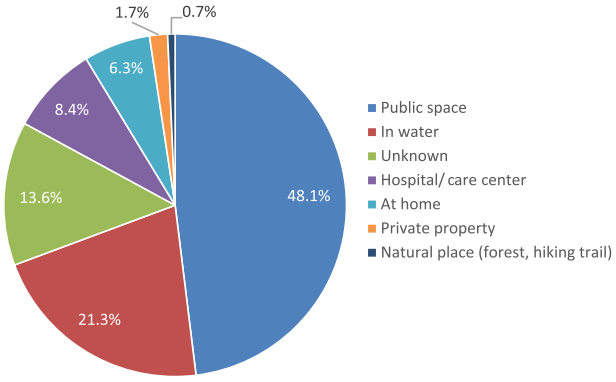

Figure 5 Place of recovery of bodies found without any element of identification.

asked the authorities to perform fingerprinting, photography, and to take a DNA sample.

The main cause of death among the persons admitted without identity was natural death, which was attributable in 50.5% of the cases. The cause of death was attributable to suicide or accident in 8.7% and 8.2% of cases, respectively. Finally, homicide was the cause of death for 3.0% of the total number of cases. The cause of death could not be determined for 29.6% of the persons, as 43.6% of bodies only underwent an external examination.

State of preservation and identification methods

Visual identification was not possible in over half (59%) of the cases admitted without formal identity due to decomposition. In addition, in 35% of cases of recently deceased "fresh" bodies, identification was problematic because no documents associated with the body were found. Charred and skeletal individuals comprised 2.8% and 2.5% of the cases, respectively. In 0.8% of the cases, the state of preservation was not registered.

Almost half of the decedents admitted without formal identification (47%) were identified based on fingerprint comparisons. Police investigation (including visual identification) was used to identify 27.6% of people, whereas 16.5% were identified using DNA comparison. Comparison of the medical information obtained from postmortem examinations at the forensic institute with the medical records of Paris hospitals led to the identification of 5.1% of the individuals. Forensic odontological examinations and comparisons were the basis for 4.3% of the identifications. The highest number of identifications was achieved when multiple methods were used. For example, a total of 87% of individuals were identified using fingerprints, police investigations, and DNA, and 88% were identified using investigations and fingerprints.

If we consider only highly decomposed individuals, the most effective method of identification was fingerprint comparison, which was used in 44.2% of the identifications carried out. This is related to the recently developed ability of the police identification team to rehydrate the epidermis and work on degraded fingerprints from mummified or carbonized bodies. Of the highly decomposed individuals, 23.6% were identified using genetic samples, whereas a police investigation made it possible to identify 17.5%. Comparisons of medical data led to the identification of 7.6% of the highly decomposed individuals within this corpus, whereas odontology made it possible to identify 6.1% of these individuals. Finally, the particularly low percentage (1.1%) of bodies identified by relatives in the IMLP can be explained by the concern of the forensic team to avoid having families see decomposed bodies. The weight of identification, as well as the shock of seeing a corpse, can mislead those close to the person, leading them not to recognize the body or, conversely, to identify a stranger's body as that of a missing relative [11, 12].

Discussion

The results of this retrospective study provided relevant information about the unidentified decedent population in Paris. Individuals arriving with an XPE or no identity comprised 13% of the cases admitted by the IMLP in the 6 years selected for this study. Almost three-quarters of the corpus was male in terms of biological profile. The age of most of the bodies, both male and female, ranged from 40 to 80 years, with an average age of 58 years. More females appear to have been identified than males; whereas 1% of females remained unidentified, 5% of males remained unidentified (Figure 3). This difference in identification could be explained by social parameters: males are much more exposed to social and family isolation than females, with loneliness being the main cause of suicide for males [11]. The prevalence of unidentified male bodies is also highlighted in the literature [4, 13–15]. In India, a retrospective study conducted over a 5-year period based on 3 165 bodies from Chandigarh hospital mortuary found that 97% of unidentified male (but only 3% of unidentified female) decedents aged between 41 and 50 years old had

