



What is a migrant death? An operational definition for a more accurate enumeration of migrant mortality along the US-Mexico border

Molly Miranker^a, Rachel Daniell^b, Molly Kaplan^c, Veronica Flores-Guillen^c,
Jasmine Hernandez^{d,e}, Heather Edgar^{d,e}, Kate Spradley^c, Nicholas Herrmann^c,
Alberto Giordano^{a,*}

^a Department of Geography and Environmental Studies, Texas State University, San Marcos, TX 78666, United States

^b School of Information, Pratt Institute, New York, NY 10011, United States

^c Department of Anthropology, Texas State University, San Marcos, TX 78666, United States

^d Department of Anthropology, University of New Mexico, Albuquerque, NM 87131, United States

^e New Mexico Office of Medical Investigator, Albuquerque, NM 87102, United States

ARTICLE INFO

Keywords:

Migrant Mortality Mapping Portal Project
US-Mexico border
Geography and GIS
Forensic anthropology
Migrant deaths

ABSTRACT

Over the last forty years an indeterminate number of persons, ranging from thousands to tens of thousands, have died along the US-Mexico border during migration, fleeing poverty, armed conflict, situations of violence, and disasters. An accurate accounting of migrant deaths along the southern US border is the first step toward an understanding of the extent and the contributing factors of these deaths. In this article, we describe a key aspect of our collaborative work aimed at developing a more representative account of migrant mortality along the southwestern US border: the determination of criteria for inclusion of specific forensic cases as “migrant.” Our intention is not to propose a definition of “what is a migrant death” applicable to all contexts and situations but rather one specific to the US-Mexico border region. Our main impetus is to build and launch a web portal to track and map migrant deaths at the US-Mexico border. The criteria we have identified are based on an examination of death data collected by various agencies in the four border states (California, Arizona, New Mexico, and Texas) and at the federal level by the National Missing and Unidentified Persons System (NamUs). They include a) context of human remains discovery; b) identification media/documentation; c) geographic setting; and d) personal effects. Taken together, these criteria will facilitate our determination, case by case, of the probability that human remains found along the United States side of the border may be from a person in the context of migration.

1. Introduction

Over the last forty years a currently indeterminate number of persons, ranging from thousands to tens of thousands, have died along the US side of the border with Mexico during migration, fleeing poverty, armed conflict, situations of violence, climate change, and disasters. An accurate accounting of migrant deaths along the US-Mexico border is the first step toward an understanding of the extent and the contributing factors to these deaths. However, reliable data covering the full border is not currently available. While several governmental agencies and NGOs report figures documenting subsets of these deaths, the variable nature of these statistics indicate data sources face significant challenges.

It is currently not possible to independently validate reported

statistics, disaggregate data to better understand spatial patterns, or develop an accurate, cross-jurisdictional count of migrant deaths. Since 1998, the US Customs and Border Protection agency (USBP) has reported 8627 deaths along the US-Mexico border; this is treated as an authoritative source for mortality counts [49,48,50]. Researchers contend that migrant deaths along the border may be much higher [16]. For example, the National Missing and Unidentified Persons System (NamUs) has published 7243 missing persons reports (inclusive of individuals who have been missing 1944-present) and 7043 unidentified person (UP) reports (inclusive of decedents who were recovered 1915-present) for California, Arizona, New Mexico, and Texas, but there is no publicly accessible way to know how many of these missing persons or UPs are (probable) transnational cases—including

* Correspondence to: Texas State University, ELA 139, San Marcos, TX 78666, United States.

E-mail address: ag22@txstate.edu (A. Giordano).

<https://doi.org/10.1016/j.forensiint.2024.112156>

Received 29 September 2023; Received in revised form 8 July 2024; Accepted 17 July 2024

Available online 18 July 2024

0379-0738/© 2024 Elsevier B.V. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

migrants—unless the Investigating Agency reporting the case to NamUs documents that information in the case Circumstances notes [33]. The International Organization for Migration estimates that 4600 migrants have gone missing or died along the US-Mexico border from 2014 to present [26]. Meanwhile, a report from the University of Austin’s Strauss Center for International Security and Law recorded 2655 cases from South Texas alone [41]. At present, there is no dataset that adequately covers the entire US-Mexico region. As a consequence, the full scope and details of these deaths have reduced visibility in research, advocacy, and public discourse. A better understanding of the number and locations of deaths of migrating persons over time can potentially assist case investigations of unidentified remains, facilitating the cross-referencing of missing person’s information and forensic research to aid in the identification process [39]. It is only through an understanding of the true scope and geographical distribution of migrant fatalities that appropriate resources, training, and procedures may be developed to mitigate loss of life and implement adequate investigative responses.

To help overcome these challenges, in 2022 the authors of this article were awarded a Human Networks and Data Science Program Infrastructure (HNDS-I) grant by the National Science Foundation (NSF) to create an open-access web portal to document the phenomenon of migrant deaths at the US-Mexico border. Our group is composed of forensic scientists, geographers, and anthropologists. We are also part of a network of researchers and forensic practitioners from Arizona, Texas, New Mexico, California, New York and Washington DC—the Regional Migrant Mortality Accounting Working Group (hereafter Working Group)—that have been meeting since 2021 to discuss the current needs for—and the obstacles to—creating a GIS-based web platform for documenting migrant deaths at the US-Mexico border. The eventual database will be explicitly designed with a humanitarian purpose in mind, meaning a platform for sharing data across government agencies and advocacy organizations that is open to the public, including relatives seeking answers about the fate of missing migrant relatives. The platform will also support humanitarian forensic action, i.e., the application of the knowledge and skills of forensic medicine and science to a range of activities that seek to alleviate human suffering and protect the dignity of all victims, especially in the aftermath of conflicts or disasters [13]. We adopt the recommendations of the International Committee of the Red Cross, which are premised upon the four Geneva Conventions of 1949 [23] and their Additional Protocols of 1977 [24]. Specifically, our work will serve “*improving the communication, coordination and cooperation of forensic and investigative agencies involved in the recovery, analysis, documentation and management of decedent migrants [...]*” ([11,10], p. e1).

In this article, we describe one key aspect of our work toward developing a more representative account of migrant mortality along the US-Mexico border: determining the criteria for inclusion of specific forensic cases. The purpose is to describe our thought process for defining the set of criteria that aids in the determination of unidentified human remains as a probable migrant case for the *HNDS - Migrant Mortality Mapping Project Portal* (M3P2 or Mortality Mapping Project). At the core of this work is the need to generate a working understanding of what counts as a death in the process of migration within the forensic context of unidentified remains discovery in a specific area.

In the next section we summarize existing definitions of “migrant” and “border death.” We continue by describing the practices of different institutions to demonstrate that different jurisdictions along the US border have adopted special processes to conduct effective forensic interventions. We then describe our process for selecting the sources from which we gathered or requested data about unidentified human remains of a probable migrant (UHRpm), such as death reports from a sheriff’s office. The bulk of our discussion is devoted to demonstrating the decision-making our colleagues and other forensic practitioners perform to recognize a UHRpm case and how that contributes to humanitarian interventions.

2. Migrant deaths, border deaths

2.1. Existing definitions of migrant

No universal, legal definition of “migrant” exists. To inform the types of deaths we aim to enumerate and represent via the Mortality Mapping Project we start by first drawing from existing definitions by international humanitarian organizations, focusing on the relationship between these definitions and the development of US immigration policy. Second, we incorporate the research and investigatory experiences of practitioners working directly on the US-Mexico border, including forensic anthropologists, federal authorities, local law enforcement, and local humanitarian NGOs.

Our understanding of “who is a migrant” is primarily based on the International Committee of the Red Cross and United Nations’ International Organization for Migration definitions. Specifically, a person or persons:

who leave or flee their habitual residence to go to new places- usually abroad - to seek opportunities or safer and better prospects ([24], p. 2)

who have died at the external borders of states, or in the process of migration towards an international destination, regardless of their legal status [25]

For juxtaposition, we highlight elements USBP’s Missing Migrant Program uses to count migrant decedent cases they discover or are otherwise involved with as an assisting agency to local law enforcement (Table 1).

Formerly the Missing Migrant Initiative (est. 2015), the Missing Migrant Program was formalized as part of the Missing Persons and Unidentified Remains Act of 2019 ([32] P.L. 116–277) as a USBP program and special operation tasked with preventing the loss of life amongst the migrant population traversing through the southern border [48,50]. We do not draw from USBP’s criteria because USBP prioritizes absence of accepted documentation or passage through official ports of entry. Instead, to ground the Mortality Mapping Project on humanitarian aims we draw directly from the International Committee of the Red Cross and other longtime governmental and nongovernmental collaborators of the Mortality Mapping Project and Working Group members, rather than solely rely on USBP criteria, which are premised on a policy of deterrence. The Mortality Mapping Project will maintain continuity, increase data transparency (eschewing aggregated data such as those publicly available on USBPs Missing Migrant Program Statistics and Summary web page; <https://www.cbp.gov/newsroom/stats/border-rescues-and-mortality-data>), and improve accountability by consolidating accounts of migrant death from the whole US southwestern border region and visualizing the phenomena of migrant death as a regional occurrence rather than isolated incidences. As enumerated by [39], the Mortality Mapping Project will:

- Collect contextual data from the death scene that could also better inform cause and manner of death;
- Provide appropriate jurisdictional information for the order of an autopsy or anthropological analysis;

Table 1
Excerpt of criteria used by USBP for accounting migrant decedents.

A suspected undocumented migrant who died*:	A suspected undocumented migrant who died*:
• In furtherance of an illegal entry,	• In furtherance of an illegal entry,
• Within a designated target zone, or	• Outside of a designated target zone, or
• Whether or not USBP was involved directly;	• If USBP was involved directly with the incident.

* The Missing Migrant Program collects data from a USBP designated target zone comprised of 45 counties along the US southwestern border.

- Assess and document the positional accuracy of the recorded location where the body or the remains were found (as Humane Borders already does; <https://humaneborders.org/migrant-death-mapping>);
- Utilize standard forensic and spatial-analytical terminology across different jurisdictions so that data is comparable across the entire border.
- Maintain continuity of human remains and associated evidence throughout all jurisdictions to ensure traceability of remains and evidence.

The International Committee of the Red Cross and International Organization for Migration’s definitions are the foundation upon which to recognize what a migrant is, as they name definitions that encompass myriad circumstances that impel migration rather than what might be core legal obligations to the dead, as is the case for the Office of the United Nations High Commissioner for Human Rights [35,46]. These definitions are motivation inclusive (e.g., safety, labor) and allude to migration as being part of a process (e.g., journey, crossing). Even with guidance from three prominent international humanitarian organizations, defining a migrant or migrant death is not without challenges.

2.2. Existing definitions of border deaths

There is no internationally standardized definition of what constitutes a “border-related death” [25,20]. Consequently, statistics of migrant deaths at international borders vary. A count can be based on bodies found near the vicinity of a border, while in other cases a count may include both bodies found and survivors’ reports of the number of missing or presumed dead, which is often the case when counting deaths at sea ([25], p. 19). Accordingly, along with a definition of migrant, we also briefly examine what is a border death. The International Organization for Migration proposed, “Border deaths are those who have died attempting to migrate by irregularly crossing international borders” (Fatal Journeys, 2016, p. 68).

Reports by the Arizona-based humanitarian NGOs No More Deaths and La Coalición de Derechos Humanos are also instructive with their definition of “border crossers.” Border crossers are individuals “who attempt to enter the US on foot between ports of entry in wilderness regions (as opposed to other unauthorized crossing methods in urban areas)” (2016, p. 2)[34]. These two organizations’ characterization of “border crossers” and border deaths describe the Southern Arizona context. Notably, a landlocked context. To mobilize a regional definition of migrant deaths in relation to the border should also include water-related contexts, which is experienced by local authorities in California and Texas—the Pacific Ocean, the All-American Canal, the Rio Grande River, the Gulf of Mexico.

We expand from the International Red Cross, the International Organization for Migration, and No More Deaths definitions of migrant and border deaths in two ways: a) we take into account the geography of the US-Mexico border as it is a contributing factor to the number of migrant deaths; b) our definition to adopts a regional view to reflect the context of US-Mexico border. Our aim is not to develop “The” definition, but “a” definition that is anchored in the local realities—physical, social, legal, and political—of the region in which we work. We continue by highlighting key research and field experiences with unidentified human remains of probable migrants specific to forensic anthropologists, local law enforcement, and local humanitarian NGOs based throughout the US’ southwestern border region.

3. UHRpm: geographic observations

At least two studies have attempted to count UHRpm across multiple jurisdictions on the US-side of the border with Mexico, Eschbach et al. [19] and Sapkota et al. [43]. Both had inclusion criteria (Table 2).

Eschbach’s *Death at the Border* definition refers to a specific geographical area (counties along the US-Mexico border), incorporates crossing the border as a circumstantial indicator, and highlights the lack

Table 2
Migrant decedent selection criteria from previous studies.

Eschbach Criteria ([19], p. 433)	Sapkota Criteria ([43], pp. 1282–1283)
1. Deaths occurring in counties near to the United States-Mexico border	1a. “Unauthorized”/ The decedent was not identified as a legal resident of or an authorized entrant into the US
2. Causes and circumstances of death that indicate that the deceased may have been crossing the border into the United States without authorizing documents	1b. Identified as a resident of another country by family members, friends, or officials or through sufficient circumstantial evidence (tattoos, personal effects, identification media such as voter cards)
3. Location found	2a. Exclude decedents who were known to have resided illegally in the US for more than a month before their death
4. Biological sex	2b. Exclude decedents who were determined not to have died while crossing the border
5. Age	
6. Date found	
7. Reported as a Juanita or Juan Doe	
8. Nationality (if identified)	
1. 9. Place of residence (if identified)	

of identifying information associated with the decedents. Similarly, Sapkota’s et al. [43] *Unauthorized Border Crossings and Migrant Deaths* also used counties along the US-Mexico border as the loci of migrant deaths but limited to counties along the 650-mile section of the US-Mexican border from Yuma County, Arizona, to El Paso County, Texas (p. 1282).

These two studies enable a historic, comparative analysis that highlights the funneling of migrants eastward following Prevention Through Deterrence deployments over time [16,31,38]. USBP’s Prevention Through Deterrence, also called the Strategic Plan, was designed to block entry from traditional and known migration routes [30,44,47]. In 1994, when the Strategic Plan was implemented, protection and enforcement of the border with Mexico shifted from interdiction (i.e., apprehending border crossers and seizing contraband) to deterrence via physical infrastructure and interior checkpoints throughout the south-west to dissuade would-be crossers from attempting the journey. Neither Eschbach’s nor Sapkota’s study, however, covers the entirety of the US’ southwestern border. To articulate a regional profile for UHRpm that may be utilized by any border jurisdiction, we revisited more recent research for each border state.

3.1. Experiences per state

The criteria for discerning a migrant decedent in Arizona, or Undocumented Border Crosser in their parlance, represents indicators emblematic of pedestrian travel over arid land in Southern Arizona. This jurisdiction is considered one of the most successful at investigating and identifying Undocumented Border Crossers. Much of the success noted in Arizona is attributed to the centralized forensic investigatory efforts through the Pima County Office of the Medical Examiner in Tucson and its sustained collaboration with USBP, academic researchers, and NGOs to bring cases to positive identification (Anonymized Reference 1, 2017; Anonymized Reference 2, 2018). We review the Pima County Office of the Medical Examiner’s best practices for the analysis of probable migrant decedents in the Section 3.2.

UHRpm in Texas, and in South Texas in particular, are discovered often by happenstance, due to the lack of death management responses and to the fact that the overwhelming majority of land is held privately. the latter a factor that limits access for regular and systematic searches (Anonymized Reference 3, 2016; Anonymized Reference 2, 2018; Anonymized Reference 4, 2019). The Texas context exemplifies the stagnation of both forensic and humanitarian interventions when UHRpm cases are treated as isolated incidences and there are insufficient means (funding, personnel, training) to document and track migrant and border deaths as a regional phenomenon and as an ongoing crisis.