cranio-cerebral damage as the most frequent cause of death [16]. The average age of the individuals was not the same in our study and those of the publications cited; the average of the latter was between 20 and 45 years [13, 14, 17–19]. The reason that explains why the age of our corpus is so much higher than that of other forensic institutes is that we considered isolated elderly people found at home, whose identity needed to be confirmed. In most cases, there is no medical doctor present to confirm the person's death. As a result, these bodies are admitted to the IMLP with putative identities, and identification must be confirmed because Paris has issues with undeclared rentals and the falsification of identities.

A previous study over a period of 6 years (2003–2009) presented an overview of all methods used for the identification and characterization of the unidentified bodies that arrived at the Department of Forensic Medicine and Pathology (University Hospital R. Poincare, Garches, France) in the west area of Paris [13]. They reported a consolidated number of 134 unidentified cadavers from all autopsies performed in the department ($N = 2\,384$). The cause of death was mainly suicide (40.3%), especially asphyxia after drowning, then accidental death (17.9%), especially multiple traumas after traffic accidents, acute carbon monoxide poisoning, or burns. In total, 11.9% died from natural causes (50% from cardiovascular causes) and 11.2% from homicide (one-third involving guns). These results differ from those found in our study, and this could be because half of IMLP unidentified bodies underwent only external examination and because our corpus also included decedents with presumed identity. The cause of death in Garches was undetermined in 18.7% of the unidentified bodies, whereas in IMLP it was undetermined in 29.6% of the unidentified bodies. In Garches, they reported that 28% of the initially unidentified bodies were identified using molecular biology (DNA), 23% using odontology, 7.5% using fingerprints, and 6.7% through autopsy examinations. The results of fingerprint identification in Garches (7.5%) differ from our study (46.5%), probably because protocol at the IMLP includes systematic fingerprinting and because we included bodies with presumed identities. They also reported that 46.4% of unidentified bodies were identified only using non-scientific elements (e.g. visual recognition of the deceased or his/her clothes/personal effects) and emphasized the need for this initial recognition to be supplemented by a scientific method to achieve a consolidated identification.

The IMLP study highlights an increase in the number of bodies without formal identification over the last 6 years. The reason for this is difficult to determine but may reflect several factors (e.g. increases in social isolation and migration), especially for decedents admitted without any element of identity. For those with presumptive identification, one reason for this may be the caution of police investigators following cases of misidentification. In addition, this retrospective study allowed the impact of this protocol to be evaluated. If we consider the number of bodies that remained unidentified ($n = 164$) in this 6-year study on a total of 2 324 decedents admitted without formal identity (7%) and the first internal study conducted at IMLP from 2014 to 2016 with a total of 1 215 bodies admitted without formal identity and 182 bodies that remain unidentified (15%), the number of bodies buried unidentified since the establishment of the protocol at IMLP in 2017 has been halved. As previously mentioned, unidentified bodies are then buried in an individual grave through an administrative procedure: the law has given the mayor the responsibility of ensuring the burial of an unclaimed/unidentified person after his/her death [20]. If identification is achieved after the burial, and the next of kin are found, they will have the opportunity to exhume the body and re-bury it according to their wishes and beliefs. Accessibility of the information is essential: the search for a missing adult is a long process for families, often lasting several years, due to the lack of centralization of data on missing persons and unidentified corpses at the national level.

In addition, the absence of a national file in France dedicated to missing persons and unidentified bodies greatly reduces the potential for search and identification. The existing national file, the Fichier des Personnes Recherchées, lists all persons subject to search or verification of legal status, which is carried out by the police and gendarmerie at the request of judicial, military, or administrative authorities. The file includes missing persons. Police and gendarmerie investigators have their own files on missing persons and unidentified corpses (CADDIS and FENIX), but unfortunately there is no possibility of cross-referencing between these two databases, which mainly operate internally [21].