In California, designating a case as a probable migrant decedent is guided by the knowledge, experience, and collaboration of local and federal law enforcement, local consulates, and forensic practitioners

such as medical examiners and anthropologists. Typically, this network of forensic investigation is activated when remains are found near the border or inland in remote areas seldom traversed by residents or tourists. Though explicit criteria for UHRpm are not listed in the 2008 publication, the article hinted at what California-based forensic practitioners most often observed ([22], p. 17):

- Deaths tend to result from exposure, dehydration, suffocation in the back of a smuggler's van, or speed-related motor vehicle accidents.
- Non-US status often indicated by identification media such as voter registration cards.
- Demographic profile based on anthropological analysis:
 - o Ages 14–75, with a majority within 20–29.
 - o Eighty-eight percent are males.
 - o Nearly 99 % originate in Mexico.

Most information related to UHRpm in New Mexico aside from the Sapkota report [43] originate from news media or US Border Patrol Media releases. As summarized by the International Organization for Migration, in the years 2016–2023 at least 29 UHRpm were reported in New Mexico. Ten of those cases were recorded and shared publicly by the USBP, the other 19 were mentioned by news media who communicated with the Office of the Medical Investigator in Albuquerque [26]. As reported in a recent article by the Washington Office of Latin America, it appears that migrant deaths are on the rise in the state [2]: “In Border Patrol’s El Paso Sector, which includes New Mexico [...] agents have recorded over 70 migrant deaths in the remote desert of New Mexico since October 2022.”

We return to discussing New Mexico UHRpm in the Section 4. Until recently there was no formal tracking of migrant deaths by the New Mexico Office of the Medical Investigator, the state’s sole medico-legal authority. Unofficial annual numbers of migrant deaths at the Office of the Medical Investigator have until recently been much lower than other border states. Potential explanations for this may include the relatively short border area, rough terrain, and a relative lack of economic draw to the state. While actual quantification of migrant deaths is only now beginning, early unofficial accounts appear to indicate approximately a tenfold increase from 2020 to 2022, and a two-fold increase from 2022 and the first half of 2023.

3.2. Unidentified human remains of a probable migrant (UHRpm): physical observations

Geography, local knowledge, and personal effects are all factors that can point to a UHRpm. There are also skeletal indicators that aid in the designation of these types of forensic cases. Forensic anthropologists at the Pima County Office of Medical Examiner in Tucson, AZ, and Operation Identification at Texas State University in San Marcos, TX, have performed some of the most successful search, recoveries, and positive identifications of UHRpm and encapsulate how human remains analysis can aid in distinguishing UHRpm cases to facilitate effective identifications (i.e., affected families trusting a positive identification; [9,36,37]). When it comes to forensic analysis of skeletal remains, we utilize the Pima County Office of the Medical Examiner’s best practices rather than generate a new set of indicators.

Arizona and Texas are the border states with the highest reported incidences of migrant death [7,1], but how the two states deal with these occurrences could not be more different. The Pima County Office of the Medical Examiner is recognized as having the best protocols for responding to migrant deaths [21]. Coinciding with the implementation of the US Border Patrol’s Strategic Plan, the Pima County Office of the Medical Examiner experienced a 20-fold increase in migrant deaths in Arizona between 1990 and 1999 and 2000–2005 [38], and even with US Border Patrol apprehensions in the Tucson decreasing between 2014 and 2020, the number of migrant deaths remained high [16]. From fiscal years 1990–2020, Pima County Office of the Medical Examiner

investigated the recovered remains of 3356 undocumented border crossers, positively identifying 2154 individuals [16]. This success is primarily due to centralized collaborative identification efforts developed by forensic anthropologists at the Pima County Office of the Medical Examiner, consulates, and partner humanitarian NGOs (Anderson and Parks, 2008; [12,40,3]). Most importantly, the Pima County Office of the Medical Examiner was the first in the country to develop a unique protocol for managing UHRpm cases, which they call “Undocumented Border Crossers” (Anderson and Parks, 2008, p. 6).

In Arizona, deceased individuals are considered an Undocumented Border Crosser if: a) their identity is known, but their crossing was clandestine and they are not US nationals as established through investigation by the Pima County Office of the Medical Examiner; b) their identity is not known but “personal effects found on the body are consistent with foreign citizenship and an anthropologic examination reveals a heritage common to many individuals from Latin American populations” (Anderson & Parks, 2008, p. 6). The anthropologic examination is integral in accounting for UHRpm because many remains found in the border context are partially or fully skeletonized. In these cases, practitioners at the Pima County Office of the Medical Examiner have utilized patterns of skeletal indicators of health status as a discriminating variable to identify probable migrants during forensic anthropology casework [5]. Other variables included shorter stature, frequency and type of carious lesions (or dental cavities), cranial asymmetry, porotic cranial lesions, and enamel hypoplasias [5,4]. Figs. 1 and 2 summarizes the assessment process for Unidentified Border Crosser cases in Arizona.

In Texas, Operation Identification, a humanitarian project of the Forensic Anthropology Center at Texas State University, utilizes similar protocols for triaging unidentified human remains likely to be migrant individuals. Founded in 2013 in response to the influx of migrant death and lacking forensic facilities in the Rio Grande Valley, Operation Identification collaborates with Texas border law enforcement, consulates, USBP, and national and international NGOs to facilitate the recovery, identification, and repatriation of unidentified migrant decedents. As at the Pima County Office of the Medical Examiner, Operation Identification utilizes both contextual and skeletal evidence to tag UHRpm cases, particularly when conducting forensic exhumations in South and West Texas cemeteries. Because many Texas border counties have historically buried UHRpm alongside local citizens, often in unmarked or temporarily marked graves, assessing the biocultural profile of the deceased is therefore critical for ensuring that only those individuals in need of forensic case management are exhumed [28,45].

Operation Identification also looks at the characteristics listed in Fig. 2. Similar health biomarkers utilized by the Pima County Office of the Medical Examiner, Operation Identification has noted that carious lesions and porotic hyperostosis are frequent among UHRpm they have received. Accoutrements such as tattoos and dental modifications can also strongly aid in the identification process [4]. However, skeletal assessment of human remains is not a “one size/one process fits all,” as the skeletal stress markers used by the Pima County Office of the Medical Examiner are not necessarily applicable or as frequent in cases recovered in Texas. In Operation Identification’s experience the presence of clothing or other personal effects indicative of long-term travel, including toiletry or food items and personalized portable items such as letters, jewelry, photos, or religious objects, are recognized as strong indicators of UHRpm. Skeletally, Operation Identification assess indicators of younger-to-middle adult age, as contrasted with elderly age and signs of end-of-life care or medical intervention often seen with the buried local citizens, such as hospital gowns or intubation tubes [28].

4. Homing in on a criteria for UHRpm determination that reflects the region

With the existing definitions of migrant and/or border deaths and some experiences of US forensic practitioners in mind, we reviewed