Among the decedents that arrive without identity at the IMLP, we can expect to find socially isolated individuals, but not ones that are completely unknown to the state. The search for identity relies largely on the capacity of the French identity verification network, which includes the national biometric (FAED) and DNA (FNAEG) databases. People found at home or known to the police, including migrants who apply for the official document "Titre de séjour" while waiting for asylum, can be identified in a timely manner. Real complexities arise when the use of these databases is rendered impossible due to the state of decomposition of the body at the time of discovery or when the individuals are not registered in these databases. The identification process then becomes long and tedious, relying largely on information that can be obtained by investigators or during examination of the body at the forensic institute. This applies to people admitted without any element of identity, mainly males, for whom no information is available to guide the investigation when the body is discovered. It is then crucial that forensic specialists (pathologists, anthropologists, radiologists, and odontologists) recover all medical/biological information and establish a complete biological profile, which will assist in narrowing the search parameters when information on missing persons is consulted or when new information arises, even months and years after the inhumation of the unidentified body. Given that identification techniques are based on comparisons, the chances of identifying a deceased individual become tiny for the judicial authorities if the individual has not been previously reported as missing. In France, the lack of a national database dedicated to missing persons and unidentified corpses is one of the main obstacles to solving these cases. Several countries, including the United States, Australia, Singapore, Spain, and Ireland, already have databases linking missing person cases with unidentified bodies at the national level, or investigative services specializing in the identification of unidentified bodies [3, 22, 23].

A recent article reviewing 24 articles on the international burden of unidentified remains emphasizes the need to preserve DNA samples at the time of autopsy for later genetic confirmation, as well as the need for an accurate and informative database of all unidentified remains in case investigations

continue months or years later [19]. Since 2003, French law has authorized judicial authorities to integrate DNA profiles of unidentified bodies into a genetic database (FNAEG) to compare them with all DNA profiles registered (such as those of offenders, relatives of missing persons, biological traces on crime scene) and, in the absence of a match, to keep them in the system for a duration of 40 years. In addition, since 2021, French law has authorized the registration of DNA profiles recovered in extrajudicial cases such as natural mass disasters and those from the second-degree kin of missing persons [24]. However, despite the appeals of families, associations, and lawyers, these laws are largely unknown and unused by the French judicial authorities [25]. Communication between forensic teams and the judicial authorities responsible for identification at the local and national levels is therefore crucial. The constraints posed by complex identifications and delays that can sometimes extend to several years require new tools to be implemented in the country, including strengthening collaboration between forensic institutes and International Criminal Police Organization (INTERPOL).

This retrospective study also highlighted that the bodies that remained unidentified in Paris ($n = 164$) died mostly of natural/accidental causes, whereas all the cases without formal identification that died in a criminal context were successfully identified by the homicide unit. This probably reflects the different attention given by the judicial authorities: when an offender must be identified, the identification of the victim is given priority. Authors from India also stated that homicide victims have a higher chance of being identified than decedents who died from natural causes [16]. Our study differs from other publications in that it also included deceased persons with an XPE, because even if the majority could be identified in a timely manner, they represent a category of vulnerable persons who pose diverse challenges to identification: those who are socially marginalized, elderly, and others who have a false identity.

Even though published studies on unidentified bodies in national and international contexts have not considered bodies with XPE, we found several common factors between our study and these references. A previous study from France addressed the burial of unidentified bodies and highlighted the need to establish standardized, compatible antemortem and postmortem files with the anthropological/odontological examinations to obtain the biological profiles needed for comparison with those in the missing persons files [26]. In the Italian context, more decomposed bodies have been successfully identified using odontology and anthropology, because these methods were cheaper, faster, and antemortem, or because DNA from relatives could not be recovered [14]. In our study, the contribution of forensic anthropology and odontology to the biological profile of unidentified bodies also reduces the range of possible missing persons and therefore allows comparative identification through digital fingerprints or medical data after the comparison of imaging data for the patient. The importance of establishing an exhaustive biological profile and documented elements associated with bodies to trigger identification has also been underlined in the Mexican context. Nearly 500 corpses are dumped each year in cemetery mass grave sites in Mexico City alone, and the authorities estimated in 2019 that there were 26 000 unidentified corpses and 40 000 missing persons [7]. In contrast, in Australia, a 20-year study of unidentified human remains found only 132 unidentified coronial cases in the state of Victoria, where standardized procedures and professional resources, including all relevant forensic disciplines, were promoted [27].