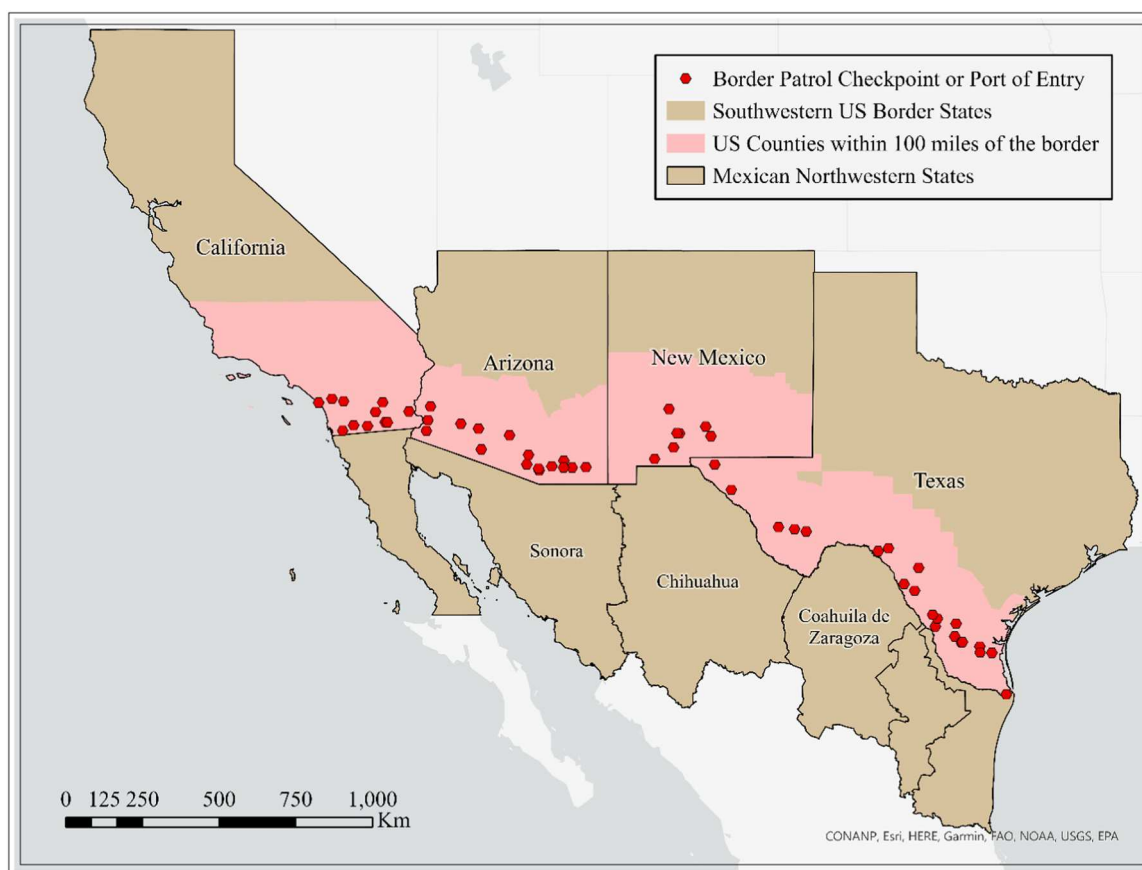


Fig. 1. The US-Mexico border region with border counties known by local authorities to have higher probabilities of migrant deaths.

*Profiles based upon these 2000 **identified** crossers (with **known** characteristics)*

Identification media

Voter card; *cedula*; birth and marriage certificates; employment records; deportation notices

Cultural accoutrements

tattoos; dental alterations; religious icons; clothing; photographs

Personal effects

bus, train, plane tickets; receipts; money; phone numbers; written notes /drawings

Geographic location

known trek corridors; remote desert locale; northbound routes

Biological profile*

skeletal measurements / observations; skeletal indicators of stress and injury; DNA profiles (STRs / mtDNA haplogroups / AIMs / Next Gen Sequencing); isotopic analyses; “phenotyping” technologies, forensic genealogy

***most scientific and reliable...**

Fig. 2. The Pima County Office of the Medical Examiner’s undocumented border crosser determination process. (Figure credit: Author 7).

medical examiner and local law enforcement unidentified deceased data. Ultimately, this review led us to produce a Regional Demonstration Dataset of UHRpm on the US side of the border for the period 2009–2020. This dataset in turn informs our case selection and inclusion protocol for the Mortality Mapping Project.

4.1. Compilation of the regional demonstration dataset

We tabulated what we termed “available datasets,” originating from medicolegal agencies, peer-reviewed academic publications, and publicly available death records to assemble our dataset. The start date of 2009 was chosen because this is when reliable data on migrant deaths

started to be available in Texas for Brooks County. Beginning with 14 sources ranging from existing peer-reviewed publications, publicly requestable data from state-entities (e.g., Death certificate data from Departments of Vital Statistics, Medical Examiner's Offices), publicly requestable information from federal-entities (e.g., NamUs), and incident reports shared directly from local law enforcement through collaborative agreements and/or university-based forensic projects (e.g., Brooks County Sheriff and Operation Identification, Pima County Office of the Medical Examiner and Humane Borders). Table 3 summarizes the data sources initially reviewed for potential regional UHRpm dataset inclusion.

From the 14 sources we winnowed our dataset to include only reports from sheriff's offices, medical examiners, and NamUs because contributions from other sources, such as the Texas Department of State Health Services' Vital Statistics' Death Certificate Records of "unknown" individuals, were inconsistent across counties or because the information was provided in an aggregate form, such as "total incidences per month."

Ultimately, a total of five sources were chosen from the initial 14 to

Table 3
Review of potential data sources with migrant decedent information.

Source	Acquisition method	Date range	Location	Unidentified decedent count
Brooks County Sheriff's Office (BCSO)	Public Information Request	2009–2022	TX	852
Operation Identification (OpID)	Information Request to Project Lead	2001–2022	TX	483
Robert S. Strauss Center for International Security and Law	Information Request to Project Lead	1990–2020	TX	2655
Hidalgo County Sheriff's Office	Public Information Request	2016–2021	TX	85
Death Certificate Data, Texas Department of Public Health, Vital Statistics	Public Information Request	1994–2020	TX	827
National Missing and Unidentified System, Unidentified Persons (NamUs)	Publicly accessible with additional access to professional users	1915–2022	CA, AZ, NM, TX	6986
New Mexico Office of the Medical Investigator	Public Information Request	2018–2022	NM	116
San Diego Medical Examiner	Public Information Request/subset of publicly accessible data	2009–2020	CA	203
Open Geographic Information System (OGIS)	Publicly accessible	1981–2023	AZ	4037
Martínez et al. [16]	Scholarly publication	1990–2020	AZ	3356
Cornelius [14]	Scholarly publication	1994–2000	CA, AZ, TX	1422
Eschbach et al. [19]	Scholarly publication	1993–1997	CA, AZ, NM, TX	1600
Jimenez [27]	Scholarly publication	1994–2008	CA, AZ, NM, TX	5607
Sapkota et al. [43]	Scholarly publication	2002–2003	AZ, NM, TX	409

serve as datasets from which to build the four-border-state-wide Regional Demonstration Dataset. Reports from Brooks County Sheriff's Office and Operation Identification are treated as one source representing Texas because of their ongoing collaborative work. Table 4 summarizes the data sources and total UHRpm count ($n = 352$ cases).

This Regional Demonstration Dataset informs our understanding of "who" or "what is a migrant death in the US" southwestern border context." It is important to note that the demonstration dataset also includes a mix of positively identified and currently unidentified individuals, with the San Diego Medical Examiner's Office comprising entirely identified persons, NamUs comprising entirely unidentified persons, and Open GIS, Brooks County [Texas] Sheriff's Office, and New Mexico's Office of the Medical Investigator comprising both identified and unidentified. Further, this regional dataset is a mixed dataset of UHRpm and non-UHRpm cases as their comparison aided in distinguishing potential indicators for a migrant case. The authors relied on case notes and informal conversations with the case managers to distinguish the dataset's UHRpm. As part of our process for identifying potential hallmarks of a migrant death, we wanted to observe and compare reports (e.g., Brooks County Sheriff's recovery reports, Medical Examiner's death reports, NamUs unidentified person reports, etc.). Therefore, a single UHRpm case from one data source could correspond with another from a separate data source. For our regional demonstration dataset, none of the San Diego Medical Examiner's or Office of the Medical Investigator cases had corresponding, or duplicated, NamUs unidentified person cases because they were identified.

We included one national-level data source, NamUs, because there were sufficient case notes to extract migrant cases. For example, an Investigating Agency may mention whether the decedent is a suspected migrant in the Circumstances section, e.g., "remains were found in an area known for [sic] illegal border crossing." Both UHRpm and non-UHRpm Unidentified Person cases were included in the NamUs sample to see if there were trends we could include in our criteria for discerning migrant forensic cases from other unidentified remains cases. Additionally, we used NamUs, managed by the US Department of Justice, because it is the national centralized repository and resource center for missing, unidentified, and unclaimed person cases across the US. The inclusion of the national data source juxtaposed with state-level sources such as a medical examiner's office helped us observe trends in how unidentified human remains of probable migrant cases are described by different agencies and at different scales.

Our tag of UHRpm is supposed to support the identification process (e.g., indicate whether to contact a consulate) in addition to lead to an improved accounting of migrant death in the US-Mexico border region.

Table 4
Unidentified decedent cases per data source in the regional demonstration dataset.

Data source	Case count	Unidentified human remains of probable migrants
San Diego Medical Examiner Office	100	100
NamUs* CA	25	9
NamUs AZ	25	23
NamUs NM	25	3
NamUs TX	25	15
Humane Border's Open GIS of Migrant Mortality, AZ ‡	100	100
Brooks County Sheriff's Office, TX	100	99
New Mexico Office of the Medical Investigator	21	13
Total	421	362

* For the initial query process, we collected 25 cases from each of the four US-Mexico border states, for a total of 100 NamUs cases.

‡ Cases in the Open GIS website are managed by the Pima County Office of the Medical Examiner.

In all, these five data sources homed our definition of migrant for the purposes of Mortality Mapping Project as we further describe in the next section.

5. Jurisdictional observations in the determination of migrant decedent cases

The following observations pertain to characteristics of a migrant and border deaths in the regional demonstration dataset that are emblematic of the jurisdiction in which they occurred (state or county, depending on the data source).

5.1. California/San Diego Medical Examiner

It is possible to determine from the San Diego Medical Examiner’s case management system when an individual is a migrant [42]. This is because in such cases, a checkbox in their case management system is marked after a positive identification is made. All cases we included from the San Diego Medical Examiner represent known/identified migrants. The San Diego Medical Examiner sample of 100 cases shared via a public information request had a majority of male migrant decedents (n = 86) ranging 24–62 years of age; females (n = 10) were between 15 and 59 years old. In four cases, sex and age were undetermined (Table 5).

5.2. Arizona/Open GIS maintained by humane borders and the Pima County Office of the Medical Examiner

As previously discussed, the Pima County Office of the Medical Examiner’s protocol for determining a decedent to be a migrant—or, as they termed the cases, Undocumented Border Crosser—is the most comprehensive of any of the southwestern border states. The Pima County Office of the Medical Examiner performs death investigation services for 11 of Arizona’s 15 counties, including all four border counties: Yuma, Pima, Cochise, and Santa Cruz [8] (Table 6).

5.3. New Mexico/Office of the Medical Investigator

When an official case management system, such as MDI Log or VertiQ, is accessible and there is not an existing means to flag potential

migrant cases, a systematic query process aids in extracting candidate UHRpm cases. One of these authors is a forensic anthropologist at the Office of the Medical Investigator and requested a query of their case management system. That query included keyword searches using “border,” “BP agent,” “migrant,” as well as obsolete or pejorative terms [6] for “migrant” such as [sic] “illegal.” These queries resulted in 21 candidate cases, of which 13 were confirmed as UHRpm based on “Circumstance of Death” notes.

Of the 13 New Mexico UHRpm, between 2009 and 2020 the majority were recovered from a desert area (n = 9). Otherwise decedents were found near a roadway, i.e., highway or parking lot (n = 1 each), or in a rural area, which may be an alternative term for desert (n = 1). We mention the general place of death (desert, highway) here to help contextualize where a strong candidate migrant case may be found. This is particularly important when other information is unavailable, or a given jurisdiction does not yet have an existing tagging practice in their case management system. One case did not have information regarding the place of death. There were 6 females and 7 males. While this sample is small, it is the only border state so far where female and male decedents are nearly the same in quantity (Arizona, Texas, and California all include more male UHRpm). These cases were recovered from three New Mexico border counties: Doña Ana (n = 7), Luna (n = 4), and Hidalgo (n = 2). In 9 cases, the cause of death was listed as exposure and heat. The New Mexico Office of the Medical Investigator has recently added a checkbox to its database that denotes probable migrant status. Use of this checkbox has been implemented prospectively. Cases will be retrospectively marked soon following a full review of cases from New Mexico’s southern counties.

5.4. Texas/Brooks County Sheriff’s Office and Operation Identification

Three of the Authors are members of Operation Identification and work in partnership with the Brooks County Sheriff’s Office. Brooks County has some of the most migrant death reported in terms of quantity and completeness anywhere in Texas (at least within 2009–2020). Given our data collection timeframe, 2009–2020, all UHRpm cases data comes from Brooks County Sheriff’s recovery reports. Of the 100 UHRpm cases included in the regional demonstration dataset, manner of death determinations were either natural causes (n = 8) or unknown (n = 92), which reflects that these unidentified decedents were found in a state of decomposition (Table 7).

5.5. National/National Missing and Unidentified Persons System (NamUs)

We included a national-level clearinghouse for missing, unidentified, and unclaimed person (NamUs) cases via a random sample of 100 Unidentified Person cases, 25 cases each from California, Arizona, New Mexico, and Texas over our designated timeframe, 2009–2020. This sampling provided a glimpse of what NamUs Unidentified Person cases look like on the website to both the public viewers and professionally registered users To winnow a sample of 100 to UHRpm candidate cases one of our Author’s input keyword searches in the “Circumstances of Recovery” section of the Unidentified Person reports. Terms included geographic themes: remote, desert, ranch, mountain, crossing (i.e., migrant crossing, immigrant crossing, border crossing, cross the border, crossing illegally, cross into the US), and border (i.e., international border). Terms related to “Actors” were also used, including border crossers, Mexican, humanitarian, Border Patrol, immigrants, undocumented, [sic] illegal aliens, crossers, and voter card.

Note that some Unidentified Person report sections, such as “Condition of Remains” and “Race/Ethnicity” were only minimally helpful in the determination of a UHRpm Most often, the most informative clues were entered in the “Circumstances” and “Location” sections. For example, UP8544 was ultimately marked “No” as a probable migrant given the Circumstance notes “Hikers came across skeletal remains in

Table 5
Summary of the San Diego Medical Examiner’s sample of migrant decedent cases.

Manner Of Death					
Female	Male		Biological sex undetermined		
Accident	9	Accident	45	Accident	-
Homicide	1	Homicide	4	Homicide	-
Natural	-	Natural	8	Natural	-
Suicide	-	Suicide	2	Suicide	-
Undetermined	-	Undetermined	27	Undetermined	4
Cause of Death					
Female	Male		Biological sex undetermined		
Drowning	1	Drowning	11	Undetermined	27
Environmental exposure	6	Environmental exposure	26	-	-
Blunt force trauma	1	Intoxication (alcohol, heroin, methamphetamine)	5	-	-
Sharp force wounds	1	Blunt force trauma (unspecified head trauma, gunshot wound, hanging)	6	-	-
Other (complications related to Diabetes)	1	Other (Complications of myocardial infarct, Sudden cardiac death)	11	-	-

Table 6

Summary of sample of migrant decedent cases from Southern Arizona.

County found	Biological sex	Cause of death				
		Blunt force injury	Exposure	Gunshot wound	Skeletal remains	Undetermined
Cochise	Male				1	
Maricopa	Female					1
	Male	1	3	2	1	5
Pima	Female	1	9		1	1
	Male	2	17	1	28	13
	Biological sex undetermined					1
Pinal	Female				1	
	Male		2			
Santa Cruz	Female				1	
	Male		2		1	
	Biological sex undetermined					3
County Unspecified	Male	1			1	

Table 7

Summary of Sample of Migrant Decedent Cases from Brooks County, TX.

	Female	Male	Biological sex undetermined			
Manner of Death	Natural	-	3			5
	Undetermined	11	35			46
Cause of Death	Dehydration	-	2	Environmental exposure	3	
	Environmental exposure	2	1	-	-	
	Undetermined	8	35	Undetermined	48	
	Blunt force trauma	1	-	-	-	-

In Brooks County, UHRpm typically are recovered from private ranch land (n = 90), near a highway or county road (n = 6), on an industrial site (n = 2), or in a seasonal hunting campground (n = 2).

the mesa area in Sierra County, NM. Homicide with multiple gunshot wounds, estimated White ancestry.” While finding skeletal remains in a remote area can be indicative of a candidate migrant decedent, the cause of death and ancestry estimation eliminated UP8544.