Despite different contexts and caseloads, we all emphasize that the collection, recording, and management of ante- and postmortem data is critical to the identification process, as this information must be accessible over a long period of time, regardless of the cause of death [3, 4, 8, 22]. It is well established that although the identification of deceased persons is the responsibility of the judicial authorities, medico-legal teams play a crucial role in providing details that may assist in the identification process. This is well reflected in mass disaster scenarios, where protocols bring together forensic teams and police/gendarmerie units to achieve identifications based on internationally validated scientific methods under the aegis of INTERPOL [28]. Routine cases should also have the benefit of this procedure, and that was the goal of the protocol at the IMLP.

The challenges associated with unidentified bodies in Paris, as elsewhere in the world, require a multidisciplinary approach involving forensic experts, law enforcement, and community collaboration to improve identification processes, ensure dignified treatment, and prevent these individuals from remaining missing without the knowledge of their loved ones.

Conclusion

This 6-year overview study covering a total of 2 324 unidentified bodies from a domestic context illustrated several key elements regarding the challenges faced by judicial authorities and forensic practitioners in improving identification outcomes. One of the key factors observed in Paris and in other countries involved in the long-term management of unidentified bodies is the need to implement standardized procedures and documentation for case files. The documentation should remain accessible not only to judicial authorities but also to missing persons associations that play a major role in correlating files when no police investigation exists. The need to establish a national database to properly document and disseminate information on missing persons and to centralize the biological profile of unidentified bodies is key, as without antemortem information or a biometric database there can be no matching. The possibility of registering DNA profiles of unidentified bodies in the FNAEG should be applied to all deceased for whom identification has failed to give their relatives a chance in the future to know their whereabouts.

By including decedents with presumed identities who are mainly vulnerable people and establishing the profiles of those who remain unidentified in the IMLP (male, aged 20–45, socially isolated, and who died of natural causes in a public space), we highlighted the need to collaborate with social workers, associations, and hospitals for identification on the basis of identities given during life and the use of medical data [29]. A major misconception that prevents a proper investigation is the frequent assumption that no one would look for someone who is socially isolated, homeless, elderly, or a migrant. It is also necessary to increase the attention of judicial authorities to unidentified bodies in cases of accidental and natural deaths, as the identification process is not adequately carried out in these cases. However, the need to bring closure to families is the same whether the deceased is a criminal or not. Implementing a protocol at the IMLP that includes systematic biological profile, police identification (fingerprints,

photographs), DNA sampling, and PMCT for all unidentified decedents halved the number of bodies buried unidentified and will provide a chance for future identifications that may take time.

Forensic practitioners both nationally and internationally need to promote human dignity in the identification process and sensitize authorities to apply all existing legal tools. The combination of a multidisciplinary and integrative approach to the identification process can improve the accuracy and efficiency in identifying bodies without a name, thereby providing closure to families and contributing to the resolution of legal and social implications associated with unidentified bodies.

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Authors' contributions

Alexandre Biro and Tania Delabarde equally contributed to this work with main conceptual idea of the article. Alexandre Biro collected data and performed statistics analysis, Tania Delabarde devised the project, drafted the manuscript and performed literature research. Bertrand Ludes contributed to the design of the study and to the article review and editing.

Compliance with ethical standards

The authors performed no studies involving human subjects or animals.

Conflict of interest

Bertrand Ludes initial holds the position of Editorial Board Member for *Forensic Sciences Research* and is blinded from reviewing or making decisions for the manuscript.

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