6. Criteria for the determination of a “migrant forensic case”

One challenge in aggregating statistics on deaths of persons in migration is bringing together data from different local and regional systems that may or may not track the context of migration as a forensic

case attribute. However, a fuller understanding of the humanitarian crisis of deaths in migration is dependent upon developing a set of criteria for evaluating past, present, and future case record data that can overcome this obstacle. To generate a more robust and accurately enumerated account of migrant deaths at the US-Mexico border, we have developed a set of criteria for understanding a case as a migrant forensic case that draws from international and scholarly research-based standards and that considers local circumstances and terrain relevant to this forensic and geographic context. Recall that our intention is not to offer a universally applicable definition of what is a migrant death, but

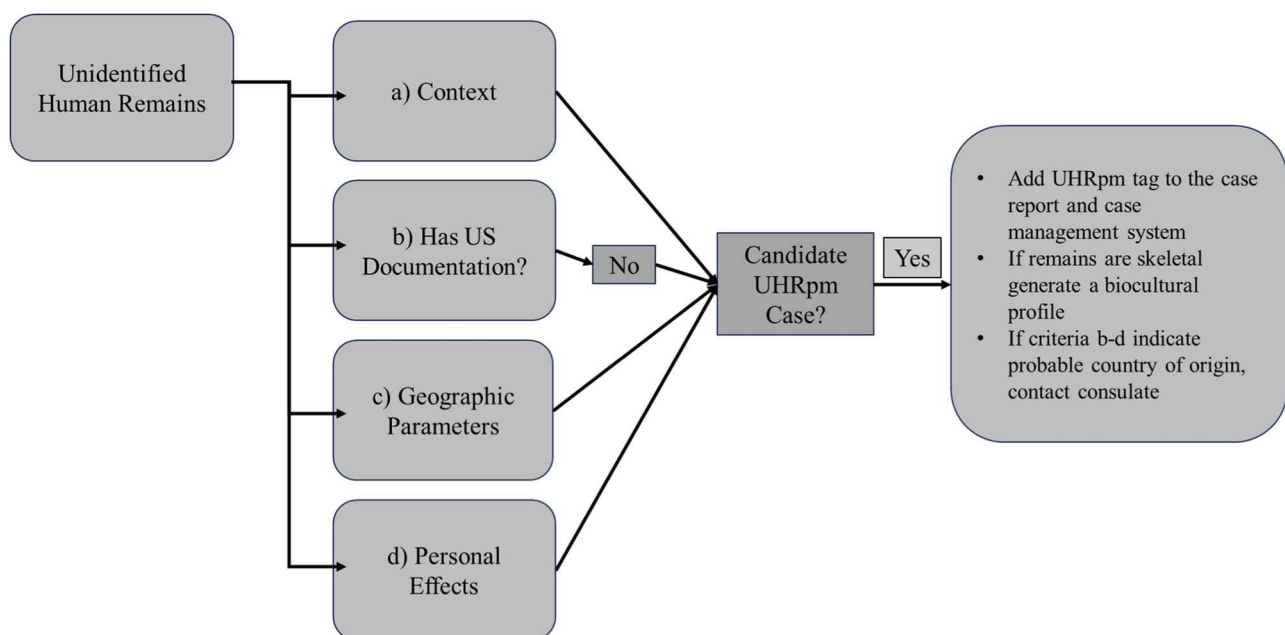


Fig. 3. Unidentified human remains of a probable migrant determination process* (Figure credit: Author 8). *While the determination of a migrant decedent typically starts with the context in which a set of human remains are found, the criteria represented in Fig. 3 inform one another and are not hierarchical.

to derive one that is applicable to the US-Mexico border and, most importantly, one that allows us to accomplish an important objective of our research as stated in the Mortality Mapping Project proposal: facilitating the future compatibility of data.

We tailored our definition to include four criteria to reflect the context in which migrants seem to typically perish in the US-Mexico border region. No specific criterion is weighted more heavily than the others, and all are considered when evaluating a UHRpm case. The criteria specified that an unidentified set of human remains should be included as a forensic case on the Mortality Mapping Project's platform when (Fig. 3):

- a) **Context.** The person died in the process of migration. The death is related to the US-Mexico border and US deterrence policy. This criterion encapsulates a regional focus that includes "known" migration route(s) to federal and local law enforcement, humanitarian NGOs, academics and researchers, and migrant family networks.
- b) **Identification documentation.** The absence of US documentation can indicate that the deceased individual migrated from outside the US. In the absence of any identification, a decedent's location (criterion c) and personal effects (criterion d) point to travel that is outside state-recognized/-authorized channels or that avoids traditional ports of entry. A decedent may have other forms of identification media such as a voter card, birth certificate, or non-US identification card, which are also indicators of a migrant decedent.
- c) **Geographic parameter(s).** We distinguish "zones" where migrants are more likely to face border protection-related concerns (in our case, mortality) associated with active transit. Approximate zones, or distance buffers, include:
 - i. **Zone A:** Distance from an international boundary, i.e., the US-Mexico Border, and US Border Patrol permanent interior checkpoints (e.g., ~70 miles inland from the border in Texas).
 - ii. **Zone B:** Between US Border Patrol checkpoints and the US Border Patrol 100-mile border zone.
 - iii. **Zone C:** Includes individual forensic cases or events within the US' interior when "death in the process of migration" [15] is evident. For example, the 50 migrants found dead in an abandoned 18-wheeler in San Antonio, TX would qualify [18]. Active transit is an integral component when considering a *Zone C* scenario. By contrast, a workplace raid conducted by USBP or Immigration and Customs Enforcement would not qualify.
- d) **Personal effects.** Items found on or in association with a set of human remains such as foreign currency, religious items, hygiene products, that suggest active transit and/or a different country of origin.

These four criteria help us justify a determination of UHRpm in the US' southwestern border context and therefore comprise our definition of a migrant who perishes at or near the US-Mexico border. Cause/manner of death are also consulted, but secondarily to the above criteria. Similarly, in the case of skeletonized remains, we would use the Pima County Office of the Medical Examiner biocultural profile rubric (Anderson and Parks, 2008; [4,5]) or another regionally appropriate bioanthropological assessment for skeletal indicators of health such as utilized by Operation Identification.

Importantly, we do not note whether the migrant is state-recognized; instead, the first and second criteria allude to extant US border deterrence policy. As such, a deceased individual discovered near the US-Mexico border and found without recognized documentation is a strong indication of an attempt to enter the US away from official ports of entry to evade detection by state and federal entities. As for our areal limitations, we understand that someone who is a migrant may not die at or near an international border. In the context of the US-Mexico border we deliberately focus on remoteness because the challenges to positive identification in urban or more populated areas in the US are different than at the border and the immediate border environs [17,29].

Additionally, we chose not to rely too heavily on cause or manner of death determinations as a criterion because it can make assumptions about risks to migrants in transit based on previous trends.

Because NamUs cases represent a mix of both UHRpm and non-migrant unidentified human decedents, this data source serves to both inform the development of criteria and help "practice" applying them to filter cases. While this means we utilized criteria, such as keywords, to classify migrant status, we now also have a better understanding of how to query the database to better target UHRpm cases from the start (i.e., by geographic locales, investigative agencies, or personal effects as listed in "Clothing and Accessories"). For all mixed datasets, however, it will be critical to comb through all queried cases one-by-one to confirm inclusion in the Mortality Mapping Project. Although for this pilot demonstration dataset we categorized mixed unidentified human remains cases as "yes" or "no" for representing a probable migrant death, defining a probability scale for inclusion will better capture case complexity and optimize accurate case inclusion. We intend to add a probabilistic dimension to our estimation of what is a UHRpm later in the project and as we collect the data to be included in the web portal for the Mortality Mapping Project. At this point, we predict that each criterion will be weighed equally, but that may not be our final determination.

7. Conclusions

It is our hope that the adoption of the four criteria listed above to inform unidentified human remains of a probable migrant determination from within available datasets will allow us to build Mortality Mapping Project as a platform to support the availability of more robust data on deaths of persons in migration at the US-Mexico border. Our aim is to enhance resources for interdisciplinary research on topics related to forensics, social and behavioral sciences, public health, geography, and the geographic information sciences, and, most importantly, to document deaths in migration to potentially shed light on this humanitarian crisis.

A concerted effort towards tagging and tracking transnational forensic cases, i.e., UHRpm, is nontrivial. In ideal circumstances for data tracking and data aggregation inter-regionally, each source dataset would incorporate evaluation of whether specific forensic cases are migrant death cases into their own data systems for potential inclusion in summary numbers across location and temporal period. We believe that having a set of criteria that can be applied throughout multiple jurisdictions and that can also accommodate place-specific experience, will make significant contributions to case management, e.g., by activating a network of collaborators that includes consulates. Furthermore, we hope that the formalization of criteria for case data inclusion in the Mortality Mapping Project's portal as cases recognized as probable migrant deaths, as well as outlining the process through which our criteria were developed to reflect local case contexts, may also contribute to further discussions of how deaths in migration might be recognized and accounted in other local geographic contexts worldwide.

Funding

This project is funded by the National Science Foundation's (NSF) Human Networks and Data Science program (HNDS) – Infrastructure grant, Award no. 2218776.

CRedit authorship contribution statement

Kate Spradley: Writing – review & editing, Visualization, Supervision, Conceptualization. **Nick P. Herrmann:** Writing – review & editing, Validation, Supervision, Conceptualization. **Jasmine Hernandez:** Writing – original draft, Data curation. **Heather Edgar:** Writing – review & editing, Supervision, Conceptualization. **Molly Kaplan:** Writing – original draft, Conceptualization. **Veronica Flores-Guillen:** Writing –

original draft, Conceptualization. **Molly Miranker**: Writing – original draft, Visualization, Conceptualization. **Rachel Daniell**: Writing – original draft, Conceptualization. **Alberto Giordano**: Writing – review & editing, Supervision, Conceptualization.

Declaration of Competing Interest

None.

Acknowledgements

We would like to acknowledge the efforts and advocacy by families who seek answers about the fate of their missing migrant relative(s). Their tenacity propels and supports forensic and humanitarian interventions. We would also like to thank the Regional Working Group for Migrant Mortality Accounting on the US-Mexico Border, a larger coalition of researchers and organizations with whom we work dedicated to producing a more accurate enumeration of migrant death in the US-Mexico-Central American migration corridor and the disaster taking place along the US-Mexico border. Additionally, we would like to thank Texas' Operation Identification, Brooks County Sheriff's Office, New Mexico's Office of the Medical Investigator, Arizona's Pima County Office of the Medical Examiner, Humane Borders, and California's San Diego Office of the Medical Examiner. Finally, a special thanks to Dr. Cate Bird, the ICRC's Missing Persons & Forensic Manager for the Regional Delegation for the United States and Canada.

Competing Interests Statement

Declaration of Interests: None.

References

- [1] 51. USBP. 2020. Migrant death mitigation: Fiscal year 2020 report to Congress. Accessed September 24, 2022. https://www.dhs.gov/sites/default/files/publications/cbp-migrant_death_mitigation.pdf.
- [2] A. Isacson, Weekly U.S.-Mexico Border Update: Extreme Heat And Migrant Deaths, Texas "Bouy Wall," June Migration, Washington Office on Latin America (WOLA), 2023. Retrieved August 4, 2023, from (<https://www.wola.org/2023/07/weekly-u-s-mexico-border-update-extreme-heat-and-migrant-deaths-texas-bouy-wall-june-migration/>).
- [3] B.E. Anderson, Identifying the dead: Methods utilized by the Pima County (Arizona) Office of the Medical Examiner for undocumented border crossers: 2001-2006, *Journal of Forensic Sciences* 53 (1) (2008) 8–15, <https://doi.org/10.1111/j.1556-4029.2007.00609.x>.
- [4] J.S. Beatrice, A. Soler, R.C. Reineke, D.E. Martínez, Skeletal evidence of structural violence among undocumented migrants from Mexico and Central America, *Am. J. Phys. Anthropol.* 176 (4) (2021) 584–605, <https://doi.org/10.1002/ajpa.24391>.
- [5] J.S. Beatrice, A. Soler, Skeletal indicators of stress: a component of the biocultural profile of undocumented migrants in Southern Arizona, *J. Forensic Sci.* 61 (5) (2016) 1164–1172, <https://doi.org/10.1111/1556-4029.13131>.
- [6] C.E. Bird, J.D. Sykes, J.D.P. Bird, The role of stigma in the medicolegal investigation of unidentified persons, in: *Our future Reflects our Past: The Evolution of Forensic Science*. Paper presented at the 69th Annual Scientific Meeting of the American Academy of Forensic Sciences, New Orleans, LA, 2017. (https://www.aafs.org/sites/default/files/media/documents/2017_Proceedings.pdf).
- [7] C. Kovic, Searching for the living, the dead, and the new disappeared on the migrant trail in Texas: Preliminary report on migrant deaths in South Texas, Houston United Prevention of Migrant Deaths Working Group, 2013. Retrieved July 31, 2023, from (<https://southtexashumanrights.files.wordpress.com/2013/09/migrant-deaths-report-edited.pdf>).
- [8] C.C.M. Vogelsberg, Identification of Deceased Border Crossers: Investigating Spatial and Skeletal Attributes of Migrant Deaths (Doctoral dissertation), Michigan State University, 2018. (<https://d.lib.msu.edu/etd/19529>).
- [9] C.E. Osorno Solís, M.C. Doretti, K.M. Hernandez, Identification notifications and their applicability to families of missing migrants. Paper presentation in the 69th Annual Meeting of the American Academy of Forensic Sciences, New Orleans, LA, 2017, p. 276. (https://www.aafs.org/sites/default/files/media/documents/2017_Proceedings.pdf).
- [10] C. Cattaneo, M.T. Binz, L. Penados, J. Prieto, O. Finegan, M. Grandi, The forgotten tragedy of unidentified dead in the Mediterranean, *Forensic Sci. Int.* 250 (2015) e1–e2.
- [11] C. Cattaneo, D. De Angelis, D. Mazzarelli, D. Porta, P. Poppa, G. Caccia, M. E. D'Amico, C. Siccardi, C. Prevederè, B. Bertoglio, M. Tidball-Binz, The rights of migrants to the identification of their dead: an attempt at an identification strategy from Italy, *Int. J. Leg. Med.* 137 (2023) 145–156, <https://doi.org/10.1007/s00414-022-02778-1>.
- [12] J.F. Chamblee, G.L. Christopherson, M. Townley, D. DeBorde, R.R. Hoover, Mapping migrant deaths in southern Arizona: The Humane Borders GIS. Unpublished report, 2006. Retrieved July 31, 2023, (https://www.researchgate.net/profile/Gary-Christopherson2/publication/242478128_Mapping_Migrant_Deaths_in_Southern_Arizona_The_Humane_Borders_GIS/links/0deec531e2d97df753000000/Mapping-Migrant-Deaths-in-Southern-Arizona-The-Humane-Borders-GIS.pdf).
- [13] S. Cordner, M. Tidball-Binz, Humanitarian forensic action—its origins and future, *Forensic Sci. Int.* 279 (2017) 65–71, <https://doi.org/10.1016/j.forsciint.2017.08.011>, s. cordner, m. tidball-binz, humanitarian forensic action—i.
- [14] W.A. Cornelius, Death at the border: Efficacy and unintended consequences of US immigration control policy, *Population and development review* 27 (4) (2001) 661–685, <https://doi.org/10.1111/j.1728-4457.2001.00661.x>.
- [15] P. Cuttitta, Preface: the increasing focus on border deaths, in: P. Cuttitta, T. Last (Eds.), *Border Deaths: Causes, Dynamics and Consequences of Migration-related Mortality*, Amsterdam University Press, Amsterdam, 2020, pp. 9–20, <https://doi.org/10.1515/9789048550203-002>.
- [16] D.E. Martínez, R.C. Reineke, J. Boyce, S.N. Chambers, S. Launius, B.E. Anderson, G. L. Hess, J.M. Vollner, B.O. Parks, C.C.M. Vogelsberg, G. Soto, M. Kreyche, R. Rubio-Goldsmith, Migrant Deaths in Southern Arizona: Recovered Undocumented Border Crosser Remains Investigated by the Pima County Office of the Medical Examiner, 1990–2020, The University of Arizona College of Social and Behavioral Sciences. Binational Migration Institute, 2021. Retrieved July 31, 2023, from (https://bmi.arizona.edu/sites/default/files/BMI%20Report%202021%20ENGLISH_FINAL.pdf).
- [17] S.M. Derrick, B. Figura, The role of the anthropologist in identification at two urban Medical Examiner Offices: New York City and Harris County, *Acad. Forensic Pathol.* 6 (3) (2016) 413–423, <https://doi.org/10.23907/2016.042>.
- [18] J. Edison, P. Svitek, At least 50 people found dead in abandoned 18-wheeler in San Antonio, *The Texas Tribune*, 2022, p. 27.
- [19] K. Eschbach, J. Hagan, N. Rodriguez, R. Hernandez-Leon, S. Bailey, Death at the border, *Int. Migr. Rev.* 33 (2) (1999) 430–454, <https://doi.org/10.1177/019791839903300206>.
- [20] Fatal Journeys. 2016. Improving Data on Missing Migrants. https://publications.iom.int/system/files/pdf/fatal_journeys_volume_3_part_1.pdf.
- [21] T.P. Gocha, M.K. Spradley, R. Strand, Bodies in limbo: issues in identification and repatriation of migrant remains in South Texas, in: K.E. Latham, A.J. O'Daniel (Eds.), *Sociopolitics of Migrant Death and Repatriation: Perspectives from Forensic Science*, Springer, Cham, 2018, pp. 143–156, https://doi.org/10.1007/978-3-319-61866-1_11.
- [22] M.J. Hinkes, Migrant deaths along the California-Mexico border: an anthropological perspective, *J. Forensic Sci.* 53 (1) (2008) 16–20, <https://doi.org/10.1111/j.1556-4029.2007.00625.x>.
- [23] International Committee of the Red Cross (ICRC), Geneva Convention Relative to the Protection of Civilian Persons in Time of War (Fourth Geneva Convention), 1949, 75 UNTS 287, available at: (<https://www.refworld.org/docid/3ae6b36d2.html>) (Accessed 23 September 2023).
- [24] International Committee of the Red Cross (ICRC), Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 1977, 1125 UNTS 3, available at: (<https://www.refworld.org/docid/3ae6b36b4.html>) (Accessed 23 September 2023).
- [25] International Organization for Migration. Fatal journeys volume 1: Tracking lives lost during migration, 2015. Retrieved July 31, 2023, from (<https://publications.iom.int/books/fatal-journeys-tracking-lives-lost-during-migration>).
- [26] International Organization for Migration, Methodology: Missing Migrants Project, 2023. Retrieved April 3, 2023, from (<https://missingmigrants.iom.int/methodology>).
- [27] Jimenez, M. 2009. Humanitarian crisis: Migrant deaths at the U.S.-Mexico border. American Civil Liberties Union. Accessed March 28, 2019. http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:policyfile&rft_dat=xri:policyfile:article:00120099.
- [28] M.A. Kaplan, C.C. Siegert, M.E. Moe, C.P. McDaniel, M.K. Spradley, Forgotten spaces: the structural disappearance of migrants in South Texas, in: J.F. Byrnes, I. Sandoval-Cervantes (Eds.), *The Marginalized in Death: A Forensic Anthropology of Intersectional Identity in the Modern Era*, Rowman and Littlefield, Lanham, 2022, pp. 37–64.
- [29] M. Miranker, Principles of Humanitarian GISci: Migrant Death Along the Texas-Mexico Border, 1990–2020 (Doctoral dissertation), Texas State University, 2023.
- [30] M. Morgan, Written testimony of CBP US Border Patrol Chief Mark Morgan for a House Committee on Homeland Security, Subcommittee on Border and Maritime Security hearing titled "Moving the Line of Scrimmage: Re-Examining the Defense-In-Depth Strategy." Department of Homeland Security, 2016. Last Modified August 13, 2016. Retrieved July 31, 2023 from (<https://www.dhs.gov/news/2016/09/13/written-testimony-cbp-house-homeland-security-subcommittee-border-and-maritime>).
- [31] D.E. Martínez, R.C. Reineke, R. Rubio-Goldsmith, B.O. Parks, Structural violence and migrant deaths in Southern Arizona: data from the Pima County Office of the Medical Examiner, 1990–2013, *J. Migr. Hum. Secur.* 2 (4) (2014) 257–286 (<https://doi.org/10.1177%2F233150241400200401>).
- [32] Missing Persons and Unidentified Remains Act, P.L. 116–277, 2019. Retrieved September 11, 2023, from (<https://www.congress.gov/116/plaws/publ277/PLAW-116publ277.pdf>).

- [33] National Missing and Unidentified Persons System, Unidentified Persons Search, National Institute of Justice, 2023. Retrieved April 20, 2022, from (<https://www.namus.gov/UnidentifiedPersons/Search>).
- [34] No More Deaths | No Más Muertes, Part 1: Deadly Apprehension Methods, The Disappeared Report, 2016. Retrieved April 3, 2023, from (<http://thedisappearedreport.org/uploads/8/3/5/1/83515082/fianlpart1.pdf>).
- [35] Office of the High Commissioner for Human Rights, Technical note: Migrants and refugees, 2018. Retrieved on August 10, 2023, from (<https://www.ohchr.org/en/documents/tools-and-resources/technical-note-migrants-and-refugees-2018>).
- [36] Pima County Office of the Medical Examiner, Annual Report, 2021. Retrieved August 10, 2023 from (<https://content.civicplus.com/api/assets/271d4f4a-2e86-4214-b2c3-837e4275b54d?cache=1800>).
- [37] Pima County Office of the Medical Examiner, Annual Report, 2022. Retrieved August 10, 2023 from (<https://content.civicplus.com/api/assets/07017517-967e-4259-a859-bacbf641598?cache=1800>).
- [38] R. Rubino-Goldsmith, M. McCormick, D. Martínez, I. Duarte, The 'funnel effect' and recovered bodies of unauthorized migrants processed by the Pima County Office of The Medical Examiner, 1990–2005, 2006. Retrieved July 31, 2023 from (<https://dx.doi.org/10.2139/ssrn.3040107>).
- [39] Reference Anonymized 1, Migrant deaths at the Arizona–Mexico border: spatial trends of a mass disaster, *Forensic Sci. Int.* 280 (2017) 200–212, <https://doi.org/10.1016/j.forsciint.2017.07.031>.
- [40] R.C. Reineke, C. Halstead, Identifying dead migrants: examples from the United States–Mexico border, *Fatal Journeys* 3 (1) (2017) 77–98.
- [41] S. Leutert, S. Lee, V. Rossi, Migrant deaths in South Texas. The Strauss Center, 2020. Retrieved April 4, 2023, from (<https://www.strausscenter.org/publications/migrant-deaths-in-south-texas>).
- [42] San Diego Medical Examiner's Office, San Diego County Medical Examiner cases, 2023. Retrieved July 31, 2023, from (<https://data.sandiegocounty.gov/Safety/Medical-Examiner-Cases/jkvb-n4p7>).
- [43] S. Sapkota, H.W. Kohl III, J. Gilchrist, J. McAuliffe, B. Parks, B. England, K.B. Nolte, et al., Unauthorized border crossings and migrant deaths: Arizona, New Mexico, and El Paso, Texas, 2002–2003, *Am. J. Public Health* 96 (7) (2006) 1282–1287, <https://doi.org/10.2105/AJPH.2005.075168>.
- [44] G. Soto, D.E. Martínez, The geography of migrant death: implications for policy and forensic science, in: K.E. Latham, A.J. O'Daniel (Eds.), *Sociopolitics of Migrant Death and Repatriation*, Springer, Cham, 2018, pp. 67–82.
- [45] M.K. Spradley, N.P. Herrmann, C.B.C. Siegert, C.P. McDanel, Identifying migrant remains in South Texas: policy and practice, *Forensic Sci. Res.* 4 (1) (2019) 60–68, <https://doi.org/10.1080/20961790.2018.1497437>.
- [46] United Nations Human Rights Office of the High Commissioner, Last rights: The dead, the missing and the bereaved at Europe's international borders. Proposal for a Statement of the International legal obligations of States, 2017. Retrieved August 10, 2023, from (https://www.ohchr.org/sites/default/files/Documents/Issues/Migration/36_42/TheLastRightsProject.pdf).
- [47] US Customs and Border Protection, Border patrol strategic plan: 1994 and beyond, 1994. Retrieved July 31, 2023, from (<http://cw.routledge.com/textbooks/9780415996945/gov-docs/1994.pdf>).
- [48] US Customs and Border Protection, Border Rescues and Mortality Data. Stats and Summaries, Department of Homeland Security, 2023. Last modified July 24, 2023. Retrieved September 10, 2023, from.
- [49] US Customs and Border Protection, US Border Patrol fiscal year southwest border sector deaths (FY1998–FY2020). Stats and Summaries, Department of Homeland Security, 2021. Retrieved July 31, 2023, from (https://www.cbp.gov/sites/default/files/assets/documents/2020-Jan/U.S.%20Border%20Patrol%20Fiscal%20Year%20Southwest%20Sector%20Deaths%20%28FY%201998%20-%20FY%202019%29_0.pdf).
- [50] US Customs and Border Protection, Programs and Special Operations. What is the Missing Migrant Program? Department of Homeland Security, 2023. Last modified August 23, 2023.